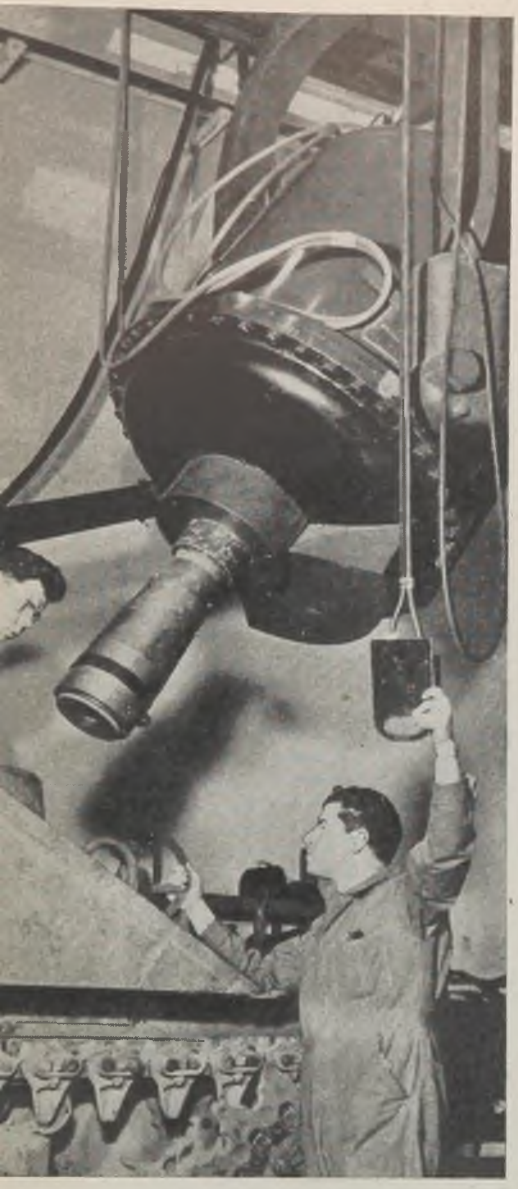


Radiographic Inspection of Metals

Ability to define swiftly and accurately the outline of casting cavities or inhomogeneous structure in rolled steel is invaluable aid to producers and fabricators. Selection of right film is extremely important

By ROBERT TAYLOR*

IN the two decades following World War I, X-ray inspection was used to detect defects and prevent failures. At Boulder Dam, and later at Grand Coulee Dam, the welds in penstocks were X-ray inspected. These penstocks welded at each section were 30 feet in diameter and in each case as much as 270,000 feet of film were utilized.

At the present time, X-ray inspection is being carried out on all vertical and circumferential welds in the 10-story stacks at the numerous synthetic rubber plants being constructed in various localities. These stacks are 10 stories high and 41 feet in diameter. Placement of the X-ray machine controls to cover such a large area of inspection requires considerable engineering knowledge. In one instance, the machine is mounted one-half the height of the stack and 60-foot cables enable placing of the X-ray tube at the desired location for all welds. The work has to be done with accuracy and speed, as inspection is carried out right behind the welders.

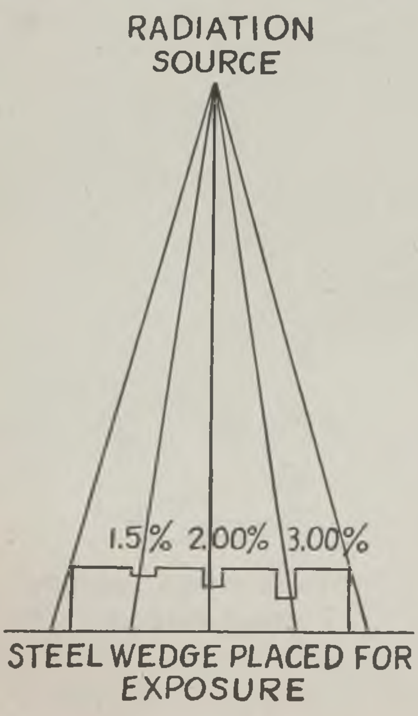
X-ray inspection of welds and castings used in the construction of ships, tanks and pressure vessels today is being carried on extensively in conformance with

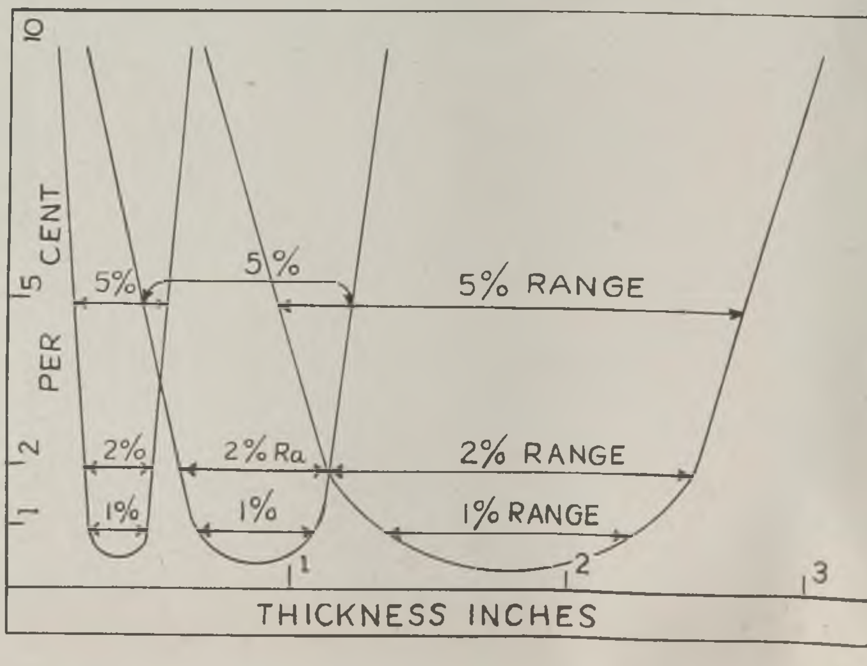
*This is the first of two articles by Robert Taylor, consultant in industrial radiology, Spokane, Wash., on radiographic inspection techniques. This account of high-powered X-ray developments will be followed by a discussion of inspection methods employing radium.

Fig. 1 (Top left)—Million-volt industrial X-ray unit ready to inspect sections of an M-4 tank manufactured by Ford Motor Co. This instrument can "see" through 8-inch steel plate and inspect in 16 minutes pieces of metal that previously required 60 hours

Fig. 2 (Bottom left)—Exposing slotted wedge for determination of density. Schematic diagram of method to find ratio, in per cent, of thickness of thinnest cavity to thickness of metal penetrated. Exposures for each thickness may be used as basis for charting standard set of densities

Fig. 3 (Below)—Chart illustrates range of sensitivities and efficiency of various degrees in achieving thoroughness and economy

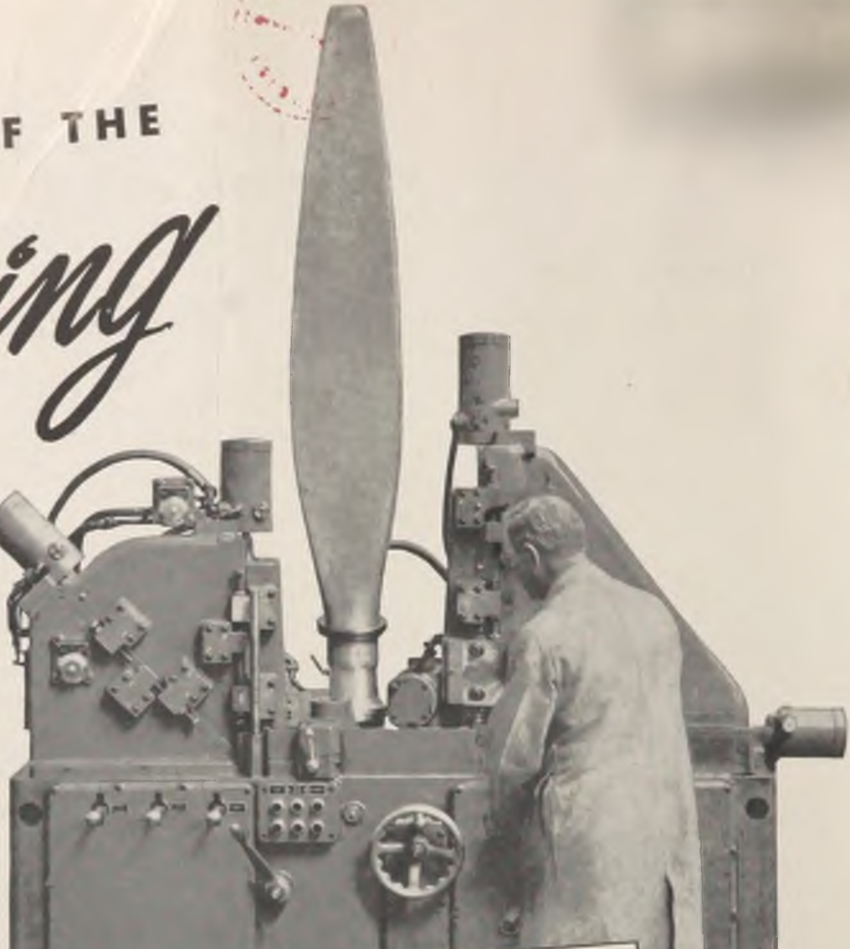




THE CASE OF THE

Sagging

PROPELLER



This special Heald Bore-Matic completely solved the customers problem of finishing the shank end of propeller blades—producing precision to such degree that hand operations have been reduced from four hours to five minutes per blade. The blade is rotated vertically and surfaces are finished by hydraulic tool slides.

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STEEL

The Magazine of Metalworking and Metalproducing

JANUARY 3, 1944

Volume 114—Number 1

1944 Yearbook of Industry Issue

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STEEL
January 3, 1944

Enough Work for Everybody

Synchronizing an exacting war production schedule with a program of partial transition to a peacetime economy promises to be the major internal problem of this nation in 1944. It will not be solved easily.

One reason is that the public is confused. Recently this writer overheard this conversation of two war workers:

"Say Bill, did you know the war is over?"

"No, Jim. Are you kidding me? What makes you think it's over?"

"Well, they're laying off men in our shop. They say the government's got more stuff than it needs. Must be the war is over—or nearly over."

Unfortunately Jim is not alone in this conclusion. In several instances men have struck in protest against down-grading resulting from cutbacks. Millions of Americans in all walks of life think that the war is in the bag and that consequently there will be less work to do.

This fallacious reasoning stems from our failure to realize that in modern global war, which involves unprecedented destruction of civilian life and property, a military victory is not an end in itself. It is only a step in the settlement of the war problem. This war will not be over until we have repaired much of the havoc of war and restored the world to a semblance of order.

If this concept can be implanted in the public mind, then the Jims and Bills and striking employes will understand that cutbacks and cancellations, instead of connoting less work as they now fear, really mean release from war production to tackle the even greater volume of work involved in restoring essential civilian needs and in reconstruction. Right now more urgently needed work lies ahead than at any time in the nation's history.

This idea must be "sold" to the man in the street. To sell it convincingly, government agencies and private enterprise must co-operate to guide the reconversion program efficiently. There is so much work to do that, were our system perfect, a man or machine released from war work would be transferred immediately to essential civilian production, to reconstruction or to normal peacetime activity. Every idle hour for man or machine is an hour lost because of the inefficiency of our administrative system—not because there is a lack of work.

To keep everybody and every facility busy on work that needs to be done is the challenge of 1944.

STEEL—AFTER THE WAR: Dawn of the new year finds the American iron, steel and metalworking industry at the point of gaining mastery over the problems of production for war and on the verge of gradually shifting a part of its capacity to neglected essential civilian needs. This initial shift is the first step in the long trek to a peacetime economy.

Uppermost in the minds of many industrialists is the question of how the industry will emerge from the ordeals of war and readjustment to peace. In what respects as to product, capacity, distribution and markets will it differ from its prewar status?

To help answer these questions, the editors of STEEL present in this issue the first of a series of studies of the iron, steel and metalworking indus-

(OVER)

try intended to throw light upon transitional and postwar developments. The current study shows the impact of war upon steel, the material; steel, the industry; steel, its distribution facilities; and steel, its markets.

From this initial study it is apparent that the steel industry is destined to begin writing a new chapter of history—one which in some respects will differ radically from the orthodox annals of the prewar period. —p. 195

• • •

BANNER YEAR FOR IDEAS: Some day in the future when the war record can be judged fairly, it is likely that a major share of the credit for the success of America's "arsenal of democracy" will be attributed to the skill and speed with which the "know how" of industrial operations was applied to war problems.

No one can read the comments of the 136 authorities who contributed to STEEL's annual review of technical progress without realizing that war stimulated a bountiful crop of new ideas during the past year. In almost every branch of technology affecting the iron, steel and metalworking industry new developments were recorded which not only are aiding materially in the war effort but also are adding to the great storehouse of new technical knowledge which will be available for use in the future.

Time may show that the pressure of war which provides the incentive for ingenuity and resourcefulness in technical matters reached its climax in the latter part of last year. If this is true, 1943 will go down in history as the most prolific year in technical progress. —p. 270

• • •

NEW RECORDS IN 1944? A year ago industry was confronted with a problem of producing to the utmost of its capacity practically every item required for war. Today, thanks to changing combat needs and to the fact we are definitely on the offensive, the objectives in production have been simplified and narrowed.

Instead of making as much of everything as possible, we now are called upon to concentrate chiefly upon the production of ships, planes, heavy construction machinery and signal material. These are the things the War Department will emphasize in its demands for 1944.

Fortunately the facilities and organization for producing these items were developed to a high point of effectiveness last year. We should be able to establish new records—particularly in ship and plane output—in the next month or two. —p. 400

END OF INDECISION? As this is written, the outlook for peaceful labor conditions in the new year has been altered by the President's decisive action of last Monday on the rail and steel situations. He ordered the railroads taken over by the government and his appeal to the leaders of striking steelworkers, coupled with a reversal of attitude by WLB, resulted in an abrupt end to the steel strike.

This summary action is in sharp contrast to the evasive tactics employed by the government in most of the earlier labor disputes. The about-face change in policy undoubtedly was prompted by the imminence of the invasion of Europe and by the growing resentment of the American public against repeated violations by unions of their Dec. 23, 1941 "no strike" pledge.

There will be grumbling about the unfairness of a policy which permits men like John Lewis to blackjack favorable terms out of WLB and later denies similar liberal treatment to more deserving minority groups. But the day of greater sacrifice is near and the necessity of uninterrupted operations at home may well overshadow the factor of injustice.

—p. 358

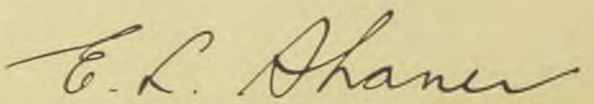
• • •

MORE NEGLECT AHEAD: Editor E. C. Kreutzberg, scanning the outlook for 1944 from his vantage point in Washington, presents a report that is not too reassuring from the standpoint of industry.

On the bright side is his belief that the reckless baiting of industry by government has run its course. This comes about through a better understanding of private enterprise by government officials, many of whom frankly concede that industrialists have done a superlative job in this war.

The chief reasons for uneasiness lie in the certainty that many of the troubles of mobilization for war will be carried over into the transition and postwar periods. Studious Washingtonians see trouble ahead in wage rates, in labor relations and in price alignments. These have been sore points in the war effort; they will be troublesome in the reconversion period.

Neglect of domestic problems by the federal government, notorious in 1943, probably will continue to plague us throughout 1944. —p. 234



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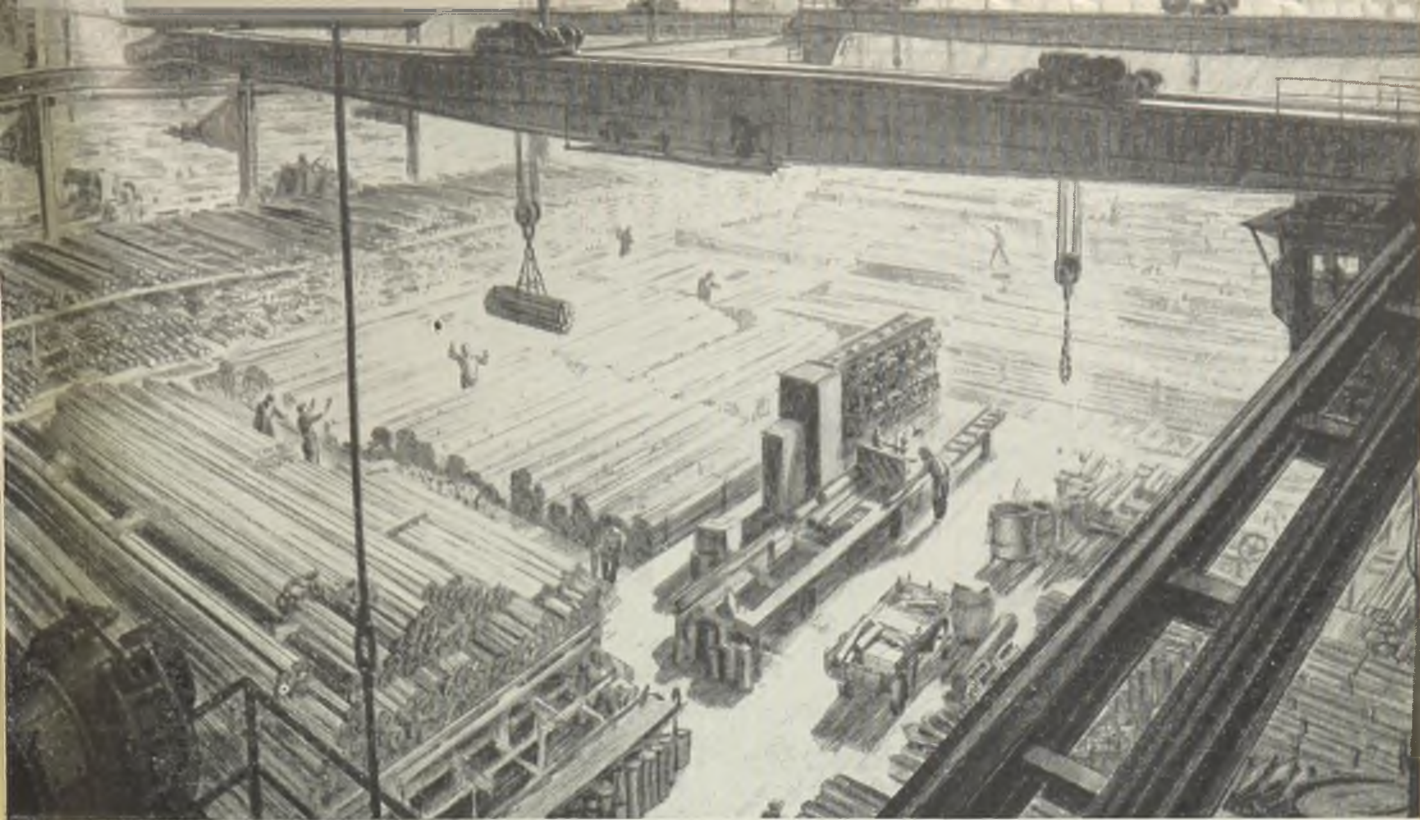

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INDUSTRY • AT • WAR
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INDUSTRY AT WAR

foreword...

It is no exaggeration to say that the war effort has changed the American iron, steel and metalworking industry more than any single factor in its entire history.

Due to the exigencies of war, plant facilities have been expanded far beyond the expectations of even the most imaginative authorities in government or in industry. The war has stimulated technological progress so that advances which normally would have been spread over a decade or more have been compressed into a period of a few months or years. The pressure of war has introduced government ownership on a grand scale, has subjected corporations and individuals to an intricate system of government controls and restrictions and has brought about new alignments in the chain from raw materials to finished products.

These characteristics of the period of production for war cannot be dismissed lightly. They are with us now and their impact will influence industrial developments throughout the transitional and postwar periods. Because of their significance, the editors of STEEL have decided that this is an opportune time to present a resume of what the challenge of production for war has done to industry. In the following pages will be found a study of the effect of war upon steel, the material; steel, the industry; steel, its distributing facilities; and steel, its markets. In this study, which is the first of a series, we strive to portray the situation as it has been created by the war—the situation with which we must work as we complete the war production job and as we move progressively into the transition and postwar periods.

The war peak situation finds steel firmly entrenched as the principal engineering material. Allowing liberally for gains in the use of light metals, plastics, glass and other engineering materials, steel will hold its commanding position into the foreseeable future. Also, while the exigencies of war have affected the types

PREPARES FOR PEACE

and forms of steel produced currently, the ultimate influence of the war will be to broaden the variety and scope of the steels available.

Most significant in the impact of war upon the industry are the changes in plant and equipment. Productive capacity has been expanded far beyond any prewar expectations. Facilities have been built in localities far removed from points of heavy demand. The government owns a modest percentage of steelmaking capacity.

The implications of these extraordinary circumstances are far-reaching. They raise questions concerning the future which cannot be answered categorically at this time. But it will be helpful, in working out the answers, to know exactly the extent and location of present production facilities. In this study, we include a detailed directory of furnaces and mills. It is the first comprehensive inventory of plant and equipment to be published since Pearl Harbor.

Also included in STEEL's study is an analysis of distribution facilities. This is necessarily incomplete, pending further changes resulting from the experience of war. It is sufficient, at this time, to say that in the sector of merchandising and distribution lie infinite possibilities for significant developments in the near future.

In reporting upon steel's markets, we have limited ourselves to the outlook for the near-future. Obviously the first demand after that of war will be for essential civilian needs. Following that will come the unpredictable requirements of reconstruction and of the postwar world.

From time to time STEEL will present other studies, calculated to supplement this one and to keep STEEL's readers informed of developments in the industry's progress toward a peacetime economy.

—The Editors

1. STEEL—THE MATERIAL

Maintains Preponderant As Basic

Manufacturers returning to peacetime pursuits will find wide variety and quantity of materials available of which steel will comprise about 85 per cent on tonnage basis—Nonferrous metals assume more important position—Increased tendency noted on part of consumers to specify materials on basis of physical requirements

STEEL has continued to maintain its preponderant position as the leading engineering material and there is every indication that it will continue to hold that position in the peace to come. Out of a total capacity in this country to produce some 112,000,000 tons of basic metallics and nonmetallics, steel is expected to comprise about 85 per cent of the total at the end of the present period of expansion which is scheduled to be largely concluded by the middle of 1944. Aluminum and magnesium combined will account for 1.3 per cent, copper 1.3 per cent, lead and zinc 1.78 per cent, plywood and synthetic rubber each slightly less than 1 per cent, glass 8 per cent and plastics less than two-tenths of 1 per cent.

Productive capacity of the steel industry in the United States will be the largest in history and in an amount far outstripping that of any other country. In fact, if up-to-date figures were available for the Axis nations it probably would be revealed that this country can turn out a larger tonnage than all the rest of the world combined.

Figures compiled by STEEL for every company in the United States and reported in detail in another article in this issue show that steel ingot capacity will be close to 96,000,000 tons when present expansion is completed even after abandoning obsolete plants. As of 1940, steel plants in Axis hands had a capacity of about 50,000,000 tons, of which 7,000,000 were accounted for by Japan and the balance by German-occupied countries.

Even allowing for a 20 per cent expansion by the Germans and the additional plants which the Japanese were known to have established in Asia, the count for the Axis probably is well under 60,000,000. Some time ago, Donald Nelson, WPB chairman, placed the figure at no more than 55,000,000 tons. In 1940, Russia had a capacity to produce about 22,000,000 tons annually, the British Empire 17,000,000 tons and the balance of the world 3,000,000 tons. As an outside guess, therefore, the world total at the end of the war may be in the neighborhood of 190,000,000 to 195,000,000 tons, of which the United States will have about half.

U. S. Will Be Competitive

American producers of steel will have the edge on those in foreign countries as far as quantities are concerned in supplying large anticipated world requirements in the postwar period. Some steel men even are inclined to believe that German, Belgian, French and Japanese mills will be eliminated from world markets for a generation.

Enemy countries have made technological advances during the war period as revealed by an examination of captured materiel but even more pronounced improvements have been made in this country. As for prices, most products have remained virtually at prewar levels which are a fraction of those obtained in World War I. Unofficial estimates by OPA indicate that steel consumers have saved more than one billion dollars during the course of World War II. Unless inflation breaks present bounds, it means the steel industry will be able to enter the postwar world market with prices likely to be com-

By IRWIN H. SUCH
Engineering Editor, STEEL

Position Engineering Metal

petitive with those of other nations able to compete, especially when other factors such as excellence of product are concerned.

What about competition between materials? There are those who envision a postwar world in which steel, aluminum, magnesium, copper and brass, lead and zinc and the nonmetallics will vie haphazardly for markets. Those persons are likely to be mistaken. There will be plenty of competition but there is every indication that it will be of an orderly character with each material seeking its natural outlets. Practically every producer of material, whether it be steel, a nonferrous metal, plastics, glass or plywood is assiduously studying outlets for his products but at the same time he is taking extra precautions to prevent possible misapplications—for he has learned through long experience that one misapplication might prevent a dozen or more perfectly justifiable applications.

Ample Market for All Materials

Unless the prognosticators are entirely wrong, there is apt to be a fairly ample market available for some years to come for all of the materials which may be produced. This is for the reason that the civilian, unlike in the last war, has been largely cut off from newly manufactured products and a potential demand running into many billions of dollars now exists not only in this country but abroad. Furthermore, there is likely to be plenty of incentive from Washington to maintain high levels of employment if the statistics now being circulated prove to be reasonably accurate. Government statisticians find that employment in the first postwar year must be 56,000,000 against 46,000,000 in 1940, which was the most prosperous peacetime year in the history of the nation. In 1940 unemployment was 9,000,000 but if industry falls back to 1940 levels of activity in the first postwar year—say 1946—19,000,000 persons would be unemployed due to increases in population and technological developments.

As 1943 came to a close, it appeared that some of the war agencies, such as the War Production Board, which had been given the job of turning industry upside down to produce an unprecedented volume of war goods, would likewise be charged with the responsibility of aiding industry in returning to some semblance of its former self and keep most of the 19,000,000 potential unemployed on the nation's payrolls.

Manufacturer Has Wide Choice

The manufacturer returning to peacetime pursuits will indeed find a wide variety and quantity of materials available. As already indicated, the steel industry will have a capacity to produce about 96,000,000 tons of ingots annually. Capacity for producing the light metals will be about 1,500,000 tons, of which 1,200,000 tons will be aluminum and 300,000 tons magnesium. Facilities will be available for the production of about 1,500,000 tons of copper and around 1,000,000 tons each of zinc and lead. Translated into percentages, steel represents 93.5


per cent of the metallics available, the light metals 3 per cent, lead and zinc 2 per cent and copper 1.5 per cent.

The most spectacular expansion of facilities in the nonferrous metals group has been made in the light metals and largely associated with the huge aircraft building program. There are now 14 plants for the production of primary aluminum and 15 for metallic magnesium.

Expansion of facilities for the production of other nonferrous metals has been less spectacular but nevertheless has been given considerable impetus over the past two or three years. The copper and brass industry has modernized its equipment through the addition of modern rolling mill, extrusion and heat treating equipment.

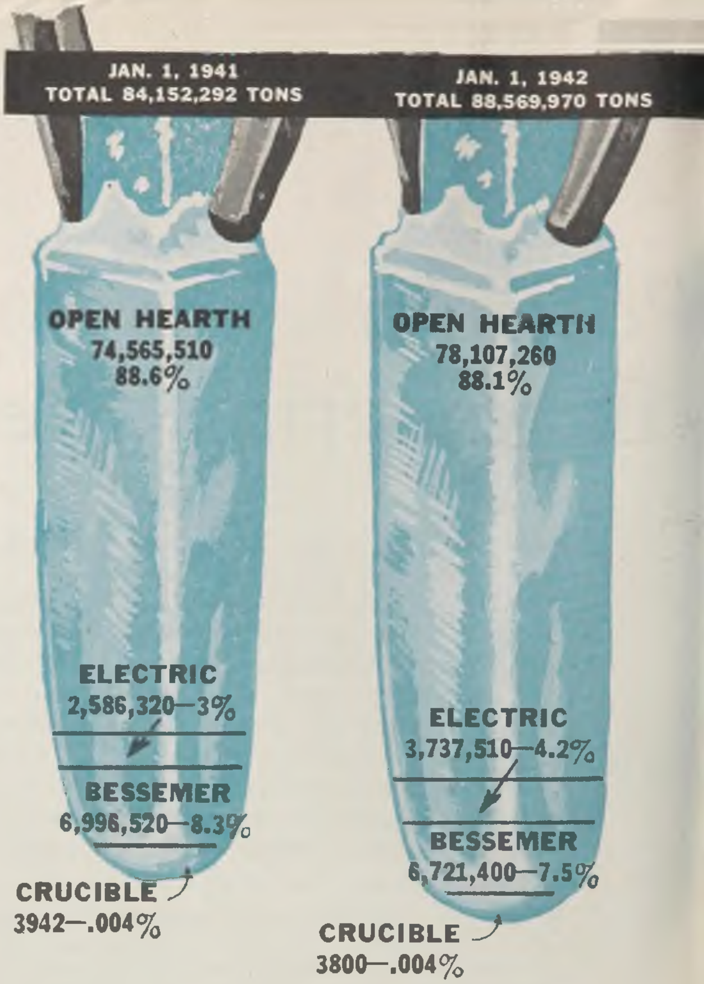
A significant development in the zinc industry has been the addition of approximately 100,000 tons of electrolytic capacity for the production of high-grade metal which has been encountering increasing favor for the production of die castings and as protective coatings for steel products. No large additions to lead smelters have been reported, expanded requirements being met by imports from other countries.

Strikes Cut Tin Output

In addition to these important base metals, facilities have been increased for production of other vital materials. An authoritative estimate places domestic production and imports of tin at 58,600 tons for 1943, most of which came from the new smelter at Texas City, Tex. operating on Bolivian ores. Had it not been for labor trouble in Bolivia this year, tonnage available probably would have approached the 1942 figure of 72,200 tons. Despite this more encouraging picture, restraint in the use of tin probably will be necessary for the next several years since little immediate production from the Malayan and Dutch East Indies properties is anticipated even after cessation of hostilities in the Far East. Stocks now on hand, plus new production, will be sufficient to last at least 6 years at the current rate of consumption.

A large part of the world's nickel deposits are close at hand in Canada and production facilities have been increased substantially to provide for large war needs, production for 1943 being estimated at close to the 226,600,000 pounds produced in 1942. Facilities also have been expanded for producing molybdenum, of which the United States is by far the most important producer. Tungsten, vanadium, chromium, manganese and antimony also have been made available in more adequate quantities.

The plastics have encountered rapidly increasing applications but the industry on a tonnage basis still ranks well below any of the leading metals. Present capacity to produce basic resins is placed by one source at 200,000 tons or only a small fraction of 1 per cent of the total for steel. Monthly capacities for production of the phenolic, urea and melanine molding compounds are 4000, 1500 and 500 tons, respectively. Plastics lack ductility and surface hardness and so far are adapted for few constructional purposes but nevertheless may be converted into an endless variety of products. In many of these applications they are complementary to steel and the metals which are used as inserts in moldings. Plastics as yet are not adapted for molding into large sections such as the automobile tops envisioned by the designers of teardrop cars. Plywood, for which the synthetic resins are



used as binders now may be termed an engineering material, and is being produced in the Pacific Northwest at the rate of 1,000,000 tons annually. This product has met with some success in construction of small houses and some types of aircraft. Synthetic rubber may be considered a part of the plastics family and will be available in the amount of some 1,000,000 tons if government-financed plants are kept in operation.

Glass has come in for an increasing share of the material market during the course of the emergency. Glass containers have been made stronger and lighter. Laminated glass with high resistance to shock has been further improved in recent months. Total productive capacity now is in the neighborhood of 6,000,000 tons, which makes it a decided factor on the materials front.

It will be readily apparent from all of the figures cited that iron and steel will maintain a dominant position as the basic raw material in the national economy if for no other reasons than low cost and high strength factors.

In the field of cast iron and steel much new data have been added to the fund of knowledge during the war period. Precision casting of parts in permanent molds is a process about which more will be heard in the near future. With this process, parts may be cast closely to the ultimate form desired thereby eliminating excessive machining and loss of material in the form of scrap. Centrifugal casting, long used in the production of cast iron pipe, ship propeller sleeves and the like, has been extended

to the production of accurately-formed small steel parts. Steel foundries, through improved casting and heat-treating methods have been able to make extremely strong cast armor plate and thereby have learned many lessons which no doubt will carry over into the peacetime era. Other innovations include a simple process now being developed for the malleableization of chilled cast iron.

As for the wrought steels, it is interesting to note some of the transformations which have been taking place. An examination of the chart showing production capacities by types reveals that electric furnace steel, or for all practical purposes alloy steel, will account for 6.6 per cent of the total when the expansion program is completed some time next year, as compared with 3 per cent at the beginning of 1941.

Open-hearth steel capacity, of course, also has been stepped up sharply but will comprise 87.2 per cent of the total, against 88.6 per cent on Jan. 1, 1941. Bessemer steel capacity in the same period shows a decline of some 900,000 tons and the proportion is down 2 points to 6.3 per cent. Crucible steel capacity has remained at slightly less than 4000 tons for several years or about 0.003 per cent.

There is an increasing tendency on the part of consumers to specify material on the basis of physical requirements rather than chemical composition in the belief that present procedure makes it difficult to select exactly the right steel for a specific application. There are those who believe that shortly tests will be developed to predetermine hardenability ratings while the steel still is in the molten state just as it is now possible to make certain of grain size in advance with a reasonable degree of accuracy.

This movement has been given considerable encouragement during the course of the emergency. Industry for many years had unrestricted access to alloying elements which were used in sufficient quantities to make a given steel practically foolproof and stand up in service despite possible poor handling during fabrication and heat treatment. The shortages of all materials which arose at the time of the emergency made it necessary to introduce conservation measures on every hand and the development of the national emergency steels usually containing alloying elements totaling less than 2 per cent was a direct result.

There is considerable evidence that the favorable experiences of some consumers with the lean alloy steels during the emergency may lead to their use in substantial quantities in the postwar period although others plan to switch back to prewar SAE analyses. From the standpoint of the steelmaker there appear to be no important economies accruing through the use of smaller amounts of alloying elements. The cost of testing and segregating scrap in most instances more than offsets the cost of larger quantities of the elements used as additions in making higher alloy steels. The fact cannot be overlooked in any event that a large percentage of the scrap returning to the mills will be alloyed as evidenced by production of 15,000,000 tons of open-hearth and electric furnace alloy steel in 1943, a figure which was nearly one-third the carbon steel total of 50,000,000 tons. And, out of the 15,000,000 tons of alloy steel, 4,250,000 tons were of the lean NE type.

Steel List Simplified

It would not be surprising if some of the economies which have resulted from production of a simplified list of steels carried over into the postwar period. The steel industry reported to the war agencies in Washington that it has been able to increase production from 5 to 15 per cent in the effective use of existing facilities through longer runs, fewer roll changes, fewer rejections and greater recoveries. Of the 250 specifications selected by the 12 advisory committees of the National Emergency Steel Specifications project, exclusive of aircraft classifications, more than half have been modified but, more significantly, sponsoring agencies have issued 12 new and amended specifications representing 70 per cent of the entire steel production of the United States.

Another development which has not been given a great deal of publicity was the issuance of Schedule 15 by the War Production Board setting up standards for hot-rolled carbon bars. This order effectively reduces the number of sizes in which bars may be rolled and one large company already has found it possible to step up production 7 to 15 per cent through fewer roll changes. To cite one large buying group, the aircraft industry has regularly been accustomed to buy bars oversize and largely as a consequence one mill had nine sets of rolls to roll a single size—¾-inch bars! So favorable has been the experience with the carbon bar schedule that another order has been formulated covering hot-rolled alloy bar classifications.

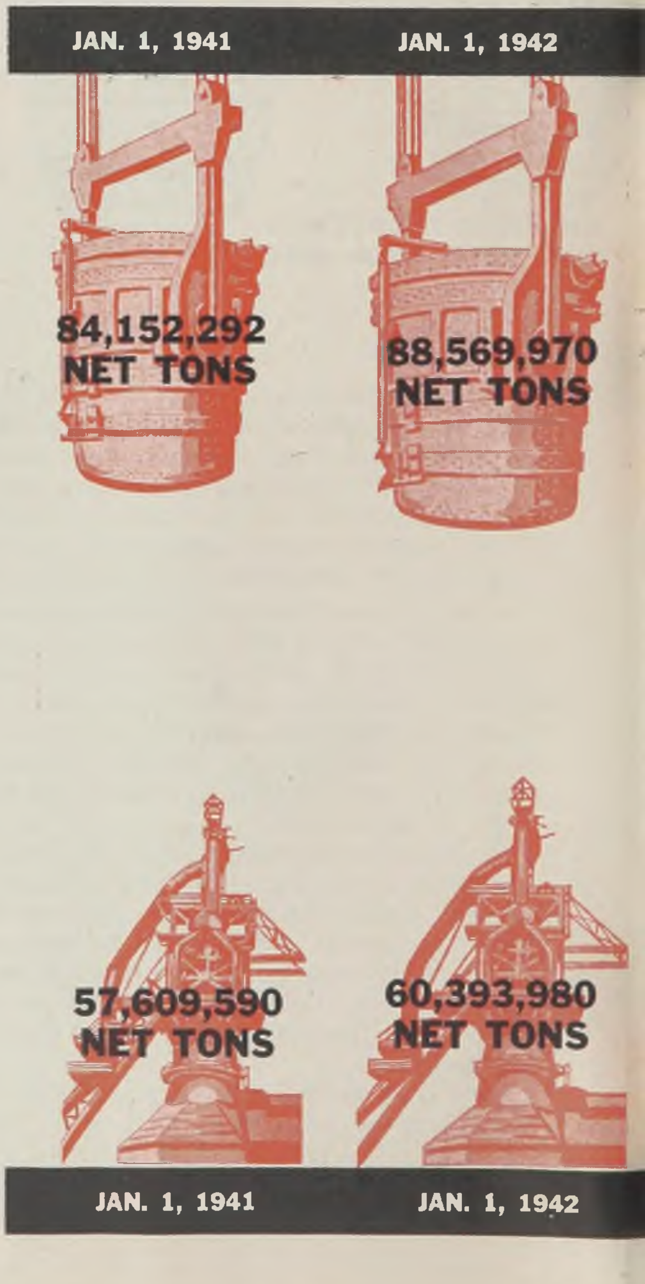
2. STEEL'S PRODUCTION At Peak as Expansion Program

By-product coke industry may have to give serious consideration to physical condition of ovens if high rate of pig iron production is to be maintained. Blast furnaces of large diameter surpass a ton of iron per minute. New blowout technique empties furnace of tons of raw materials in matter of minutes. Once-flourishing charcoal iron industry now down to a single stack. Four "grass root" plants are established in consuming areas

FINISHING touches here and there are about all that remain to be done with the huge steel expansion program launched by the government shortly after the outbreak of the war. Today—thanks to mill executives, engineers, metallurgists and many others associated with the steel industry for their concerted effort—more ingots are being poured in steelmaking shops than at any time in the history of this country. More iron is coming from our blast furnaces than at any time since "keepers" began opening iron notches. More coke is passing into quenching towers than at any time since the invention of the coke pusher.

Whether the war continues for many months or whether it comes to an abrupt close, many in the industry believe a heavy program of rehabilitation will have to be undertaken at many plants. Repair work has been postponed in order to throw everything into war effort but the time is not far distant when millwrights and repair crews will have to start putting a polish on the handles of their wrenches. Take the matter of coke ovens alone. Fully 45 per cent of the by-product ovens in this country are 25 years or older; obsolescence has left its scar in every one of these plants. In the near future these ovens must be replaced if they are to keep even with or abreast of blast furnace requirements. Down through many an open-hearth shop rebuilds are almost a "must" in the notebook of the brickmason boss. So that if the physical condition of plants is to be maintained, regardless of wartime conditions, the sound of hammers chipping furnace brick or of those driving rivets must soon be heard above the dull thud made by ingots rumbling on their way into the bite of the blooming mill rolls.

Last year 1000 new by-product ovens were completed with an annual capacity in excess of 5,637,000 net tons of coke for blast furnace use. In addition the Columbia Steel Co. built two back-to-back batteries of 250 beehive ovens each near the Geneva Coal Mine, Utah. Fuel from these ovens supplies the additional stack erected at Ironton, Utah, about 124 miles northwesterly of the coke plant. Records covering many decades have to be consulted to find any semblance of beehive oven construction outside of the Connellsville district. While the completion of the Utah installation appears somewhat unusual in view of the efficiency of by-product ovens, yet those of the beehive type were authorized to conserve

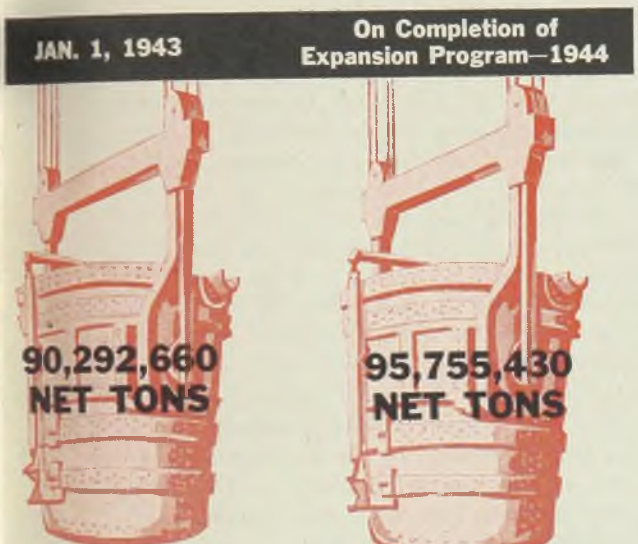


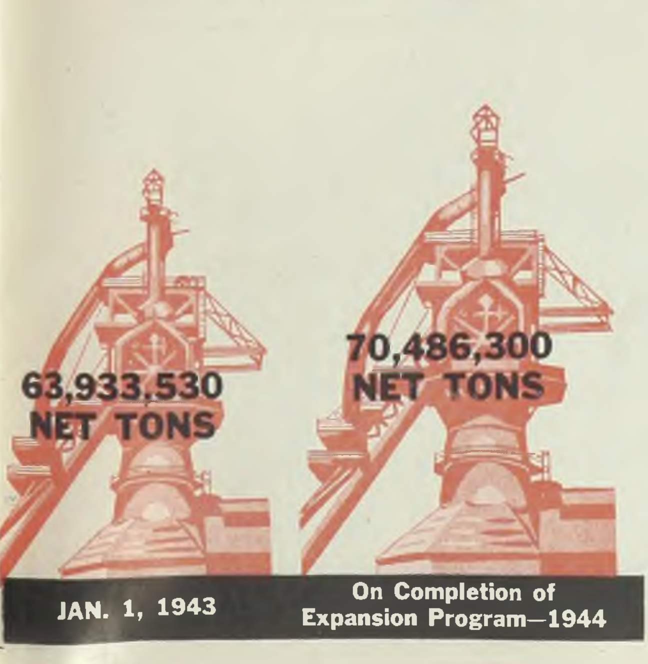
FACILITIES
Nears Completion

By JOHN D. KNOX
Steel Plant Editor, STEEL

steel which at the time was the order of the day.

Who of the older school of blast furnace operators recalls the statement made by J. G. West Jr. 25 years ago: "The 1000-ton furnace is not an idea that will be abandoned but will be attained . . ." When he stated his conviction modern blast furnaces were operated with 15 to 18-foot hearths. One did not have to cock his ear to hear a snicker when the 1000-ton stack was the center of conversation whether "Jim" was present or whether he was over in the cast house visualizing the time when blast furnace hearths would demand bigger ladles and more of them. Many an idea has been born out in the cast house where little flakes of graphite flicker in the glow of running metal and come to rest on the shoulders of men who catch the vision. Even today, furnacemen are heard talking about 30-foot hearth furnaces—in low tones and sometimes whispers, but nevertheless talking in terms of 30-foot diameters. Moreover, a shrug of the shoulder and a snicker are still a part of the conversation just as they were 25 years ago. While the same type of graphite still fills the air yet its source at the present time is from the heavy jacketed hearth that requires a tape measure to be pulled out 28½ feet to obtain the diameter.





A study of the accompanying list of blast furnaces in this country discloses the trend toward larger hearth furnaces over the last few years. Eleven furnaces are casting iron from 18-foot hearths and 15 from hearths 18½ feet diameter. Sixteen stacks have 19-foot hearths and the same number 23-foot hearths. Furnaces with hearths ranging from 23¼ to 24½ feet total nine. Twenty stacks are being operated with 25-foot hearths, seven with 26-foot, 11 with 27-foot and two with 28½-foot. There is only 1½ feet to go between the present status of hearth diameters and the next snicker. Just how far away is the 30-foot hearth furnace from the standpoint of time?

Some idea is had of the smelting capacity of these big hearth furnaces from the record tonnages produced. Back in July 1931 the No. 10 stack, Carnegie-Illinois Steel Corp., Gary, Ind. (25-foot hearth) hung up a record of 41,701 tons per month. This record stood until January 1942 when the No. 3 Carrie stack at Rankin, Pa. (26-foot hearth) made 41,782 tons for that month. Then the records began to be shattered thick and fast. In March 1942, "C" furnace (25-foot hearth) of Great Lakes Steel Corp. tapped 43,478 tons. This was broken in May by the No. 3 stack (26-foot hearth) of the National Tube Co., Lorain, O. with 43,866 tons. In August "H" stack (27-foot hearth) of the Bethlehem group at Lackawanna put 44,065 tons down the runners and two months later replaced this record with 46,246 tons. In March 1943, the No. 3 Aliquippa stack (28½-foot hearth) of the Jones & Laughlin Steel Corp. boosted the record to 48,505 tons. In May 1943, the present record of 49,705 tons was established by "B" stack (27¼-foot hearth) of the Great

Lakes Steel Corp., Ecorse, Mich. This amounts to 1603 tons per day which is a lot of iron to pass beneath the skimmer brick in any blast furnace cast house.

One of the tallest stacks in the world—"B" furnace, second of the DPC furnaces at the Edgar Thomson plant of the Carnegie-Illinois Steel Corp., Braddock, Pa.— was blown in Dec. 16, 1943. It is a duplicate of "C" stack which started its initial campaign July 19, 1943. Each stack is 105 feet from the hearth brickwork to the top ring or 227 feet overall top rigging, is equipped with a 27½-foot hearth diameter and is designed for a production of 430,100 net tons of iron annually.

A comparison of present-day hearth diameters with the 6 and 9-foot hearth diameters of our charcoal stacks gives some indication of the progress made since the days when all stacks were operated with charred wood. And yet, all that remains of the charcoal iron industry after almost 300 years of existence in this country is the Newberry stack at Mancelona, Mich. Plans subject to the approval of WPB involve moving a stack at Pembroke, Fla. to Rusk, Tex. where there is an abundant supply of hard wood. The carbonizing and charcoal by-product chemical plant of the Delta Chemical & Iron Co., Wells, Mich. will be moved to the furnace site at Rusk. The Wells charcoal stack completed its last campaign a year ago because of depletion of hardwood in Michigan.

Tapping the salamander at the blow-out of a blast furnace has been employed rather freely during the past few years as a means for holding to a minimum the time of rebuild. Stress has been laid on this method as a wartime measure for getting the furnace back into production a few days sooner than is possible by dynamiting the salamander and removing it in chunks. A blowout procedure which goes even beyond this and allows the repair crews to get inside the furnace many days in advance of the conventional schedule, especially when the stack is to undergo a complete relining, was tried out recently with success.

After charging was discontinued the stack was blown down to 65 feet above tuyere level. All the iron possible was tapped out the iron notch and then the salamander was drained through a channel made with an oxygen lance in the lower part of the hearth jacket at hearth level. Meanwhile, two barricades of railroad ties flaring out from the bosh for about [illegible] feet and at bustle pipe height, served to confine brickbats to the protected area when a section of the bosh at the cinder notch was blasted out with dynamite. On the opposite side of the furnace three high-pressure nozzles were inserted in the tuyere openings. A high-pressure nozzle also was mounted in each barricade on the cinder notch side as well as high-pressure line over the skips in the stockhouse.

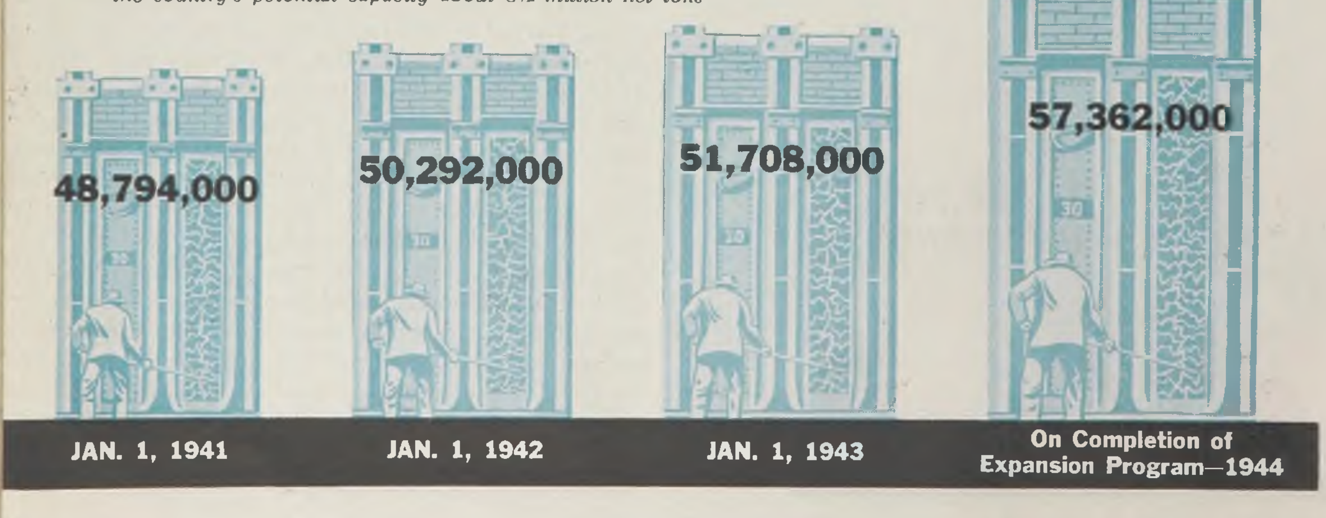
When the salamander had completely drained itself from the hearth, water was dumped into the top of the stack as fast as the skips could get it there, high-pressure water was passed into the bottom of the furnace through the three nozzles mounted in the tuyeres and as fast as the material was washed from the furnace into the area formed by the barricade, the nozzles there kept it moving into the cinder pit beyond. In the almost unbelievable time of 25 minutes the entire burden extending 65 feet up in the stack was emptied into the slag pit and as soon as equipment could be cleared away, the repair crews were into the furnace tearing out the lining for the rebuild. The procedure is highly acclaimed by blast furnace operators as a means for getting stacks back into operation in a minimum of time following the rebuild, thereby bolstering up national production.

Then there is the unique and comprehensive study to be made this year on the new 1300-ton stack operated by the Republic Steel Corp., Cleveland, to determine how present operating technique can be improved to better operating efficiency. Controlled top pressures ranging from 5 to 10 pounds above atmosphere are involved. Sufficient wind will be supplied by two 90,000 cubic foot turboblowers operating in series until 350 pounds of flue dust per ton of iron is produced; once the stack blows this quantity of dust into the dust catcher it will be considered as operating under normal conditions and at this point the tests will be carried to conclusion.

Three fully integrated "grass root" plants have been added to the country's steel producing capacity as the outcome of a pattern followed by the government to decentralize the industry, establish plants in consuming areas and draw upon raw material sources outside the ore mining regions in the Great Lakes area. These are located at Houston, Tex., Geneva, Utah, and Fontana, Calif.

The plant at Houston, Tex., operated by the Sheffield

By-product coke ovens completed during last three years has increased the country's potential capacity about 8½ million net tons



Steel Corp., Kansas City, Mo., subsidiary of the American Rolling Mill Co., Middletown, O., was built for the purpose of supplying plates for oil storage tanks in the Southwest oil fields and the shipbuilding industry in the Gulf Port region. It includes a 700-ton blast furnace, 47 by-product coke ovens, five 110-net ton open-hearth furnaces, a 36-inch blooming mill and a 112-inch 3-high plate mill designed to produce 216,149 tons of plates.

Then, too, not far from Dallas at Daingerfield, Tex., the Lone Star Steel Co. is completing a 1200-ton blast furnace. Oklahoma coal will be coked, and local Texas ores used. A more exhaustive analysis of raw materials was presented in STEEL, Oct. 11, 1943, page 264.

About 40 miles south of Salt Lake City, Utah, situated on a 1600-acre site is the $180,000,000 plant of the Geneva Steel Co., which the Columbia Steel Co. built for the government. The plant includes 252 by-product coke ovens, three 1100-ton blast furnaces, nine 225-ton open hearths, a 45-inch blooming and slabbing mill, a 132-inch plate mill, and a 28-inch blooming mill to serve a 26-inch structural mill. The first coke was pushed from the by-product ovens Dec. 14.

Iron ore is mined by open-pit methods at Iron Mountain, Utah, and shipped about 225 miles to the Geneva plant. Coal is obtained from the Geneva mine at Horse Canyon, approximately 130 miles from the plant. Water is secured from three sources: the Deer Creek Reservoir, artesian wells and springs. Reclaimed water is cooled in a 309-acre reservoir and used over again.

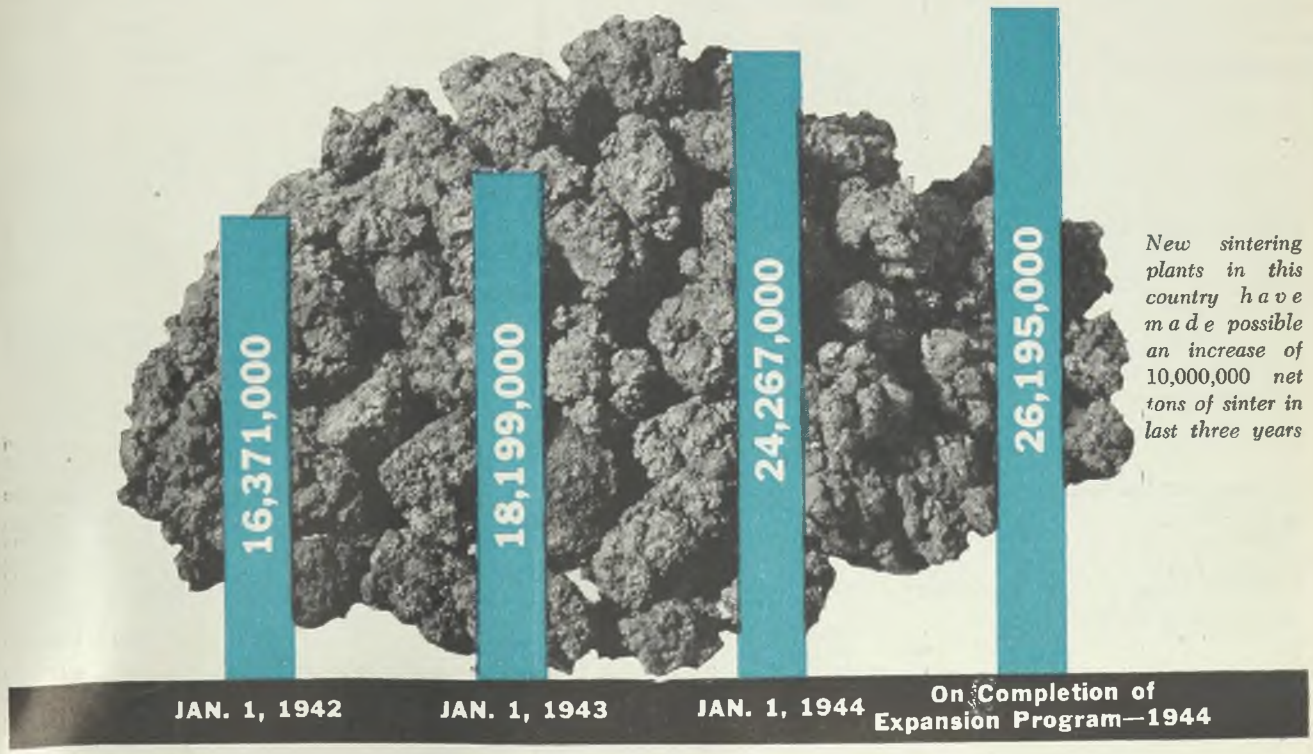
Construction of this plant was authorized by the government in order to supply plates and shapes to shipyards on the Pacific Coast which supply otherwise would have involved transcontinental haulage from eastern mills. The plant when in normal operation will produce 700,000 net tons of plates and 200,000 net tons of structural shapes, billets and rounds. Early in December, the War Production Board notified the Defense Plant Corp. to halt all construction of its 26-inch structural mill; as it now stands, the work is about 40 per cent completed.

Frequently the question is asked what part this plant will play in the postwar era. Can it continue to operate with output confined to plates and shapes or will rolling facilities have to be rounded out in line with its open-hearth production? While no definite information is available at the moment concerning future plans, yet from the layout it would seem feasible to convert the plate mill into a hot strip mill merely by the addition of a slab squeezer, a couple of finishing stands of rolls, some coilers and miscellaneous finishing equipment.

Addition of cold rolling facilities would permit cold strip to be shipped to Pacific Coast canmakers and sheet fabricators. With the structural mill scheduled on rounds a seamless tube mill might well fit into the picture of postwar markets. Nearby at Ogden, Utah, is a depot for loading 20 and 37 millimeter shells and certainly it would be advantageous for the government to draw upon a nearby seamless mill for its tubular shell stock and bomb cases. Then there is the market for tubes in the oil industry in Oklahoma, California and the Rocky Mountain states in which such a mill could participate.

All this, of course, is a matter of conjecture yet it would seem as though the Geneva plant in the postwar era would either have to curtail production or else round out its finishing facilities to conform to peacetime markets.

Then there is the plant of Kaiser Co. Inc. at Fontana, Calif., the first fully integrated plant ever to be erected on the Pacific Coast. It comprises 90 by-product coke ovens, a 1200-ton blast furnace, six 185-ton open-hearth furnaces, a 110-inch plate mill, a 28-inch structural mill and an electric furnace and merchant mill for turning out alloy shapes in merchant sizes. The plant is designed to roll 300,000 net tons of plates, 82,000 net tons of bars and 90,000 net tons of structural shapes. Output at the present time is being used for ship construction.



New sintering plants in this country have made possible an increase of 10,000,000 net tons of sinter in last three years

THE STATISTICAL POSITION

In the following tables are presented blast furnace, coke and steel-making capacities by individual companies at the end of the expansion program scheduled for completion in 1944. Also shown are

BLAST FURNACES IN THE UNITED STATES

COMPANY	Furnace identification	Hearth Dia.	Capacity, n. t.
Alan Wood Steel Co.			
Swedeland, Pa.	2	15′ 0″	198,950
	3	18′ 0″	255,850
Total			454,800
American Rolling Mill Co.			
Ashland, Ky.	1	13′ 9″	148,000
	Norton	14′ 6″	188,000
	Bellefonte[3]	27′ 0″	430,000
		Total	766,000
Hamilton, O.	1	17′ 0″	265,000
	2[2]	18′ 0″	292,000
		Total	557,000
Sheffield Steel Corp. Houston, Tex.	1[2]	22′ 0″	245,300
Total American Rolling Mill Co.			1,568,300
Antrim Iron Co.			
Grand Rapids, Mich.	Mancelona[4]	6′ 0″	28,200
Bethlehem Steel Co.			
Bethlehem, Pa.	A[5]	20′ 0″	300,000
	B	18′ 0″	237,600
	C[6]	26′ 0″	432,000
	D	19′ 0″	237,600
	E	19′ 0″	237,600
	F	19′ 0″	237,600
	G	18′ 5″	237,600
		Total	1,920,000
Johnstown, Pa.	E	22′ 6″	324,000
	F	18′ 0″	198,000
	G	21′ 0″	324,000
	H	17′ 6″	198,000
	J	19′ 0″	270,000
	K	19′ 0″	270,000
	L	18′ 0″	252,000
		Total	1,836,000
Lackawanna, N. Y.	A	19′ 0″	279,600
	B	19′ 6″	300,000
	C[7]	27′ 0″	432,100
	F	24′ 0″	378,000
	G	25′ 0″	410,400
	J	21′ 6″	324,000
	H[8]	27′ 0″	432,000
		Total	2,556,100
Sparrows Point, Md.	A	23′ 0″	420,000
	B	22′ 3″	410,400
	C	23′ 3″	410,400
	D	25′ 0″	432,000
	E	19′ 0″	303,600
	F	19′ 0″	303,600
	G[9]	27′ 0″	432,000
		Total	2,712,000
Steelton, Pa.	A	18′ 0″	228,000
	B	22′ 0″	348,000
	E	16′ 0″	216,000
		Total	792,000
Total Bethlehem Steel Co.			9,816,100
Brooke Iron Co.			
Birdsboro, Pa.	Birdsboro	14′ 0″	161,300
Colonial Iron Co.			
Riddlesburg, Pa.	Riddlesburg[10]	11′ 0″	80,650
Colorado Fuel & Iron Corp.			
Pueblo, Colo.	A	16′ 9″	161,300
	D	19′ 4″	191,500
	E	20′ 6″	211,700
	F[11]	21′ 0″	225,800
		Total	790,300

COMPANY	Furnace identification	Hearth Dia.	Capacity, n. t.
Crucible Steel Co. of America			
Midland, Pa.	2	18′ 0″	255,350
	3	18′ 0″	282,250
Total			537,600
Cumberland Iron Co.			
Cumberland, Tenn.	Cumberland[12]	9′ 0″	34,950
Delta Chemical & Iron Co.			
Wells, Mich.	Wells[13]	9′ 0″	26,900
Ford Motor Co.			
Dearborn, Mich.	Henry	18′ 6″	255,350
	Benson	18′ 6″	241,900
Total			497,250
Globe Iron Co.			
Jackson, O.	Jackson	14′ 6″	84,000
Inland Steel Co.			
Indiana Harbor, Ind.	1	20′ 0″	329,000
	2	19′ 0″	302,400
	3	17′ 3″	266,800
	4	20′ 0″	324,050
	5	25′ 0″	427,000
	6[14]	25′ 0″	427,000
	A[15]	25′ 9″	450,250
	B[16]	25′ 9″	450,250
Total			2,976,750
Interlake Iron Corp.			
Erie, Pa.	Perry	15′ 7″	171,350
South Chicago, Ill.	A	15′ 7″	216,400
	B	19′ 6″	296,500
		Total	512,900
Toledo, O.	A	19′ 6″	237,600
	B	21′ 0″	268,800
		Total	506,400
West Duluth, Minn.	Zenith	12′ 8″	125,400
Total Interlake Iron Corp.			1,316,050
International Harvester Co.			
Wisconsin Steel Div.			
South Chicago, Ill.	1	18′ 6″	235,850
	2	17′ 0″	235,850
	3	18′ 6″	247,950
Total			719,650
Jackson Iron & Steel Co.			
Jackson, O.	Jackson	13′ 2″	67,200
Jones & Laughlin Steel Corp.			
Aliquippa, Pa.	1	28′ 6″	423,350
	2	21′ 6″	302,400
	3	28′ 6″	423,350
	4	27′ 0″	402,850
	5	24′ 6″	383,400
		Total	1,935,350
Cleveland	1	18′ 6″	240,000
	2	17′ 7″	240,000
		Total	480,000
Pittsburgh	1	20′ 0″	282,000
	2	26′ 0″	379,200
	3	21′ 6″	314,400
	4	18′ 9″	282,000
	5	20′ 0″	271,200
	6	18′ 6″	271,200
		Total	1,800,000
Total Jones & Laughlin Steel Corp.			4,215,350
Kaiser Co. Inc.			
Fontana, Calif.	1[17]	27′ 0″	431,400

OF THE STEEL INDUSTRY

the new rolling mill and tube mill facilities, electrolytic tin plate lines, iron ore sintering installations and new iron ore mines. All data are from authoritative sources and include late revisions.

BLAST FURNACES IN THE UNITED STATES

COMPANY	Furnace identification	Hearth Dia.	Capacity, n. t.
Koppers United Corp.			
Granite City, Ill.	A[13]	17′ 9″	193,550
	B[19]	19′ 6″	233,850
Total			427,400
Lavino & Co., E. J.			
Reusens, Va.	Oriskany	12′ 6″	36,300
Sheridan, Pa.	Sheridan	11′ 3″	36,300
Total			72,600
Lone Star Steel Co.			
Daingerfield, Tex.	1[20]	23′ 0″	399,850
Mystic Iron Works			
Everett, Mass.	Everett	17′ 0″	174,000
National Steel Corp.			
Great Lakes Steel Corp.			
Detroit	A	17′ 9″	262,700
	B[21]	27′ 3″	443,500
	C	25′ 0″	393,800
		Total	1,100,000
Hanna Furnace Corp.			
Buffalo	1	15′ 6″	187,500
	2	15′ 6″	187,500
	3	14′ 0″	196,000
	4	20′ 0″	327,600
		Total	898,600
Weirton Steel Co.			
Weirton, W. Va.	1	25′ 6″	411,250
	2	23′ 6″	369,600
	3[22]	27′ 0″	419,350
		Total	1,200,200
Total National Steel Corp.			3,198,800
New Jersey Zinc Co.			
Palmerton, Pa.	1	12′ 6″	67,200
	2	10′ 0″	67,200
Total			134,400
Pittsburgh Ferromanganese Co.			
Chester, Pa.	Delaware	13′ 0″	134,400
Pittsburgh Coke & Iron Co.			
Neville Island, Pa.	Neville	19′ 0″	295,700
Sharpsville, Pa.	Sharpsville	15′ 0″	141,100
Total			436,800
Pittsburgh Steel Co.			
Monessen, Pa.	1	19′ 0″	276,850
	2	18′ 0″	260,150
	3[23]	25′ 0″	432,100
Total			969,100
Republic Steel Corp.			
Birmingham, Ala.	1	16′ 0″	225,100
	2	16′ 0″	194,900
		Total	420,000
Buffalo	1	19′ 0″	280,350
	2	22′ 0″	334,650
		Total	615,000
Canton, O.	Canton	18′ 4″	235,000
Cleveland	1[24]	25′ 6″	390,000
	2	17′ 0″	235,200
	3	16′ 3″	219,750
	4	25′ 6″	395,150
	5[25]	27′ 0″	450,250
		Total	1,690,350
Gadsden, Ala.	1	16′ 0″	209,650
	2[26]	25′ 0″	280,350
		Total	490,000
Massillon, O.	Massillon	18′ 6″	235,000
South Chicago, Ill.	1[27]	27′ 0″	450,250

COMPANY	Furnace identification	Hearth Dia.	Capacity, n. t.
Republic Steel Corp. (Continued)			
Troy, N. Y.	1	17′ 6″	235,000
Warren, O.	Trumbull-Cliffs	27′ 0″	450,000
Youngstown, O.	2	24′ 6″	350,000
	3	25′ 6″	390,000
	4	17′ 0″	245,000
	5	19′ 0″	265,000
	6[28]	25′ 0″	392,000
		Total	1,642,000
Total Republic Steel Corp.			6,462,600
Sharon Steel Corp.			
Lowellville, O.	Mary	13′ 6″	174,700
Shenango Furnace Co.			
Sharpsville, Pa.	1	19′ 0″	211,700
	3	19′ 6″	252,000
Total			463,700
Sloss Sheffield Steel & Iron Co.			
Birmingham, Ala.	1	15′ 0″	145,150
	2	15′ 4″	135,750
		Total	280,900
North Birmingham, Ala.	3	12′ 8″	105,500
	4	12′ 2″	105,500
		Total	211,000
Total Sloss Sheffield Steel & Iron Co.			491,900
Struthers Iron & Steel Co.			
Struthers, O.	1	16′ 0″	188,150
Superior Charcoal Iron Co.			
Mancelona, Mich.	Newberry	7′ 0″	28,200
Tennessee Products Corp.			
Lyles, Tenn.	Wrigley	7′ 4″	32,250
Rockdale, Tenn.	Rockdale	12′ 6″	25,400
Rockwood, Tenn.	1	11′ 9″	21,500
	2	11′ 9″	30,250
		Total	51,750
Total Tennessee Products Corp.			109,400
Tonawanda Iron Corp.			
North Tonawanda, N. Y.	Tonawanda	15′ 6″	174,700
U. S. Steel Corp.			
American Steel & Wire Co.			
Cleveland	B	18′ 6″	244,600
	D	21′ 0″	286,250
		Total	530,850
Donora, Pa.	1	18′ 0″	224,450
	2	18′ 6″	224,450
		Total	448,900
Duluth	1	16′ 10″	182,800
	2[29]	27′ 0″	259,400
		Total	442,200
Total American Steel & Wire Co.			1,421,950

(Continued next page)

[1] New. Blown in Aug. 20, 1943. [2] Enlarged from 13′ 6″ in 1940. [3] New. Scheduled to be blown in Dec., 1943. [4] Blown out Oct., 1943. [5] Enlarged from 19′. Blown in July 3, 1941. [6] New. Blown in July 1, 1943. [7] New. Blown in July 18; 1943. [8] New. Blown in Nov. 23, 1941. [9] New. Blown in Oct. 10, 1941. [10] Blown out May, 1943. [11] New. Blown in Jan. 29, 1942. [12] Blown out Aug., 1942. [13] Blown out Jan., 1943; by-product plant will be moved to Rusk, Tex. [14] New. Blown in Nov. 16, 1942. [15] New. Due June, 1944. [16] New. Blown in Nov. 16, 1943. [17] New. Blown in Jan., 1943. [18] Rebuilt. Blown in Jan. 16, 1943. [19] Blown in Sept. 15, 1941. [20] New. Scheduled to be blown in Dec., 1943. [21] Rebuilt. Blown in Dec. 9, 1941. [22] New. Blown in Dec. 25, 1941. [23] New. Due Jan., 1944. [24] Enlarged from 17′, 1940. [25] New. Blown in Oct. 28, 1943. [26] New. Blown in May 28, 1942. [27] New. Due Jan., 1944. [28] New. Blown in Oct. 12, 1942. [29] Moved from Joliet, Ill. Enlarged from 19′. Blown in Feb. 24, 1943.

(Continued)

BLAST FURNACES IN THE UNITED STATES

COMPANY	Furnace identification	Hearth Dia.	Capacity, n. t.
U. S. Steel Corp. (Continued)			
Carnegie-Illinois Steel Corp.			
Braddock, Pa.	B[30]	27′ 6″	430,100
	C[31]	27′ 6″	430,100
	D	26′ 0″	409,900
	E	19′ 3″	225,800
	F[32]	25′ 0″	379,000
	G[33]	25′ 0″	379,000
	H[34]	25′ 0″	379,000
	I	23′ 0″	321,200
		Total	2,954,100
Clairton, Pa.	1	20′ 0″	321,200
	2	17′ 6″	185,450
	3	17′ 6″	186,150
		Total	692,800
Duquesne, Pa.	1	19′ 0″	219,050
	2	20′ 6″	255,350
	3[35]	23′ 0″	321,200
	4[36]	23′ 0″	321,200
	5	20′ 0″	241,900
	6	19′ 0″	219,050
		Total	1,577,750
Etna, Pa.	1	16′ 0″	174,050
	3	17′ 0″	181,450
		Total	355,500
Farrell, Pa.	2	21′ 6″	279,550
	3	19′ 6″	231,150
		Total	510,700
Gary, Ind.	1	20′ 6″	278,900
	2	20′ 6″	278,900
	3	20′ 6″	278,900
	4	20′ 6″	278,900
	5	20′ 6″	278,900
	6	21′ 3″	299,700
	7[37]	26′ 6″	465,700
	8	25′ 0″	413,950
	9	22′ 3″	329,300
	10	25′ 0″	413,950
	11	25′ 0″	413,950
	12	24′ 0″	413,950
		Total	4,145,000
Mingo Junction, O.	2	23′ 0″	321,200
	3[38]	19′ 3″	225,800
	4	20′ 0″	241,900
		Total	788,900
Rankin, Pa.	1	22′ 6″	306,450
	2	22′ 6″	321,200
	3[39]	26′ 0″	409,900
	4[40]	26′ 0″	409,900
	6	23′ 6″	336,000
	7	23′ 6″	336,000
		Total	2,119,450
South Chicago, Ill.	1	21′ 6″	306,450
	2	23′ 0″	350,800
	3	18′ 9″	232,500
	4	25′ 0″	415,300
	E	21′ 6″	306,450
	5	23′ 0″	350,800
	6	22′ 3″	329,300
	7	18′ 9″	232,500
	8	25′ 0″	415,300
	9	19′ 3″	245,950
	10	23′ 0″	399,150
		Total	3,584,500
Youngstown, O.	1	23′ 0″	321,200
	2	25′ 0″	379,000
	3	23′ 6″	336,000
	4	21′ 0″	267,450
	5	21′ 0″	267,450
	6	21′ 0″	267,450
		Total	1,838,550
Total Carnegie-Illinois Steel Corp.			18,567,250
Columbia Steel Co.			
Provo, Utah	1	15′ 9″	204,300
	2[41]	20′ 9″	299,700
		Total	504,000
Geneva Steel Co.			
Geneva, Utah	2[42]	25′ 0″	383,050
	3[42]	25′ 0″	383,050
	4[42]	25′ 0″	383,050
		Total	1,149,150

COMPANY	Furnace identification	Hearth Dia.	Capacity, n. t.
National Tube Co.			
Lorain, O.	1	23′ 0″	279,550
	2	22′ 6″	279,550
	3[43]	26′ 0″	413,950
	4[44]	26′ 0″	413,950
	5	22′ 3″	279,550
		Total	1,666,550
McKeesport, Pa.	1	20′ 1″	259,400
	2	21′ 7″	279,550
	3	23′ 0″	301,050
	4	21′ 7″	301,050
		Total	1,141,050
Total National Tube Co.			2,807,600
Tennessee Coal, Iron & R.R. Co.			
Ensley, Ala.	1	21′ 0″	275,500
	2	18′ 6″	293,000
	3	19′ 6″	259,400
	4	22′ 0″	275,500
	5	17′ 0″	189,500
	6	12′ 0″	149,200
		Total	1,442,100
Fairfield, Ala.	5	22′ 6″	315,850
	6	23′ 0″	315,850
	7[45]	23′ 0″	353,450
		Total	985,150
Holt, Ala.	Tuscaloosa[46]	14′ 6″	112,200
Total Tenn. Coal, Iron & R.R. Co.			2,539,450
Total U. S. Steel Corp.			26,989,400
Wheeling Steel Corp.			
Benwood, W. Va.	Riverside	18′ 3″	201,000
Martins Ferry, O.	Martins Ferry	14′ 0″	152,000
Portsmouth, O.		18′ 0″	256,400
Steubenville, O.	1	21′ 6″	272,650
	2	21′ 6″	287,350
		Total	560,000
Total Wheeling Steel Corp.			1,169,400
Wickwire-Spencer Steel Co.			
Tonawanda, N. Y.	X	15′ 0″	188,150
	Y	17′ 6″	248,650
Total			436,800
Woodward Iron Co.			
Woodward, Ala.	1	17′ 6″	205,650
	2	17′ 0″	184,150
	3	16′ 6″	147,850
Total			537,650
Youngstown Sheet & Tube Co.			
Campbell, O.	1	21′ 0″	311,800
	2	21′ 6″	353,450
	3[47]	23′ 0″	392,450
	4[48]	23′ 0″	392,450
		Total	1,450,150
East Chicago, Ill.	1	18′ 6″	295,700
	2	22′ 0″	325,250
		Total	620,950
Hubbard, O.	Hubbard	16′ 0″	200,250
South Chicago, Ill.	3	18′ 6″	287,600
	4	16′ 0″	165,300
	5	18′ 6″	233,850
		Total	686,750
Youngstown, O.	1	16′ 0″	208,300
	2	18′ 6″	294,000
		Total	502,300
Total Youngstown Sheet & Tube Co.			3,460,400
Total all companies			**70,441,100**

[30] New. Blown in July, 1943. [31] New. Blown in Nov. 15, 1943. [32] Enlarged from 22′ 11″, 1940. [33] Enlarged from 20′ 10″, 1940. [34] Enlarged from 20′ 10″, 1940. [35] Enlarged from 19′, 1942. [36] Enlarged from 20′ 6″, 1942. [37] Enlarged from 20′. Blown in July 4, 1943. [38] Replaced by Braddock "K". [39] Enlarged from 21′ 6″. Blown in May, 1941. [40] Enlarged from 21′ 6″. Blown in April, 1942. [41] Moved from Joliet, Ill. Blown in Jan. 16, 1943. [42] New. Due Jan., 1944. [43] Enlarged from 20′ 6″, 1941. Blown in March 2, 1941. [44] Enlarged from 22′ 3″, 1942. Blown in June 27, 1942. [45] New. Blown in May 1, 1942. [46] Rebuilt, 1943. [47] Enlarged from 18′ 6″. Blown in June 3, 1941. [48] Enlarged from 18′ 6″. Blown in Sept. 26, 1942.

BY-PRODUCT COKE OVENS AND CAPACITIES

(Iron and Steel Plants)

COMPANY	No. of Ovens	Kind of Oven*	Annual Capacity, Coke, n.t.
American Rolling Mill Co.:			
Hamilton, O.	85	K-B	538,650
Sheffield Steel Corp.			
Houston, Tex.	47	K-B	245,000
Bethlehem Steel Co.:			
Bethlehem, Pa.	212	K	855,609
Bethlehem, Pa.	204	K-B	847,900
Johnstown, Pa.	120	C-I	450,350
Johnstown, Pa.	88	S-S	476,700
Johnstown, Pa.	154	K-B	769 388
Lackawanna, N. Y.	171	K-B	977,879
Lackawanna, N. Y.	60	S-S	317,570
Lackawanna, N. Y.	152	W-S	849,400
Sparrows Point, Md.	300	K	1,400,060
Sparrows Point, Md.	122	K-B	540,960
Steelton, Pa.	60	K	266,721
Steelton, Pa.	70	K-B	485,070
Colorado Fuel & Iron Co., Minnequa, Colo.	120	K	476,762
Colorado Fuel & Iron Co., Minnequa, Colo.	74	K-B	327,000
DeBardleben Corp., Holt, Ala.	60	S-S	260,000
Donner-Hanna Coke Corp., Buffalo	150	K	716,345
	66	K-B	347,900
Ford Motor Co., Dearborn, Mich.	183	K-B	1,182,920
Inland Steel Co., Indiana Harbor, Ind.	66	K	351,620
Inland Steel Co., Indiana Harbor, Ind.	353	K-B	1,927,580
Interlake Iron Corp.:			
Duluth, Minn.	41	K-B	249,375
Erie, Pa.	37	W	190,000
Erie, Pa.	35	W-S	202,000
South Chicago, Ill.	120	S-S	480,340
South Chicago, Ill.	110	K-B	686,200
Toledo, Ohio	94	K	398,720
Jones & Laughlin Steel Corp., Pittsburgh	60	W	297,313
Aliquippa, Pa.	203	K-B	1,325,250
Cleveland	100	S-S	320,000
Pittsburgh	300	K	1,415,673
Kaiser Co. Inc., Fontana, Calif.	90	K-B	390,000
Koppers United Co., Granite City, Ill.	49	K-B	305 000
Lone Star Steel Co., Daingerfield, Tex.	78	K-B	375,000
National Steel Corp., Pittsburgh			
Great Lakes Steel Corp., Detroit	130	S-S	907,481
Weirton Steel Co., Weirton, W. Va.	156	K-B	980,490
Pittsburgh Coke & Iron Co., Pittsburgh	70	K-B	447,271
Pittsburgh Crucible Steel Co., Midland, Pa.	100	K	471,391
Pittsburgh Steel Co., Monessen, Pa.	74	K-B	460,000
Rainey-Wood Coke Co., Swedeland, Pa.	110	K	519,764
Swedeland, Pa.	41	K-B	190,124
Republic Steel Corp.:			
Canton, O.	62	K	264,330
Chicago	75	W-S	465,000
Cleveland, O.	204	K	866,400
Cleveland, O.	75	K-B	465,000
Republic Steel Corp. (Continued)			
Gadsden, Ala.	37	K	158,100
Gadsden, Ala.	65	W-S	400,000
Massillon, O.	49	K-B	319,913
Thomas, Ala.	57	K-B	283,130
Warren, O.	64	K-B	431,063
Warren, O.	61	W-S	375,000
Youngstown, O.	100	K	516,563
Youngstown, O.	112	K-B	679,000
Sloss-Sheffield Steel & Iron Co.,			
Birmingham, Ala.	120	S-S	614,000
United States Steel Corp.:			
American Steel & Wire Co.:			
Cleveland	180	K	763,800
Duluth, Minn.	90	K	315,643
Carnegie-Illinois Steel Corp.:			
Clairton, Pa.	768	K	3,316,915
Clairton, Pa.	714	K-B	4,383,799
Gary, Ind.	280	K	1,175,700
Gary, Ind.	418	K-B	2,280,000
Gary, Ind.	280	O-W	1,470,000
Gary, Ind.	77	W-S	400,000
Joliet, Ill.	280	K	885,198
Columbia Steel Co.:			
Ironton, Utah	56	K-B	376,900
Geneva Steel Co.:			
Geneva, Utah	252	K-B	1,006,000
National Tube Co.:			
Lorain, O.	208	K	883,500
Tennessee Coal, Iron & R.R. Co.:			
Fairfield, Ala.	154	K	533,800
Fairfield, Ala.	355	K-B	2,019,450
Wheeling Steel Corp.:			
Follansbee, W. Va.	94	K	393,064
Follansbee, W. Va.	51	K-B	217,185
Portsmouth, O.	108	S-S	435,600
Wisconsin Steel Co.:			
South Chicago, Ill.	88	W	400,500
South Chicago, Ill.	45	K-B	244,287
Woodward Iron Co.:			
Woodward, Ala.	168	K	794,124
Woodward, Ala.	60	W	254,600
Youngstown Sheet & Tube Co.:			
Campbell, O.	306	K	1,296,750
Indiana Harbor, Ind.	120	S-S	617,500
So. Chicago, Ill.	70	K-B	428 189
Youngstown, O.	84	K	376,913
Total all companies	11,302		56,329,683

*C-I, Cambria Improved; K, Koppers; K-B, Koppers-Becker; S-S, Semet-Solvay; W, Wilputte; W-S, Wilputte-Solvay; O-W, Otto-Wilputte.

(Commercial and Gas Plants)

COMPANY	No. of Ovens	Kind of Oven*	Annual Capacity, Coke, n.t.
Alabama By-Products Corp., Tarrant, Ala.	100	K	486,227
Alabama By-Products Corp., Tarrant, Ala.	74	K-B	416,500
Battle Creek Gas Co., Battle Creek, Mich.	18	K-B	64,719
Brooklyn Union Gas Co., Brooklyn, N. Y.	90	K-B	529,541
Central Illinois Elec. & Gas Co.,			
Rockford, Ill.	21	K-B	69 992
Central New York Power Corp., Utica, N. Y.	42	K-B	148,011
Citizens Gas & Coke Utility,			
Indianapolis, Ind.	41	S-S	120,000
Indianapolis, Ind.	120	W	610,500
Indianapolis, Ind.	41	K-B	184,100
Connecticut Coke Co., New Haven, Conn.	70	K-B	420,480
Consolidated Edison Co. of N. Y. Inc.,			
New York	111	K-B	694,071
Consumers Power Co.:			
Flint, Mich.	29	K-B	95,640
Jackson, Mich.	26	K-B	58,966
Zilwaukee, Mich.	19	K-B	53 933
Diamond Alkali Co., Painesville, O.	46	K-B	244,358
Domestic Coke Corp., Fairmont, W. Va.	60	K	273,741
Eastern Gas & Fuel Associates,			
Everett, Mass.	55	W	263,150
Everett, Mass.	149	K-B	785,214
E. I. du Pont de Nemours & Co.,			
Belle, W. Va.	71	W	470,000
E. I. du Pont de Nemours & Co.,			
Morgantown, W. Va.	74	W-S	488,600
Empire Coke Co., Geneva, N. Y.	46	S-S	104 800
Hudson Valley Fuel Corp., Troy, N. Y.	55	F	387,900
Hudson Valley Fuel Corp., Troy, N. Y.	31	K-B	191,121
Indiana Consumers Gas & By-Prod. Co.,			
Terre Haute, Ind.	60	K	324,311
Koppers Co.:			
Minnesota Division, St. Paul	65	K	267,881
Seaboard Division, Kearny, N. J.	170	K	733,546
Laclede Gas Light Co., St. Louis	56	K	29[illegible]
Laclede Gas Light Co., St. Louis	8	P	28,000
Lynn Gas & Electric Co., Lynn, Mass.	11	K-B	39,600
Michigan Alkali Co., Wyandotte, Mich.	39	K-B	220,045
Midwest Smokeless Fuel Co., Millstadt,			
Mich.	20	C-K	88,240
Milwaukee Solvay Coke Co., Milwaukee	80	S-S	230,100
Milwaukee Solvay Co., Milwaukee	100	K	480,020
North Shore Coke & Chemical Co.,			
Waukegan, Ill.	31	K-B	112,537
Peoples Gas, Light & Coke Co., Chicago	5	K-B	30,193
Peoples Gas, Light & Coke Co., Chicago	100	K	512,591
Philadelphia Coke Co., Philadelphia	74	K-B	447,271
Philadelphia Suburban Gas & Elect. Co.,			
Chester, Pa.	25	K-B	116 950
Providence Gas Co., Providence, R. I.	40	K	167,560
Providence Gas Co., Providence, R. I.	25	K-B	133,480
Public Serv. Elect. & Gas Co., Camden, N. J.	37	K-B	130,056
Public Serv. Elect. & Gas Co., Camden, N. J.	37	K	132,229
Radiant Fuel Corp., W. Frankford, Ill.	26	C-K	114,700
Rochester Gas & Elect. Corp.,			
Rochester, N. Y.	97	K-B	308,237
Semet-Solvay Co.:			
Ashland, Ky.	120	S-S	630,000
Detroit	216	S-S	1,023,250
Buffalo	120	S-S	756,680
Ensley, Ala.	240	S-S	1,186,780
Ironton, O.	85	S-S	440 000
Ironton, O.	76	W-S	450,000
Tennessee Products Corp.:			
Alton Park, Tenn.	24	S-S	120 600
Chattanooga, Tenn.	20	W-S	115,000
Wilkeson Products Co., Tacoma, Wash.	17	C-K	75,000
Wisconsin Public Service Co.,			
Sheboygan, Wis.	15	K-B	30,457
Total all companies	3428		16,834,408

*K, Koppers; K-B, Koppers-Becker; S-S, Semet-Solvay; W, Wilputte; W-S, Wilputte-Solvay; F, Foundation; P, Piette; C-K, Curran-Knowles.

STEEL PRODUCING CAPACITY IN THE UNITED STATES

COMPANY	Open Hearths		Bessemer		Electric		
	No.	Capacity	No.	Capacity	No.	Capacity	Total
Alan Wood Steel Co.							
Ivy Rock, Pa.	8	550,000	..	......	..	......	550,000
Allegheny Ludlum Steel Corp.							
Brackenridge, Pa.	9	260,000	..	......	10	134,700	394,700
Dunkirk, N. Y.	..	......	..	......	3	33,000	33,000
Watervliet, N. Y.	..	......	..	......	8	25,000	25,000
Total	..	260,000	..	......	..	192,700	452,700
American Locomotive Co.							
Chicago Hts., Ill.	3	78,400	..	......	..	......	78,400
Latrobe, Pa.	3	103,000	..	......	..	......	103,000
Total	..	181,400	..	......	..	......	181,400
American Rolling Mill Co.							
Ashland, Ky.	8	759,000	..	......	..	......	759,000
Butler, Pa.	10	591,000	..	......	..	......	591,000
Middletown, O.	9	929,000	..	......	5	51,000	980,000
Total	..	2,279,000	..	......	..	51,000	2,330,000
Sheffield Steel Corp.							
Houston, Tex.	5	507,000	..	......	..	......	507,000
Kansas City, Mo.	4	426,000	..	......	..	......	426,000
St. Louis	6	178,000	..	......	..	......	178,000
Sand Springs, Okla.	1	54,000	..	......	..	......	54,000
Total	..	1,165,000	..	......	..	......	1,165,000
Total American Rolling Mill Co.		3,444,000	..	......	..	51,000	3,495,000
Andrews Steel Co.							
Newport, Ky.	7	438,000	..	......	3	195,300	633,300
Atlantic Steel Co.							
Atlanta, Ga.	3	154,000	..	......	..	......	154,000
Babcock & Wilcox Tube Co.							
Beaver Falls, Pa.	..	......	..	......	2	50,400	50,400
Barium Stainless Steel Co.							
Canton, O.	3	59,000	..	......	..	......	59,000
Bethlehem Steel Co.							
Bethlehem, Pa.	29	2,345,000	..	......	8	158,000	2,503,000
Johnstown, Pa.	21	1,640,000	3	260,000	..	......	1,900,000
Lackawanna, N. Y.	30	3,120,000	..	......	..	......	3,120,000
Los Angeles	4	117,000	..	......	..	......	117,000
San Francisco	5	235,000	..	......	..	......	235,000
Seattle	5	210,000	..	......	..	......	210,000
Sparrows Point, Md.	23	3,835,000	3	240,000	..	......	4,075,000
Steelton, Pa.	9	740,000	..	......	..	......	740,000
Total		12,242,000	..	500,000		158,000	12,900,000
Braeburn Alloy Steel Corp.							
Braeburn, Pa.	..	......	..	......	2	20,730	20,730
Byers, A. M. Co.							
Ambridge, Pa.	3	72,000	..	......	2	108,000	180,000
Cabot Shops Inc.							
Pampa, Tex.	..	......	..	......	1	12,350	12,350
Carpenter Steel Co.							
Reading, Pa.	..	......	..	......	6	74,880	74,880
Central Iron & Steel Co.							
Harrisburg, Pa.	6	336,000	..	......	..	......	336,000
Colonial Steel Div.							
Vanadium Corp. of America							
Colona, Pa.	..	......	..	......	1	5,800	5,800
Colorado Fuel & Iron Co.							
Pueblo, Col.	16	1,121,000	..	......	..	......	1,121,000
Columbia Tool Steel Co.							
Chicago Hts., Ill.	..	......	..	......	2	6,600	6,600
Connors Steel Co.							
Birmingham, Ala.	..	......	..	......	3	60,000	60,000
Continental Steel Corp.							
Kokomo, Ind.	5	364,000	..	......	..	......	364,000
Copperweld Steel Corp.							
Warren, O.	..	......	..	......	9	484,000	484,000
Crucible Steel Co.							
Harrison, N. J.	1	31,750	..	......	13	130,350	162,100
Midland, Pa.	12	739,200	..	......	4	215,040	954,240
Pittsburgh (La Belle)	..	......	..	......	..	* 3,780	* 3,780
Pittsburgh (Park)	4	144,000	..	......	5	37,500	181,500
Syracuse, N. Y. (Holcomb)	..	......	..	......	5	61,150	61,150
Syracuse, N. Y. (Sanderson)	..	......	..	......	2	24,000	24,000
Total		914,950	..	......	..	471,820	1,386,770
Disston, Henry & Sons Inc.							
Philadelphia	..	......	..	......	2	25,000	25,000
Edgewater Steel Co.							
Oakmont, Pa.	4	140,170	..	......	..	......	140,170
Empire Sheet & Tin Plate Co.							
Mansfield, O.	5	378,070	..	......	..	......	378,070
Erie Forge & Steel Co.							
Erie, Pa.	5	208,950	..	......	..	......	208,950

* Crucible ingots.

STEEL PRODUCING CAPACITY IN THE UNITED STATES

COMPANY	Open Hearths No.	Open Hearths Capacity	Bessemer No.	Bessemer Capacity	Electric No.	Electric Capacity	Total
Firth-Sterling Steel Co. McKeesport, Pa.					5	17,540	17,540
Follansbee Steel Corp. Toronto, O.	4	141,120					141,120
Ford Motor Co. Dearborn, Mich.	10	703,200			5	198,240	901,440
Granite City Steel Co. Granite City, Ill.	13	705,400					705,400
Harrisburg Steel Corp. Harrisburg, Pa.	3	100,750					100,750
Heppenstall Co. Pittsburgh	2	57,880			2	2,680	60,560
Ingersoll Steel & Disc New Castle, Ind.					5	24,000	24,000
Inland Steel Co. Indiana Harbor, Ind.	36	3,400,000					3,400,000
International Harvester Co. Wisconsin Steel Div. South Chicago, Ill.	10	900,000					900,000
Isaacson Iron Works Seattle					2	75,000	75,000
Jessop Steel Co. Washington, Pa.					5	43,410	43,410
Jones & Laughlin Steel Corp.							
Aliquippa, Pa.	5	1,182,000	3	582,000			1,764,000
Cleveland (Lakeside)	8	204,000			1	6,900	210,900
Cleveland (Riverside)	8	816,000					816,000
Pittsburgh	20	1,896,000	2	336,000	1	1,500	2,233,500
Total		4,098,000		918,000		8,400	5,024,400
Joslyn Mfg. & Supply Co. Ft. Wayne, Ind.					2	36,000	36,000
Judson Steel Corp. Oakland, Calif.	3	86,720					86,720
Kaiser Co. Inc. Fontana, Calif.	6	675,000					675,000
Keystone Steel & Wire Co. Peoria, Ill.	3	302,400					302,400
Kilby Steel Co. Anniston, Ala.	1	48,000			2	15,600	63,600
Knoxville Iron Co. Knoxville, Tenn.					2	32,000	32,000
Laclede Steel Co. Alton, Ill.	4	349,170					349,170
Latrobe Electric Steel Co. Latrobe, Pa.					4	12,000	12,000
Lukens Steel Co. Coatesville, Pa.	13	714,340					714,340
Mesta Machine Co. West Homestead, Pa.	4	85,000			3	106,900	191,900
Midvale Co. Philadelphia	8	373,720			3	110,400	484,120
National Forge & Ordnance Co. Irvine, Pa.					3	25,000	25,000
National Steel Corp.							
Great Lakes Steel Corp. Detroit	16	2,050,000					2,050,000
Weirton Steel Co. Weirton, W. Va.	12	1,850,000					1,850,000
Total		3,900,000					3,900,000
National Supply Co. Torrance, Calif.					3	45,900	45,900
Newport News Shipbuilding & Drydock Co. Newport News, Va.					1	6,000	6,000
Northwest Steel Rolling Mills Inc. Seattle					2	32,400	32,400
Northwestern Steel & Wire Co. Sterling, Ill.					2	321,000	321,000
Oregon Electric Steel Co. Portland, Ore.					2	60,000	60,000
Pacific States Steel Corp. Niles, Calif.					3	86,400	86,400
Phoenix Iron Co. Phoenixville, Pa.	6	240,770					240,770
Pittsburgh Steel Co. Monessen, Pa.	12	1,148,000					1,148,000
Republic Steel Corp.							
Buffalo	9	810,000					810,000
Canton, O.					18	965,000	965,000
Cleveland	14	1,570,000					1,570,000
Gadsden, Ala.	8	715,000					715,000
Massillon, O.	9	610,000					610,000
South Chicago, Ill.	8	560,000			9	750,000	1,310,000
Warren, O.	8	950,000					950,000
Youngstown, O.	15	1,330,000	2	700,000			2,030,000
Total		6,545,000		700,000		1,715,000	8,960,000

(Continued next page)

STEEL PRODUCING CAPACITY IN THE UNITED STATES

(Continued)

COMPANY	Open Hearths No.	Open Hearths Capacity	Bessemer No.	Bessemer Capacity	Electric No.	Electric Capacity	Total
Roebling's, John A. Sons Co.							
Roebling, N. J.	4	211,600					211,600
Rustless Iron & Steel Corp.							
Baltimore,					6	114,000	114,000
Rotary Electric Steel Co.							
Detroit					2	170,400	170,400
Sharon Steel Corp.							
Lowellville, O.	6	600,000			1	36,000	636,000
Simonds Saw & Steel Co.							
Lockport, N. Y.					8	21,600	21,600
Standard Steel Works Co.							
Burnham, Pa.	5	169,910			1	* 20	169,930
Stanley Works							
Bridgeport, Conn.	3	188,280					188,280
Texas Steel Co.							
Ft. Worth, Tex.					2	22,320	22,320
Timken Roller Bearing Co.							
Timken Steel & Tube Div.							
Canton, O.	3	201,600			6	345,600	547,200
Union Electric Steel Corp.							
Carnegie, Pa.					2	25,200	25,200
U. S. Steel Corp.							
American Steel & Wire Co.							
Donora, Pa.	13	876,800					876,800
Duluth	7	610,400					610,400
Worcester, Mass.	6	300,000					300,000
Total American Steel & Wire Co.		1,787,200					1,787,200
Carnegie-Illinois Steel Corp.							
Braddock, Pa.	16	1,625.000	4	672,000			2,297.000
Clairton, Pa.	12	805,000					805.000
Duquesne, Pa.	29	1,974.000			4	166,200	2,140.200
Farrell, Pa.	15	1,050,000					1,050.000
Gary, Ind.	54	5,718,800					5,718,800
Homestead, Pa.	11	1,740,000					1,740,000
Johnstown, Pa.	1	15,900			1	5,500	21.400
Munhall, Pa.	59	3,507,000					3,507,000
Mingo-Junction, O.			2	200,000			200 000
Pencoyd, Pa.	10	242.000					242.000
South Chicago, Ill.	31	3,755,000	3	500,000	8	236,500	4,491,500
Vandergrift, Pa.	12	500,000					500.000
Youngstown, O.	15	1,499,800	2	784,000			2,283,800
Total Carnegie-Illinois Steel Corp.		22,432,500		2,156,000		408,200	24,996,700
Columbia Steel Co.							
Pittsburg, Calif.	7	375,200			1	11,400	386 600
Torrance, Calif.	4	201,400			1	9,600	211.000
Total		576,600				21,000	597,600
Geneva Steel Co.							
Geneva, Utah	9	1,300,000					1,300,000
National Tube Co.							
Lorain, O.	12	1,350,000	2	594.000			1.944 000
McKeesport, Pa.	3	900,000	3	300,000			1,200,000
Total		2,250,000		894,000			3,144,000
Tennessee Coal, Iron & R.R. Co.							
Ensley, Ala.	9	1,648,000					1.648.000
Fairfield, Ala.	11	1,012,000					1,012,000
Total		2,660,000					2,660,000
Total U. S. Steel Corp.		29,671,500		3,050,000		529,200	33,250,700
Universal Cyclops Steel Co.							
Bridgeville, Pa.					4	50,680	50,680
Vanadium Alloys Steel Co.							
Latrobe, Pa.					3	11,910	11,910
Vulcan Crucible Steel Co.							
Aliquippa, Pa.					2	11,090	11,090
Washburn Wire Co.							
Phillipsdale, R. I.	3	67,200					67,200
Wheeling Steel Corp.							
Benwood, W. Va.			2	336,000			336 000
Portsmouth, O.	10	616,000					616,000
Steubenville, O.	11	1,008,000					1,008,000
Total		1,624,000		336,000			1,960,000
Wickwire Brothers Inc.							
Cortland, N. Y.	3	47,040					47,040
Wickwire-Spencer Steel Co.							
Tonawanda, N. Y.	4	224,000					224,000
Worth Steel Co.							
Claymont, Dela.	6	443,520					443,520
Youngstown Sheet & Tube Co.							
Campbell, O.	12	1,212,000	2	240,000			1,452,000
East Chicago, Ind.	9	1,116.000	2	330,000	2	120,000	1,566,000
Youngstown, O.	12	1,104,000					1,104.000
Total		3,432,000		570,000		120,000	4,122,000
Total all companies	981	83,351,260	35	6,074,000	236	6.248,470	95,948,030

ROLLING MILL EXPANSION PROGRAM

(CAPACITY FIGURES IN NET TONS)

COMPANY	Plate Mills	Bar Mills	Structural Mills	Elec.-Weld Tube Mills	Seamless Tube Mills
American Rolling Mill Co.[1]					
Sheffield Steel Corp.					
Houston, Tex.	216,149	......	......	......	......
Babcock & Wilcox Tube Co.					
Alliance, O.	......	......	......	48,000	......
Beaver Falls, Pa.	......	......	......	......	47,250
Brown Fence Wire Co.					
Adrian, Mich.	......	......	......	......	30,000
Bundy Tubing Co.					
Detroit	......	......	......	24,000	......
Copperweld Steel Co.[2]					
Warren, O.	......	312,000	......	......	......
Detroit Seamless Steel Tubes Co.					
Detroit	......	......	......	......	2,000
Follansbee Steel Corp.					
Toronto, O.	......	......	75,000	......	......
Granite City Steel Co.[3]					
Granite City, Ill.	191,000	......	......	......	......
Jessop Steel Co.[4]					
Washington, Pa.	......	10,000	......	......	......
Kaiser Co.[5]					
Fontana, Calif.	300,000	82,000	90,000	......	......
Lukens Steel Co.[6]					
Coatesville, Pa.	300,000	......	......	......	......
Michigan Steel Tube Products Co.					
Detroit	......	......	......	•......	......
National Supply Co.					
Ambridge, Pa.	......	......	......	......	6,000
Oregon Electric Steel Co.[7]					
Portland, Ore.	......	42,000	......	......	......
Pacific Tube Co.					
Los Angeles	......	......	......	16,500	7,800
Pittsburgh Steel Co.					
Allenport, Pa.	......	......	......	......	19,200
Republic Steel Co.					
Chicago[9]	......	360,000	......	......	......
Brooklyn, N. Y.	......	......	......	36,000	......
Cleveland	......	......	......	7,800	......
Revere Copper & Brass Inc.					
Rome, N. Y.	......	......	......	7,000	......
Timken Roller Bearing Co.					
Timken Steel & Tube Div.					
Newton Falls, O.	......	......	......	......	28,800
Talon Inc.					
Steel Tube Div.					
Oil City, Pa.	......	......	......	50,000	......
United States Steel Corp.					
Carnegie-Illinois Steel Corp.[9]					
Homestead, Pa.	1,140,000	......	......	......	......
Geneva Steel Co.[10]					
Geneva, Utah	700,000	......	200,000	......	......
Tubular Alloy Steel Corp.					
Gary, Ind.	......	......	......	......	83,760
Tube Reducing Corp.					
Wallington, N. J.	......	......	......	......	21,000
Total all companies	**2,847,149**	**806,000**	**365,000**	**189,300**	**245,810**

[1]36" 2-high blooming mill, 110" 3-high reversing plate mill. [2]24", 21" bar mills. [3]Revamped 90" plate mill. [4]18" bar mill. [5]Equipment includes 42" 2-high reversing blooming mill, 36" breakdown mill, 110" plate mill, 28" structural mill, 18", 14" merchant mills. [6]120" 4-high reversing plate mill. [7]20", 12", 9" bar structural mills. [8]44" 2-high reversing blooming mill, 36" secondary blooming mill, 32" bar mill. [9]44" 2-high reversing blooming mill, 160" 4-high reversing plate mill, 100" revamped plate mill. [10]44", 28" 2-high reversing blooming mills, 132" 6-stand 4-high continuous plate mill, 24" structural mill.
[9]Equipment added does not increase capacity and tonnage not included in total.

NEW IRON ORE MINES

COMPANY	Annual Cap. (net tons)
Alan Wood Steel Co.	
Oxford, N. J.	200,000
Ringwood, N. J.	250,000
American Rolling Mill Co.	
Sheffield Steel Corp.	
Atlanta and Jacksonville, Tex	480,000
Cleveland-Cliffs Iron Co.	
Ishpeming, Mich. (Mather Shaft)	500,000
M. A. Hanna Co.	
Clifton, N. Y.	300,000
Jones & Laughlin Steel Corp.	
Benson Mines, N. Y.	1,000,000
Kaiser Co. Inc.	
Kelso, Calif.	756,000
Lone Star Steel Co.	
Daingerfield, Tex.	778,000
National Lead Co.	
McIntyre, N. Y.	600,000
Penn Iron Mining Co.	
Norway, Mich.	85,000
Pickands Mather & Co.	
Biwabik, Minn. (Embarrass Lake)	3,000,000
Republic Steel Corp.	
Minesville, N. Y.	900,000
Spaulding, Ala.	470,000
Scotia Mining Co.	
Scotia, Pa.	400,000
U. S. Steel Corp.	
Columbia Steel Co.	
Cedar City, Utah	550,000
Geneva Steel Co.	
Cedar City, Utah	2,100,000
Ozark Ore Co.	
Iron Mountain, Mo.	300,000
Warren Foundry & Pipe Corp.	
Sharon, N. J.	408,000
Youngstown Mines Co.	
Babbitt Lake, Minn.	450,000
Total all companies	**13,527,000**

ORE SINTERING PLANT EXPANSION

COMPANY	Annual Cap. (net tons)
American Rolling Mill Co.	
Hamilton, O.	300,000
Bethlehem Steel Co.	
Bethlehem, Pa.	360,000
Colorado Fuel & Iron Corp.	
Pueblo, Colo.	720,000
Inland Steel Co.	
Indiana Harbor, Ind.	432,000
Interlake Iron Corp.	
Chicago	224,000
Toledo, O.	224,000
Total	448,000
Jones & Laughlin Steel Corp.	
Benson, N. Y.	700,000
Pittsburgh	558,000
Total	1,258,000
Kaiser Co.	
Fontana, Calif.	467,000
Pittsburgh Coke & Iron Co.	
Neville Island, Pa.	45,000
Republic Steel Corp.	
Chicago	300,000
Port Henry, N. Y.	385,000
Port Henry, N. Y.	380,000
Spaulding, Ala.	350,000
Warren, O.	382,000
Youngstown, O.	392,000
Total	2,189,000
United States Steel Corp.	
Columbia Steel Co.	
Ironton, Utah	300,000
Geneva Steel Co.	
Geneva, Utah	800,000
Total	1,100,000
Lone Star Steel Co.	
Daingerfield, Tex.	255,000
National Lead Co.	
Tahawus, N. Y.	630,000
Wheeling Steel Corp.	
Steubenville, O.	360,000
Youngstown Sheet & Tube Co.	
Campbell, O.	720,000
South Chicago, Ill.	300,000
Total	1,020,000
Total all companies	**9,824,000**

ELECTROLYTIC TIN PLATE LINES

COMPANY	No. of Lines	Annual cap., net tons
Bethlehem Steel Co.		
Sparrows Point, Md.	3	225,000
Crown Cork & Seal Co.		
Baltimore, Md.	2	100,000
Crucible Steel Co.		
Midland, Pa.	1	30,000
Granite City Steel Co.		
Granite City, Ill.	1	50,000
Inland Steel Co.		
Indiana Harbor, Ind.	2	150,000
Jones & Laughlin Steel Corp.		
Aliquippa, Pa.	2	100,000
National Steel Corp.,		
Weirton Steel Co.		
Weirton, W. Va.	3	300,000
Republic Steel Corp.		
Niles, O.	2	150,000
United States Steel Corp.		
Carnegie-Illinois Steel Corp.		
Irvin Works, Dravosburg, Pa.	3	225,000
Gary, Ind.	4	300,000
Tennessee Coal, Iron & R.R. Co.		
Birmingham, Ala.	3	225,000
Wheeling Steel Corp.		
Yorkville, O.	1	75,000
Youngstown Sheet & Tube Co.		
Indiana Harbor, Ind.	2	150,000
Total all companies	**29**	**2,080,000**

3. STEEL'S DISTRIBUTION

Flexible for Transitional
The Postwar

New and complex problems to be presented with war's end. . . Mechanics of distribution to be tested in adapting sales and service functions of mills and warehouses to changed conditions

THIS country not only is the largest producer of iron and steel, it also constitutes in total consumption, in intensity of use, and in geographic area, the largest single market. Because of this fact, distribution is singularly important.

The complex factors involved in channeling steel into use make necessary a highly effective and flexible system for efficient and economical marketing. Output of steel varies from bulky, relatively low-value products sold on a tonnage basis, to highly finished, high-value items sold by the pound. Further, individual orders range from a few pounds to thousands of tons, and cover a wide variety of specifications.

From 85 to 90 per cent of total production is sold direct from the mills to consumers. The remainder is handled through warehouses, agents and brokers. This preponderance of direct-mill sales is attributable to various factors; such as, concentration of areas of production and consumption, heavy volume of products involved, and frequent need for product adaptation to specific requirements.

Warehouse and broker distribution largely is concerned with small lot orders from small fabricators, "fill-in", and emergency demands of the large consumers. Bulk of tonnage handled by these stores is in the finished products.

Only a small percentage of total pig iron and semifinished steel production is disposed of in the open market. Virtually all steelmaking iron is consumed within producers' own organizations, but merchant iron reaches consumers direct from producers; and also through agents and brokers in substantial tonnage. In the case of semifinished steel, bulk of output is consumed in producers' own mills with a relatively minor tonnage being shipped to nonintegrated mill customers.

At present considerable semifinished is being moved under government directive to foreign outlets. Also, transfer of large tonnage between competing producers, under government order, in an effort to maintain at all points uninterrupted peak finishing-mill operations, is accounting for an extensive movement of ingots and semifinished. Such, however, is largely a war expedient.

The overall distribution problem is chiefly concerned with disposal of finished rolled products in their various forms and analyses, and the peculiarities inherent in marketing these items present varying complexities of organization and administration. Necessarily, the mechanics of distribution take into account multiple factors, not only those related to actual shipping of steel into use, but also those of price, competition, product analysis in its adaptability to end-use, shipment convenience to consumer, and market development.

Recent survey by the American Iron and Steel Institute indicates that normally the steel mills have as direct customers nearly 22,000 manufacturing establishments, located in every state in the union. In addition to manufacturers who place their orders direct with the producers, it is estimated by the American Steel Warehouse Association, there are in excess of 200,000 buyers who order their requirements from the warehouses.

Just prior to the war, to serve their customers, the steel producers maintained district sales offices in no less than 165 cities in 36 different states. The territories covered by some district offices included only a few counties while others served territories extending over several states. Roughly estimated, there were over 3000 full-time sales representatives linking the industry with its consuming markets, as well as an undetermined number of agents who sell on a commission basis where the volume of business may not be sufficient to justify employment of full-time sales representation.

FACILITIES and Periods

By WILLIAM M. ROONEY
News and Market Editor, STEEL

Distribution through district sales offices is complemented by that afforded by the warehouses. Warehousing, while accounting for only 10 to 15 per cent of total production, is a highly important arm of distribution. A number of the larger producers maintain branch warehouses and mill depots at strategic points, but warehousing also is performed by hundreds of independent operators throughout the country. War service has increased the stature and reinforced the position of the warehouse industry as an integral part of the steel distribution system. Always a top-ranking peacetime outlet, in the welter of war, it has demonstrated its function is essential.

For convenience and economy, sales offices and agents are established in or near areas which constitute important markets. For instance, in Pennsylvania, the steel companies maintained more than 500 full-time salesmen in 110 sales offices. In Illinois there were 78 sales offices with over 400 salesmen; in New York, 93 with 386 salesmen; Ohio, 99 offices and 340 salesmen; Michigan, 54 offices and 233 salesmen; California, 47 offices and 175 salesmen; Missouri, 39 sales offices with 136 salesmen, and Massachusetts, 40 offices and 130 salesmen.

Actually, there are only eight states which had neither a steel company sales office nor the office of a steel sales agent. These states are: Arkansas, Idaho, Maine, Nevada, New Hampshire, New Mexico, North Dakota and Wyoming.

Outside continental United States, before the war, according to the American Iron and Steel Institute, the steel companies maintained about 40 sales offices. Nearly all of these were in Canada, Central and South America, Hawaii, and the Philippines. More than 200 persons were employed in these foreign offices of which 79 were salesmen.

Something like six and a half million tons of finished steel, it is estimated, were funneled into consumption through the warehouses during 1943. This was not a record-breaking year, being topped by 1941 and 1940, but it registered a comfortable gain over 1942, and bettered by a fair margin any year prior to 1940.

Analysis of available data reveals wartime warehouse tonnage expansion, percentage-wise, about paralleled the percentage increase in finished steel production.

Warehousing of steel is a complex business. Properly, the industry blankets the nation through a network of some 1500 distributing plants, through which flow thousands of tons of steel daily. Some distributors are specialists, confining their activities to specific products, such as tool steels. Others operate subsidiary or complementary businesses, such as sheet metalworking and fabricating shops. And there also are operators whose activities are largely devoted to the handling of so-called seconds or reject material. In general, however, the recognized prime warehouse is one where complete and diversified lines of standard steel products are available for prompt shipment.

Although there are some 1500 prime warehouses, it is estimated that more than 90 per cent of the steel tonnage handled in the warehouse industry is moved to consumers through less than 500 stores.

Distribution of steel involves more than the employment of thousands of salesmen, sales agents and warehouses. Backing up every one of the industry's 3000 full-time salesmen are two more members of the sales department whose work does not include calls on customers.

According to the American Iron and Steel Institute there are close to 6000 non-selling members of the industry's sales organizations. This total includes sales executives, branch office managers, clerks and office workers, and large staffs of engineers and metallurgists assigned to sales departments to work with steel users. Market research and development, advertising and sales promotion are other important functions related to distribution, requiring employment of hundreds of specialists and experts.

Orders Less Aggressively Pressed

Drain of manpower from business and industry by the armed services has been reflected to some extent in steel sales staffs. With steel supply allocated under government direction and essential demands most of the time in excess of available mill tonnage, order solicitation has been less aggressively pressed. A few companies have closed some district sales offices for the duration. In certain cases, salesmen, many of whom are engineers, have been made shipment expediters and trouble shooters, and in this work have performed outstanding service in the war effort.

Some drastic shifts in steel distribution have resulted from the war with many normal consuming avenues cut off from supplies, and the flow of metal to many others greatly reduced. Methods and mechanics of distribution have had to be adjusted to meet these unusual conditions.

What of the future trend in distribution?

Postwar warehousing will be influenced by developments within the steel industry proper. For the independent warehouseman a number of pertinent questions are presented.

For one thing, he must take into consideration possible establishment of new mill depots and extension of mill-owned warehouse chains.

Still another factor involves mill relationships with independent distributor interests. With mill capacity in excess of normal market demand at the war's end, the possibility is increased for more intensive competition in the warehouse field from mill sources, especially in areas where productive capacity exceeds local consumptive needs and freight disadvantages make mill shipments to distant points uneconomic.

A matter of concern to the warehouses is mill policy with respect to small orders. Throughout the war small lots gravitated to the warehouse distributor as a matter of course. Prior to the war, however, the mills at times, especially when business was in the doldrums, booked orders of warehouse size. This class of business is uneconomical for the mills to handle as a general thing, and, disposal of the question surrounding small lot business would remove some of the uncertainty of the warehouse trade in planning for its postwar market.

Postwar warehouse business should follow the pattern of business in general, volume rising and falling in line with manufacturing activity. It is interesting to note, however, that over a period of years distribution statistics indicate the warehouses handle a relatively high percentage of steel production in years when output of steel is low, and in years of relatively high production move a somewhat smaller percentage.

Disposition of government-owned steel surpluses after the war will concern both the mills and the warehouse distributors. No one knows how large the volume of such material will be, nor how it will be dealt with.

Increasing popularity of alloy steels holds promising possibilities for both mill and warehouse distribution. In introducing the NE low alloy steels to the consuming trade during the emergency, the warehouses demonstrated a capacity for service beyond anything demanded of them before the war.

In still another direction, thinking on postwar distribution concerns possible extension of mill participation in the production of finished manufactured goods. In recent years a few producers have engaged on a fairly broad scale in such manufacturing activities, and conditions in the postwar era may accelerate this trend.

Further, distribution methods and policies would be vitally affected should any great decentralization of general manufacturing develop. This has been hinted in some circles as socially and economically desirable, but it would seem not of immediate concern for the transitional period, since such a trend necessarily would be years in evolving.

Price Policies Exert Far-Reaching Influence

Because of the basic nature of steel, the industry's price policies exert far-reaching influence. Continued government price regulation, some believe, will be necessary for a time in the postwar period to facilitate orderly transition of the market to peacetime routine. Some practices developed under OPA regulations may be continued on a voluntary basis indefinitely. For example, zone pricing in warehouse distribution has proved a stabilizing factor which has met with wide acceptance in the trade. Its continuance, in the opinion of many, would lend to orderly peacetime marketing.

Whether government regulation will continue indefinitely, is uncertain, but it seems likely in any circumstances, steel pricing policy eventually will resume its former pattern, being determined largely by the factors of supply and demand.

For many years prior to the war, the iron and steel industry was absorbed in technological and production problems, rather than in those of distribution. From now on indications point to a shift in emphasis in the direction of the latter. If for no other reason than because of the huge productive capacity available, the steelmakers will be compelled to direct greater attention to development of consumption outlets. Disposal of product on the large scale necessary to maintain mill operations above break-even point will necessarily stimulate the distribution urge.

4. STEEL'S MARKETS
Teem with Accumulated Demand

AUTOMOBILES

CONSERVATIVE planners forecasting 6,500,000-car years in postwar period. Full year or more of production to be needed to bring the nation's car and truck pool back to the 34,000,000 level of 1941

By A. H. ALLEN
Associate Editor, STEEL

ONCE the problem of reconversion to production of cars and trucks has been licked, the automotive industry looks forward with relish to licking up record servings of metals and materials. Even the conservative planners are forecasting 6,500,000-car years, and a number of plants already have mapped out production schedules 50 per cent beyond the highest level ever attained in the past.

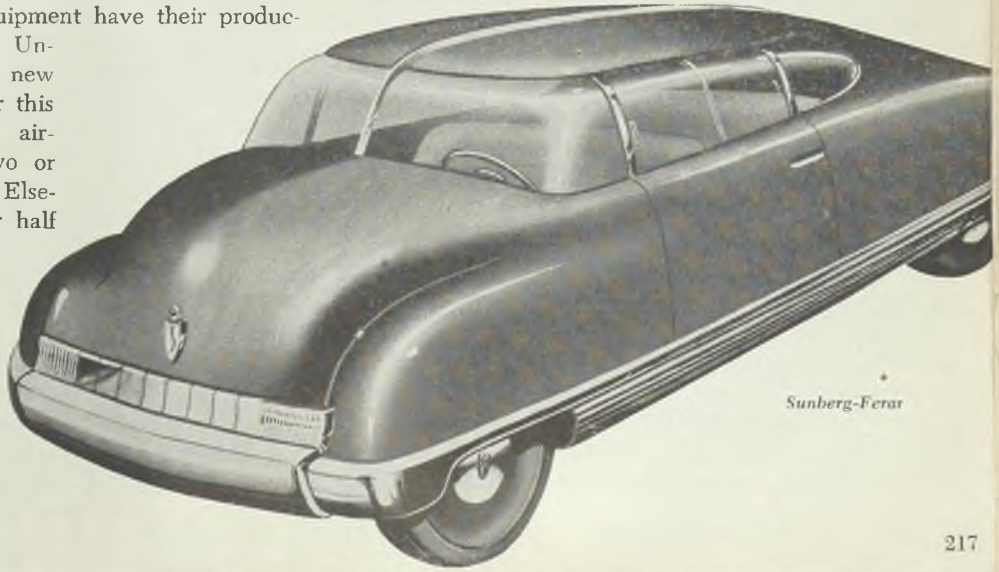
Cars and trucks fortunately hold a top position on lists of "things to be bought" when war fires are quenched. Two, and perhaps three, years of virtual drouth of supplies of new vehicles, together with a steady deterioration of those still on the road, will make new purchases essential when they can be made. It will require a full year or more of production by the automotive industry to bring the nation's car and truck pool up to the 34,000,000 level of 1941, and there are some optimists who believe this country can handle 60,000,000 vehicles without any danger of "saturation."

Thus the market is assured, and probably for several years to come. The 30-odd builders of passenger and commercial transportation equipment have their production job cut out for them. Unquestionably there will be new competition making a bid for this waiting market. From the aircraft industry may come two or three venturesome producers. Elsewhere there may be another half dozen seeking a share in the motor market. The new competition should be a healthy thing for the industry at large, being the stimulus for new production techniques and new material utilization, leading to greater values for the buyer.

With swarms of buyers a foregone conclusion, what is needed to fill their orders? First, there must be time; next, in order, men, machines and materials.

As far as the first of these is concerned, the time for reconversion has been set variously at three to six months. Much will depend upon the suddenness and extent of the relaxation of wartime government controls. If manufacturers could be informed sufficiently far in advance of an impending reconversion, they could reduce their changeover time by an appreciable margin; if the go-ahead is an overnight proposition, the switch will require just that much longer. It appears likely at this writing that something akin to an actual overproduction of many classes of war materiel has occurred, in which event 1944 may see some early plans for reconversion. Presidents of at least two motor companies have stated privately they expect to be building cars sometime this year.

Certainly, if anything approaching unemployment



Sunberg-Ferar

should develop by virtue of cancellation and modification of war contracts, it would be a mistake to ignore the possibilities of reconversion, even assuming the continuation of the war. Maximum employment throughout industry is recognized as essential to the maintenance of a reasonable degree of prosperity in the country. Unemployment must be avoided at all costs.

Respecting machines, the automotive industry generally has taken steps to outline to suppliers what it will need in the reconversion, even going so far as to place actual orders for a variety of "key" equipment. Delivery naturally is entirely in the hands of the government through the WPB.

$600,000,000 Reconversion Bill

General Motors Corp. has indicated it will require expenditure of $250,000,000 in reconverting its divisions to automobile manufacturing. Relating this figure to an industry basis, it appears a total of around $600,000,000 will be the reconversion bill. Much of this will be in the form of specialized tools and equipment—say 75 per cent at the most. This should prove heartening to the machine tool and equipment manufacturers for many of whom the war, as far as new orders are concerned, is just about over. A $500,000,000 investment in equipment for automotive reconversion would mean, for the machine tool industry as an example, six months of production at the rate prevailing in October, 1943.

Another thing equipment designers and builders should keep in mind: The pressure on costs will be terrific in the postwar era. New metalworking methods which permit reduction in the man-hours required to do a job will be selling at a premium. They have been, of course, the key to the attainment of the present mass-production eminence of the automotive industry, but the demands for mechanization and automaticity should be even stronger because inflated labor costs and high taxation will be imposing such a burden on manufacturing costs.

On the score of materials, a 6,500,000-car year obviously presages bonanza days. Taking a 1942 model as the basis for calculations, the annual material bill for primary metals, in gross weights runs about as follows:

Steel	11,000,000	tons
Cast iron	2,275,000	tons
Copper	177,125	tons
Lead	231,660,000	pounds
Zinc	165,750,000	pounds
Aluminum	26,000,000	pounds

Steel, representing 70 per cent of the gross tonnage of automobile production, will continue to be the No. 1 material required by the industry, a fact which has its good and bad sides. Good, because it represents roughly 20 per cent of the steel industry's capacity for finished steel, even at its 1943 peak, and thus will help to keep the nation's mills busy. Bad, because it creates the incentive to bring inordinate pressure on the price structure, resulting in temptations which have not been resisted in the past and presumably will have equal allure in the future.

Within the ferrous group of metals, engineers look for considerable competition to be generated by the necessity to hold down material costs. Carbon steels, the old S.A.E. alloy steels and the newer N.E. lean-alloy steels will be fighting it out in the automotive field on a performance and price basis. A logical development is a sharp reduction in the price of the N.E. steels, since they are now virtually carbon steels with residual alloys. There appears small justification for pricing N.E. steels on a level with the electric furnace full-alloy steels. A general clarification of the entire steel extra picture, with many important reductions, is impending. Ample electric furnace capacity, together with operating economies attending larger production of these steels, should narrow the price spread between open-hearth and electric furnace grades of comparable analysis.

Many metallurgists have little doubt that the "needled" steels, or those containing small quantities of special addition agents for cleaning and deoxidizing, will find important automotive applications because of their favorable hardenability characteristics.

In any event, cost will be the determining factor. If a steel for a gear can be purchased for a fraction of a cent per part less than some other steel, for example, or if one steel permits a fraction of a cent unit reduction in processing cost over another, then the newer type will be specified without delay. The higher car production goes, the greater the incentive for seeking out lower cost materials and processing treatments.

Gray iron castings, which in the past have bulked to something over 500 pounds per car, may run into strong competition from castings of secondary aluminum.

Zinc die castings should continue to be important elements of automotive accessories, and by virtue of wartime extensions to aluminum die casting capacity, the normal complement of zinc die castings may be supplemented with aluminum in certain parts.

No significant change appears in store in the relation between chromium plate and stainless steel for decorative applications.

Knowledge of the utilization and adaptation of the various metals, gained from wartime production, presages no revolutionary changes as far as the automobiles of tomorrow are concerned. Rather, it might be said that the rate of evolution of such applications has been accelerated. Which is a healthy thing for all the metals industries. The rate at which changes are effected, naturally, will depend in considerable measure upon the speed with which the automotive industry is able to resume normal peacetime production; also, the degree of consumer insistence for innovations in design and construction.

There is much conjecture along this latter point, and there is little question there are some in the industry who hold the view that the postwar car buyer will be hesitant about placing his purchase order so long as design and structural changes are held within narrow limits. Much of this speculation, however, fails to take into consideration the obvious handicaps which the automotive industry will face in the immediate postwar period in adapting new developments to current production. Further, the urgent need for cars to replace the millions of worn-out vehicles on the highways will be a compelling influence to bring most car users into the market. There is little doubt that once the industry is given the "go-ahead" signal on civilian car production it will be flooded with an avalanche of orders, regardless of changes and innovations in design and construction.

OIL, GAS, WATER

POSTWAR steel demands of petroleum industry will approximate 2,400,000 tons annually. . . . Larger merchant fleet and increased aviation activity will spur demand for oil products

By R. L. HARTFORD
Associate Editor, STEEL

STEEL consumption patterns of the petroleum industry have been changed radically by the necessities of war. Construction of high-octane gasoline refineries to supply fuel for the air forces of the United Nations and the building of large-diameter pipelines to carry oil from the producing fields to eastern markets and ports have to a large extent offset restrictions on new well drilling.

Rationing of gasoline and fuel oil and increased emphasis on military requirements have caused a complete shifting of markets.

One of the most spectacular changes due to the war has been the building of large new pipelines. Greatest of these is the "Big Inch", a 24-inch line from Texas to New York and Philadelphia, necessitated by the transfer of tankers to war service. Second largest is the "Little Big Inch", a 20-inch line from Texas to the eastern seaboard.

Some suppliers believe the construction of these large lines will encourage further pipeline construction after the war. At least they expect pipeline construction will retain its normal rate of growth, which for the past 20 years has averaged about 4000 miles, including main and feeder lines.

Will Seek To Re-establish Normal Markets

The oil industry's postwar program will be one of re-establishing its normal distribution channels, evaluating its needs and bringing its production back to normal levels. Refinery capacity must be analyzed in terms of demand in order to shed some light on the need for further construction. The demand from aviation is a large question mark and is so dependent on government policy that no study of economic or commercial trends helps much in pointing out probable developments. The size of the United States air force after the war is the primary factor, and disposition of surplus planes by the Army has important bearing on the problem. Immediate resumption of passenger service and private flying can be expected, but the much talked about freight lines and proposed transoceanic routes are not so easily predicted.

Fuel oil demand seems destined to continue its upward trend. The wartime oil shortage may have some effect on the popularity of oil heat for homes, but this will be only temporary. Diesel power will continue to increase, and our position as the world's leading nation in merchant ship tonnage reflects an immense increase in demand for fuel since it indicates a heavy rise in both imports and exports from this country. This means increased bunkering, whether of our own ships or the vessels of other countries.

In 1940, about 1,650,000 tons of steel went into the oil business, one of the industry's best years. Since 1941 the trend has been slightly downward because of drilling limitations. Beginning with 1943 and probably continuing for the duration, the total steel consumption will reach new peaks, stemming from all three of the primary consuming operations of the industry—drilling, refining and pipeline construction. In all probability the immediate postwar years will see a slight drop in steel consumption while normal petroleum demands catch up with the inflated capacity. This will not be a prolonged period, but will probably cover slightly more than the reconverting period of other industry.

Utilities Create Substantial Steel Demand

Total demand for about two billion barrels of petroleum products can be expected after the postwar adjustment period. This is an increase of about 48 per cent over the 1940 figure. Because steel consumption by the industry reflects almost directly drilling activity and line pipe construction, and because these factors in turn are directly relative to total demand for petroleum, it is reasonable to assume that steel demand will be in the neighborhood of 2,400,000 tons annually. The character of the products used will not vary to any great extent. The bulk will continue to be drill pipe, line pipe and casing, with about 25 per cent of the total split up into other miscellaneous products.

Substantial steel demand normally also is provided by the gas, water and other utilities. In 1942 the oil, gas, water and utilities consumption classification accounted for 1,325,000 tons of finished rolled steel production, representing 2.1 per cent of total output. Oil, gas, water and other utilities accounted for 5.48 per cent of total consumption in 1939, 5.52 per cent in 1938, 5.84 per cent in 1937, 5.33 per cent in 1936, 4.29 per cent in 1935, 4.97 per cent in 1934, 4.88 per cent in 1933, 5.50 per cent in 1932, 9.75 per cent in 1931, and 9.48 per cent in 1930.

Postwar demand from these outlets should gain markedly, since it is expected many projects deferred by wartime restrictions will be revived.

SHIPBUILDING

WARTIME'S No. 1 steel customer will face sharp cutback when hostilities end. Enlarged merchant marine may utilize some facilities, but unemployment and excess yard capacity pose difficult problems

By W. J. CAMPBELL
Associate Editor, STEEL

SHIPBUILDING, prodigy of this war's steel consumers, is destined for a sharp cutback when hostilities end. Now the industry's No. 1 customer, taking about one-third of total steel production, shipbuilding will slip far back toward its former obscurity—but not as far back as it was before the war.

Before the war started in Europe, shipbuilding was not even listed in the steel consuming groups. In 1940, when naval and merchant shipbuilding were stepped up, ships took 940,000 tons of steel, or 2 per cent of total output.

This trend was accelerated in 1941 when 2,733,000 tons, 4.4 per cent of total production, were required for vessels. In 1942, shipbuilding became the No. 1 customer, using 9,425,000 tons, or 16 per cent of the total. In the year just ended, the industry's steel requirements again were more than doubled, and an estimated 22,000,000 tons, about a third of total production, went into ships.

For 1944, even more will be required. Several hundred more merchant ships are scheduled for completion than in 1943.

Shipbuilders recognize their industry will be one of the first casualties of peace. Ending of the war inevitably will mark an extensive liquidation in shipbuilding and to a lesser extent in ship repairing.

Commendable Expansion Records

Expansion of shipbuilding in the United States has been one of the marvels of the preparedness and war period. In 1936, when the Maritime Commission was established to rehabilitate an obsolete merchant marine, this country had only ten shipyards with 46 ways capable of building ocean-going ships 400 feet long. About half of these were occupied with naval construction. Others were idle. Today the Maritime Commission alone has 70 yards with more than 300 ways, and all are busy. These do not include naval yards.

With outbreak of war in Europe, it became apparent American yards would be called upon for a great many more bottoms than had been contemplated in the commission's program. The program was increased, but by 1940 it was realized the yards were reaching the limit of their production with existing facilities.

Accordingly two steps were taken: 1. New yards and facilities to increase capacity for building hulls were authorized. 2. To avoid the bottleneck imposed by limited capacity for high-speed propulsion equipment, the commission adopted a design of a vessel that would permit more rapid construction. This was the Liberty ship—propelled by reciprocating steam engines.

With the entrance of the United States into the war the shipbuilding program was further stepped up. More new yards and ways were built.

Deliveries Jump 150 Per Cent

In tonnage, merchant ships built last year approximated 19,000,000 deadweight tons. With the addition of various minor and military types of craft also on the Maritime Commission's program, a total of about 20,100,000 deadweight tons was delivered during the year, an increase of 150 per cent over the 1942 tonnage of 8,090,800. In 1918, only 1,951,000 deadweight tons were constructed.

During 1944, the Maritime Commission will add new vessels at a rate of nearly six a day. Some 800 will be Liberty ships, about 340 will be the new larger and speedier Victory ships, and the remainder will be C-types, tankers and special-purpose craft.

From the inception of the merchant ship program to the end of 1944, a total of 5000 ocean-going vessels, aggregating 50,000,000 deadweight tons, will have been built.

Steel producers converted wide strip mills to roll ship plates, permitting production to be doubled from the last quarter of 1941 to the beginning of 1943.

Liberty ships require 2725 tons of plates, plus 700 tons of shapes and considerable tonnage of tubing and miscellaneous products. Tankers and the larger C-type and Victory models require from 600 to 1600 tons more, depending on type.

A 35,000-ton battleship requires 17,000 to 18,000 tons of steel, plus 10,000 to 12,000 tons of armor plate. A 45,000-ton ship takes about 10 per cent more. From 1200 to 1500 tons are required for a destroyer and about 1000 tons for a submarine. Cruisers generally take between 4500 and 6000 tons.

Prewar employment in the shipbuilding and repairing industry was about 200,000. At present it is estimated at 1,500,000 or more, and additional workers are needed.

Postwar problems of the shipbuilding and repair industry admittedly will be difficult. Neither branch of the industry is readily adaptable to work other than which they now are engaged.

With a merchant fleet of 50,000,000 deadweight tons built during the current program, it is likely that, after allowing for losses, this country will enter the peace period with 35,000,000 to 40,000,000 tons of shipping, equivalent to half the world's tonnage at the beginning of the war.

The industry's postwar problems have two major aspects. The first concerns the period immediately following the end of the war. The second era will be experienced when world conditions return to normal.

Immediately after the war, there will be a large demand upon shipping for the repatriation of troops, return of war equipment, and sending of food and other supplies to foreign countries. According to H. Gerish Smith, president, Shipbuilders Council of America, New York, economy will prompt the immediate discontinuance of work on those types of vessels for which there will be no further need. He says preparation of plans and specifications and a readiness to start immediately on construction of type of ships or conversion of vessels now building best adaptable for special services would help materially to fill the gap caused by the suspension in the building of ships for war services.

Mr. Smith is fearful that there will be a lapse of several years before any considerable construction is undertaken due to the large number of ships, comparatively new, that will be on hand.

Much will depend on the size of our foreign trade after the war, which as yet cannot be estimated with any accuracy.

Admiral Emory Land, Maritime Commission chairman, believes fifteen to twenty million tons of shipping will be necessary to maintain an efficient merchant marine. At war's end this country probably will have twice that amount on hand.

AIRCRAFT

CAREFULLY processed alloy steels constitute principal steel requirements of aviation industry. Volume limited with applications restricted. Experiments indicate broader use of stainless steel possible

By A. H. ALLEN
Associate Editor, STEEL

AIRCRAFT manufacturing represents the "carriage trade" of the various steel-consuming groups. Carefully processed alloy steels, checked and double checked for "aircraft quality," have constituted the principal requirements of airplane builders, so that even the wartime inflation of the aviation industry to its present production level of over 100,000 craft a year means little as far as tonnage is concerned for steel, but means plenty in terms of grief occasioned by rejections resulting from meticulous inspection.

Aircraft alloy steel output, as figured by Wright Field experts, was running something over 120,000 product net tons a month last summer, against plane production of close to 7500 a month. This would indicate unit requirements of 15 tons of alloy steel per plane; obviously this figure is far out of line. The discrepancy probably is accounted for by the fact that practically all aircraft alloy steel parts lose from 65-80 per cent of their semi-finished weight in machining and grinding operations. Further, the steel tonnage figure reported is in terms of mill products and does not take into account such things as conversion loss in forgings, which might run as high as 30 per cent. Thus, out of the 120,000 net tons earmarked aircraft alloy steel, probably only 20,000 tons is actually used in finished planes, or an average of something over 2 tons per unit.

Approximately 20 per cent of aircraft alloy steel has now been converted to NE steel analysis, and it is estimated that this figure could be increased to 65 per cent, were it not for the difficulties over continual shifting in the degree of availability of ferroalloys, inability to obtain proper deliveries on NE steels, large amount of type testing involved in making a substitution, etc.

Principal Uses in Engines

Principal uses of alloy steel in airplanes are confined to engine parts, such as crankcases, crankshafts, connecting rods, valve mechanisms and the like; landing gear elements, and propellers. As far as the airframe proper is concerned, relatively little ferrous metal is required, since of course aluminum and magnesium by virtue of their lower unit weights have always been considered the "air metals". Experiments in the use of both stainless steel sheets and flat-rolled material of low-alloy high-tensile steel have been successfully concluded, but with minor exceptions on the score of stainless steel, practically no specifications call for steel "skins". The same situation applies to structural framework.

But if the aviation industry now appears in the light of a specialty consumer of steel, the future appears even less promising, despite the prediction of C. F. Kettering, director of research, General Motors Corp., that we will be building steel airplanes before aluminum automobiles. In the first place, manufacturing volume will hit the skids once the war is ended, and for the immediate postwar years, airplane production cannot conceivably go much beyond 10,000 units a year. Secondly, aluminum and magnesium have won their spurs as primary aircraft metals, and will hold onto them jealously, particularly since the capacity for light metal production has been built up so tremendously in the past two years.

Granting that the aircraft industry will settle down as a user of specialty alloy steels, the business should prove profitable for mills catering to this trade. Electric furnace steels, special finishing treatments, magnaflux inspections and the other extras required by aircraft steels all add to the material bill, so that the per-pound profit possibilities are far beyond those in most other consuming groups. There will be pressure for price reductions on A.M.S. steels, make no mistake about that, but they will certainly continue to be premium materials for some time to come.

CONSTRUCTION

PUBLIC works plans of states and cities to offer considerable postwar outlet for structural steel. . . Competition from light metals not worrying fabricators. . . Welding to be greater factor

By L. E. BROWNE
Associate Editor, STEEL

FOR the duration, the structural steel fabricating industry will occupy an important niche in the shipbuilding program, building complete ships and barges in many instances and multiple subassemblies. With the industrial war plant complete and the continuance of restrictions on the use of structural steel for other construction, fabricators are demonstrating flexibility and versatility in the production of new products and broadening markets many of which may be retained after the war.

The industry is thinking less in terms of tonnage, and more as fabricating specialists covering a wider range of work. That mere tonnage is all-important is refuted by bookings and shipments in the last year; both were the lowest in many years, yet manpower employment has been maintained, shop schedules well filled, and, for the most part, profits improved.

Transition in the type of work has been radical, resulting in the use of new steel products, more plates and sheets, but fewer shapes, design and practices.

No substantial conversion has been necessary to produce new types of products; the problem of re-conversion will not seriously confront the industry after the war.

Considering the large tonnage years 1940-42, at first glance it would seem postwar demand for structural steel would be adversely affected, but this conflicts with facts. The industrial market, as with the machine tool industry, probably has been sold out for some years, but even in that field there has been little or no construction in the consumer goods industries with a pent-up accumulation of tonnage held up by restrictions due to the war.

For the moment, due to restrictions on use, competitive materials have made some inroads on structural steel, but the greater tonnage has been displaced by lumber. Of the lighter metals, aluminum and magnesium, postwar capacity for which will be greatly expanded, some competition may be expected, but members of the industry are not seriously alarmed.

That keen competition will return is probable, but it will be centered within the industry, from rolling mill to fabricating shop.

Not only has the industry branched out into shipbuilding to a degree thought impossible, but no small part of the nation's record in pontoon production, heavy equipment and miscellaneous direct war products, has been due to the structural fabricating shop.

Utilization of welding in this has been so great, conjecture as to its place in the postwar schedule, if the industry is to operate in a broader field, is universal.

Proportion of welded structures to riveted will increase after the war, due largely to experience in welding ships and heavy equipment. Impetus has been given the art of welding by the war necessity to conserve every ton of steel possible; there will be an ample supply of better trained welders. Much research, experiment and testing is yet to be done, notably in the welding of high-strength steel, now restricted for building, but which will return to favor in greater volume.

The question of two types of structural steel, one for welding and one for riveting may arise, but is not favored by either the steelmaker or fabricator. Building stresses for permanent steel structures is another postwar question affecting design, welding and other practices. To fit some of these problems, steelmakers might be asked to produce ordinary structural steel to greater strength.

Structural welding has been advanced years by the war, notably in ship yards. Much of this work has been done with green personnel, but after the war many will be well-trained.

It may be pointed out, however, considerable war welded work is duplication; the same part being produced repeatedly. After the war, there will be less duplication of work for the structural fabricator. More specifications will be of an individual character, tending to require more welding skill.

While some sections of plain material will be short immediately after the war, increased capacity and the withdrawal of large tonnages now entering directly into war equipment should make plenty of structural steel available within a short period. Limitation orders have cut the number of shapes that may be rolled to about half the number previously allowed. A demand will arise for some of these prohibited sections, but because many of the rolls have been converted to the rolling of unrestricted sections, a lag is probable.

Continued increases in the demand for smaller shapes is a factor not to be overlooked considering the strides made in prefabrication. Prefabricated parts for houses would be a logical development in this branch of work.

The public and industry has been more postwar conscious than during the last war and more advanced planning for construction is in process. Many are already at work on actual designing; planning commissions are organizing for surveys and plans with the aid of engineering experts. In this the American Society of Civil Engineers has organized a campaign for engineers and planners throughout the country to start, and perfect as far as possible, actual designs which will be ready for bids and prompt construction at the end of the war.

Outstanding Example of Advance Planning

An outstanding example in advance planning is that formulated separately by New York city and state. New York city has work lined up for 689,450 tons of structural steel. Plans and specifications are complete for 38,700 tons; projects with plans and specifications in progress or provided for, 290,500 tons; new projects recommended for inclusion in the postwar program, 360,250 tons. Extensions to the New York subway system, 14 in number, will take an estimated additional 288,878 tons; also 24,114 tons for other Board of Transportation projects. Included in the program: Docks and piers, 76,680 tons; schools, 76,680 tons; hospitals, 41,225 tons; department of marine and aviation, 18,300 tons.

New York state program, exclusive of New York city and state highway bridge tonnage: Projects with plans complete, 17,109 tons; projects with plans under way, 138,680 tons; projects partially planned, 70,473 tons. Engineering has been started on plans in 28 states requiring 650,875 tons which include 158 grade crossings, New York, 264,975 tons; Maryland, 59,000 tons with bridges over the Patapsco, Potomac and Severn rivers; New Jersey, 30,000 tons; Missouri, 30,000 tons; and Connecticut, 14,525 tons. Preliminary surveys by the Public Roads Administration indicate an early demand for highway bridges after the war amounting to 975,150 tons.

Railroads are going to be large buyers of structural steel and elevated highway structures in the larger cities will supply a heavier market.

Until the war ends, fabricators must continue to seek their market largely outside normal channels, but a strong recovery for an extended period is indicated. Railroads and utilities have large deferred maintenance and improvement programs with facilities overstrained by war demand; many important heavy construction projects, designed to serve civilian needs, are held in abeyance by limitation orders.

As to the immediate outlook, the Bureau of Planning and Statistics of the War Production Board has issued a preliminary estimate for all construction in 1944 which totals $3,925,000,000 or approximately 50 per cent of the anticipated total for 1943. Defense plant construction requirements are listed as $850,000,000. Expenditures for direct military requirements are estimated at $1,800,000,000, or 43 per cent under the 1943 figures.

Trend Toward Light Shapes

The vast changes effected in the fabricating shop have had an impact on the rolling mill. The drop in tonnage was less sharp, although output of heavy structural shapes went from 4,937,795 tons, 1942, to an estimated 3,754,251 tons last year, the industry operating about 69 per cent.

The trend toward greater production of light structural shapes continues. Production schedules for both rolling mill and fabricating shop appear to have stabilized for the duration.

This is especially true of mill schedules which for 1943 averaged slightly better than 300,000 tons of heavy shapes a month, but included are the lighter sections in that category. With bookings estimated at 717,608 tons and production 3,754,251 tons of heavy shapes, it becomes apparent more shape tonnage is by-passing the structural shop than ever before.

Part of the answer is shipbuilding which is channeling less plain structural material to the fabricating shop and more plates and sheets. In 1941, according to the American Iron and Steel Institute, 54.1 per cent of all structural shapes produced were consumed by the construction industry. In 1942 this was reduced to 41.9 per cent and in 1943 was further reduced to slightly more than 20 per cent. Because of this situation, the normal market has been greatly restricted and the industry has been obliged to turn to other types of work, fabricators adapting their facilities to the manufacture of ship subassemblies, barges of all types, pontoons, portable bridges for military use, tank assemblies, and numerous other items.

Strictly in terms of tons, the fabricating industry will have another light year in 1944, again probably well under 1,000,000 tons. Shipments will also be below subnormal. Again there will be an abnormal relationship between structural rollings and fabricating shop tonnage.

Since January, 1942, there has been an increase in heavy structural shape rolling capacity, from 5,047,000 tons to 5,412,580 tons and in only two months during that period have operations surpassed theoretical capacity.

MACHINE TOOLS

NUMEROUS problems confront machine tool industry as war needs taper. Shops converting to other lines of production. Postwar market prospects dimmed by uncertainties. Renegotiation preventing companies from accumulating reserves

By GUY HUBBARD
Machine Tool Editor, STEEL

PROBABLY no industrialist has to keep any more balls in the air at once than does the average machine tool builder at present. While his orders are tapering and cancellations are coming in, he still is being pressed for immediate delivery of many machines most difficult to build and tool. In the meantime, increasing inroads are being made by the draft, this now affecting his workmen who heretofore have been deferred for industrial and family reasons.

In some shops loss of skilled manpower has definitely slowed down conversion to other types of war work.

This conversion to things other than machine tools by machine tool builders has proceeded much faster on the part of the smaller companies than it has in the case of the larger ones.

The problem is no easy one. In the first place, care must be taken not to allow this work to interfere in any way with critical machine tool building operations. Secondly, it is seldom that all equipment needed is available and it is just as difficult for a machine tool builder to get new equipment of scarce varieties as it is for any other industrialist. The third difficulty is that the cream of the war contracts long since has been skimmed off. Hence, machine tool builders are not able to pick and choose that which most exactly fits their shops and the capabilities of their working forces.

Considerable Subcontract Work Already Undertaken

According to a statement by John S. Chafee, director of Tools Division, War Production Board, non-machine tool work already undertaken by machine tool builders includes: Aircraft and aircraft engine and propeller assemblies and parts; steam engine parts; bomb parts; aircraft torpedoes; hydraulic cylinders and pistons; power drives for tanks; gear and gear assemblies; rifle bolts; valves; diesel engine parts; mechanical portions of radar devices; chemical shell; ship steering gears; turbines and turbine parts; and various artillery items.

Of companies within the scope of the Tools Division who themselves still are in need of subcontracting assistance on their own regular products, he mentioned particularly those manufacturing heavy metal forming and forging machinery—including forging hammers.

In order to establish some kind of a base for its advance planning (1944 planning, not postwar planning), the machine tool industry has made a diligent effort to forecast the dollar value of its production for 1944. After reviewing the situation with competent authorities of Army, Navy, Air Corps, War Production Board and Lend-Lease, the conclusion arrived at is that output of $325,000,000 worth of machine tools will be required of the industry during 1944. While only one-fourth of the prodigious annual peak output achieved in this war, this still is not a figure to be sneezed at when compared to any normal year.

Demand Varies with Type of Machine Tool

Advance planning would be relatively simple if this reduced figure could be taken as the foundation for every individual manufacturer's scheduling—which of course it cannot. There will continue to be heavy demands for some types of tools. For others there will be little or no demand. Every company must consider its own backlog, its current sales, trend of cancellations, and must be on the alert to interpret effects of sudden changes in the war's emphasis. For instance, at the time of writing, the landing barge program—including both hulls and power plants—suddenly has been given priority above tanks, planes and practically everything else. This has led to a spurt in plate fabrication and in the building of small marine propulsion units.

In their current efforts to bring production schedules into line with probable requirements, machine tool builders are impelled by a commendable desire to get their inventories under control. During the most hectic stages of their expansion program, when sources of supply of materials and of outside purchased items rapidly were drying up, machine tool builders practically were forced to tie up millions of dollars in inventory in order to insure against any interruption of their constantly mounting output. While some of this inventory, antifriction bearings for example, can be—and in fact is being—reallocated to help others who were less foresighted, a great deal of it will represent assets of extremely doubtful value if not used up for its original purpose by the time the war ends.

Machine tool builders have become painfully conscious of what canceled contracts mean—such cancellations having averaged $15,000,000 per month (approximately 1000 machines a month) during the first six months of 1943. As long as the industry was operating on pool orders, the canceled machines simply were "thrown back into the pool," but now with no new pool orders, and with existing pools rapidly being worked out, this problem in 1944 will become serious.

In the meantime, the Army, the Navy and the War Production Board are striving to find ways to simplify and speed up termination procedure on government contracts in order that prompt settlements up to 75 per cent of the claim may be effected on the basis of negotiations with the contracting officer—this without having to wait for the comptroller general of the United States to approve the case. The industry hopes that with the help of Senator Murray, chairman, Senate Committee on Small Business, congressional action will be taken which will get around the objections of the comptroller general to these plans.

One of the major shocks to the machine tool industry in 1943 was the drastic manner in which renegotiation was enforced against a large number of companies, thus syphoning off what were alleged by government authorities to be "excessive profits" on war business.

Vigorous action has been taken by capable spokesmen for the industry to explain the case clearly to the public and to members of Congress. As a result, the House Ways and Means Committee will recommend some changes in the law which may insure more adequate postwar reserves. At the same time, plans are under consideration to prevent uncontrolled "dumping" of government owned or controlled stocks of machine tools at the end of the war.

When it is considered that the War Department will own or control approximately $500,000,000 worth of machine tools by the time the war ends, the importance of damming back this potential flood becomes obvious. Authorities stress that, if properly controlled, the 400,000 or more comparatively new machine tools (that is, machines less than 10 years old) which will exist in the United States at the end of the war should be kept in America and protected as one of our most valuable national assets in meeting the fierce world competition which, it is predicted, will follow this war. The recent sour reaction of Congress to subsidies indicates that if some kind of temporary "freezing" of this backlog of industrial equipment is to be accomplished by governmental action, no time should be lost in educating Congress to this idea.

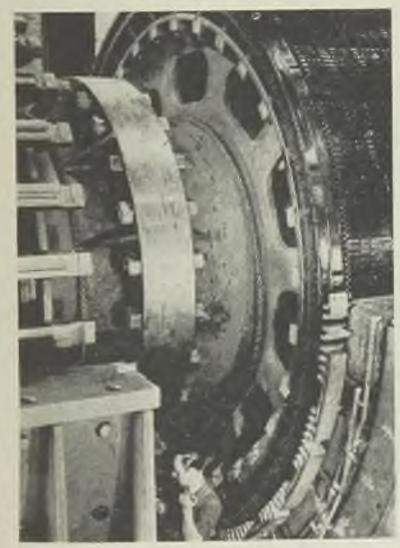
Can Contribute Much to Postwar Economy

In the face of considerable pessimism as to the postwar future of the machine tool industry, the following statement by Frederick V. Geier, president, Cincinnati Milling Machine Co., and member of the Committee on Planning of the National Machine Tool Builders' Association gives solid food for thought:

"In striving for the postwar goal of full national employment and production, do machine tool builders realize that they have more to contribute—and more to gain—than any other group?

"The most productive machines and most effective cost-cutting methods in all history must be developed by the machine tool industry, if America is to have jobs for 56,000,000 and an annual production income of $135,000,000,000.

"If we help to achieve that—if we help to build up industry to that extent—we will have as our reward an American market far sounder, far larger and far better able to support and develop the machine tool industry than any which ever before existed."



MACHINERY and EQUIPMENT

HUGE outlet for steel envisioned in postwar era in the replacement of outmoded machinery and equipment. Production men surveying the fields for developments which can be advantageously applied to peacetime manufacturing

By J. M. KURTZ
Assistant Editor, STEEL

WAR with all its hardships, misery, destruction and death in the last analysis probably has only one redeeming feature—that is the telescoping of decades of technical developments into a few years which, when applied to production of peacetime civilian products, will mean lower unit costs and an improved standard of living.

Blueprints of postwar plans are appearing. Production men are surveying the heavy and light equipment fields for developments which will enable them to compete on favorable basis in peacetime. Thousands of tons of steel will be poured into such equipment.

There have been tremendous advancements in heavy and light equipment. Materials handling equipment, it appears, will have the greatest single influence on unit costs of postwar products.

Engineers say the nation during the war would be faced with a fantastic shortage of manpower by comparison with present standards if it were not for the development of newer materials handling equipment. Assembly-line technique has been introduced into production of many types of war products, moving the product to the material rather than the material to the product. Overhead cranes, conveyor belts, industrial lift trucks and similar machines are making it possible to achieve the production figures set by President Roosevelt.

A number of plant designers contend that future plants will be nothing more than vast materials handling units inclosed within four walls. Even the roof is expected to figure into the scheme of manufacturing civilian products.

Small power-driven handling units designed especially for handling small loads and for operating in crowded quarters have been developed and will make possible further reduction in production costs. One company has produced a battery-powered lift truck built in capacities of 4000 to 6000 pounds with platform lengths ranging from 36 to 72 inches and platform widths of either 20 to 26½ inches.

Construction Equipment Improved

Construction equipment needs will be enormous in the postwar period as hundreds of cities, counties and states announce their construction programs.

There have been many improvements in construction equipment which will help to meet the needs of construction companies. A significant development is a heavy-duty wheel tractor 36 feet long. It weighs 34,000 pounds with its wagon and is capable of handling a load of 25 tons.

Another substantial consumer of steel is the vast radio and radar industry. This relatively new field is overhauling in dollar volume the great production of heavy turbines and power generator equipment. Electronic production tools will play a great role in future industrial development.

There are many promising applications for electronics in industrial plants. Value of electronics is foreseen in induction heating for the processing of plastics, annealing and heat treating of steel and other conducting metals.

Tin plate makers save as much as 60 per cent of tin by electrolytic plating. As a result of this process, metalworking industries foresee the possibility of applying high-frequency power in other operations and processes. The mass spectrometer shows promise for indication of certain phases of chemical analysis and processes such as those used in petroleum and synthetic rubber production.

There are a great many other wartime developments, now shrouded by military secrecy, which will be released when the war ends. Automotive designers are speculating even now on the possibility of utilizing one of the unique developments in use on the M-4 tank. Experience in the war disclosed the need for holding the guns on tanks steady while the attacking tank was in motion over rough terrain. Engineers evolved a solution by developing a stabilizer which may eventually be incorporated into the postwar auto and provide superb riding comfort. Application of this stabilizing system undoubtedly will be made in the construction of future railway equipment. This would make possible the smooth operation of trains oh rough tracks with a maximum of safety and a reduction of track maintenance.

Equipment engineers were responsible for a development early in 1943 which made it possible for two employes at an aircraft plant in California to produce 12,666 miscellaneous alloy sheet metal parts in an eight hour shift on single, revolving table hydraulic press. It was was accomplished by the incorporation of the uninterrupted cycle principle of operation into a conventional rubber pad press. The automatic positioning of the table combined with the automatic ram operation is the key to the amazing output.

Thousands of tons of steel will be shaped into new equipment to replace the old. Under the grind of the war production machine, the cranes, rolling equipment, etc., have been pressed around the clock for the past three years. Much of this equipment is beginning to show signs of wear and is becoming inefficient and costly to operate.

Checking through equipment records of a number of plants shows that improvisation supplied badly needed equipment and machinery in order to avert a production delay. At the Iron Plant division of General Metals Corp., Oakland, Calif., the maintenance division early in 1943 built a heavy duty 20-ton overhead crane from scrapped and salvaged parts collected from four different states. Although this crane is meeting the needs of the West Coast plant and probably will continue in use for some time, it is equipment such as this which will be replaced by newer and more efficient equipment.

Little information has been released concerning a new kind of engine, the gas turbine, which is in use in a number of industrial plants. Engineers declare this engine will have a startling effect in the postwar era inasmuch as it can compete with the diesel power plant.

Aviation engineers believe the gas turbine engine will make possible the design of larger planes. The present 2000-horsepower engine for aircraft has 14 separate cylinders with thousands of moving parts and designers say that its limitations have nearly been reached. Gas turbine engines of 5000-horsepower already have been produced and blueprints are on drawing boards for units as large as 10,000-horsepower. Although no gas turbine engine, adaptable as a power plant for automobiles, has been developed, design engineers predict that a gas turbine engine of such small size that it could be slipped into a glove compartment would be large enough to power an automobile.

Makes Claims for Steam Engine

A Chicago inventor unveiled the cloak of secrecy surrounding his development of a steam engine for airplanes which can operate on any type of crude fuel, even lard. The engine reportedly is noiseless and vibrationless as well as inaudible 200 feet above the earth's surface. The inventor claims the engine can power a plane at a speed of 650 miles per hour at 50,000 feet with only 400 horsepower. The inventor declares that a steam powered plane can take off in one third the distance required by a plane using an internal combustion engine. He explained that a head of steam, generating 600 horsepower, can be obtained in one minute and 20 seconds in a cold boiler.

No one can accurately predict the shape of things to come. The war's techical developments will not appear in civilian products overnight. But plants have become more integrated and mechanized during the war than ever before and the trend will continue in that direction in the postwar era.

APPLIANCES

ACCUMULATED and replacement demand for ranges, washing machines, refrigerators and other household equipment expected to provide large postwar steel demand. . . Innovations thought likely to be introduced gradually

By R. L. HARTFORD
Associate Editor, STEEL

WITHIN a few weeks after the war ends, 1942 models of ranges, refrigerators, washing machines and similar products will be rolling off assembly lines. That's a promise made by the nation's leading makers of such equipment.

Many firms are pointing to the end of the European war. High government officials have predicted the end of as much as 80 per cent of war production with the collapse of Germany. It is only reasonable to assume, therefore, there will be some household equipment made before Japan's surrender.

One question being booted around concerns the much publicized "new model" bugaboo. Some large manufacturers have bluntly stated that in order to meet tremendous immediate demands, they will produce prewar models at least at first. Some other companies say they're already prepared with new models.

Regardless of when or how demand for appliances will be met, the fact is certain the market for them will be immediate and it will be large. It is only reasonable to assume future markets will follow past trends to considerable degree, particularly on consumer goods for which there is a known or estimated market.

Three Principal Appliances Consume Bulk of Tonnage

There is a tremendous range of household appliances, running the whole gamut of equipment from the refrigerator to the hand iron. However, as a market for steel, there are three principal appliances which consume the bulk of tonnage. These are the refrigerator, the range and the washing machine. It has been found in the past that all fluctuations in the household appliance market follow pretty much the same trend.

It has been found that the average life of a household appliance is ten years. Therefore by 1950 every appliance bought prior to 1940 will be worn out, and in the ten years from 1940 to 1950 there will be a replacement market equal to the production of these appliances from 1930 to 1940. Subtracting 1941 and 1942 replacements from total sales of the preceding ten years, and the remainder is the potential replacement market.

New markets for appliances arise from three principal sources. These are (1) the increase in number of families during the period 1940-1950; (2) residential customers with heat and power who do not own such appliances; (3) residential customers who have been connected with heat and power during that period.

Replacement demand for refrigerators in the period 1943 to 1950, based on a study by the Porcelain Enamel Institute, is estimated at 15,049,040 units. New markets through expansion of rural electrification from 1945 to 1950 should add 2,082,844 units, increase in the number of families from 1940 to 1950 should add 5,304,728, increase in the number of customers of light and power without electric refrigerators in 1940 should add another 7,762,232 units, with total potential new customers accumulated 1940 to 1950, 15,149,804. Deducting from this total 1941-42 sales of 3,339,040 there is left a new potential market (1943 to 1950) of 11,810,764 units, which added to the replacement demand for the period results in a full potential market of 26,859,804.

Replacement Demands for Cooking Ranges Large

Replacement demand for cooking ranges, including gas, electric, coal and wood, for the period 1942 to 1950 is estimated at 17,587,272 units. New markets in the period should provide an additional 4,064,728 units, making the full potential market for the period 21,652,000 units.

Electric washing machine replacements (1943 to 1950) are expected to total 10,075,000 units. Entirely new demands for equipment will add 9,739,626, bringing the full potential market (1943 to 1950) to 19,814,626 units.

Full potential market for bathroom equipment accumulated to 1950 is placed at 69,000 units, while potential kitchen equipment demand is placed at 17,500 units. These latter figures are based on residential construction.

The potential market runs consistently ahead of actual demand, the amount varying with the degree of saturation.

As a potential market for steel, projected figures show a consistently high demand for sheets during the postwar period. Modern practice in manufacture of these three items requires heavy sheet tonnages, with about 190 pounds of steel in every refrigerator and stove, and about 57 pounds in each washing machine. This is exclusive of the motor and compressor unit in the case of the refrigerator, and exclusive of the motor and gearbox in case of the washing machine.

Translating theoretical figures into potential steel demand approximately 5,200,000 tons of steel—largely sheets

—are contained in the finished products. In addition there is a substantial tonnage in operating equipment. Since this is composed of a wide range of products, including sheets, bars, castings, forgings, etc., it is difficult to allocate the tonnage by products. Weight of a motor-compressor assembly on a refrigerator is about 100 pounds for the average box, much of which is steel.

In addition to these items of household equipment which are more or less portable, there will be a rapidly expanding potential for other household appliances which are fixed, such as steel kitchen cabinets, drainboards, sinks, etc., as well as permanent bathroom equipment of pressed steel.

Postwar Inroads by Alternate Materials Unanswered

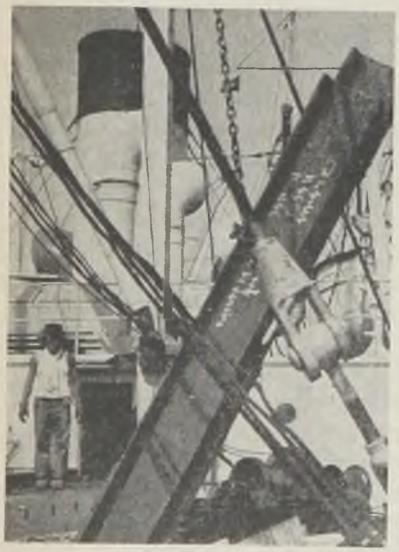
An unanswered question in regard to the potential steel markets in this type of equipment is the inroads which may be made by alternate materials.

Public demand is expected to be largely for the conventional items, and while innovations will make their bow, and technological improvements gradually assume their relative place of importance, no highly unusual changes are expected to upset normal practice. Innovations will be accepted. The automatic washing machine will be popular, as will more efficient refrigeration incorporating quick freezing units and non-dehydrating zones. Effects of these changes on steel consumption will be slight, however. The main influence will be to obsolete many of the units now in operation and create new demand from owners of older appliances. This may help to saturate the market, inasmuch as the replaced units will then be available at a lower cost to consumers in the low income groups who otherwise might not be able to buy this type of equipment.

It is probable there will be more manufacturers of household appliances after the war. Some companies, among them aircraft manufacturers, have indicated they will enter the field.

Several plants in the coastal area have already made tentative agreements with parts suppliers for subassemblies and such accessories as thermostats and heat controls. The same is true in other sections of the country, and in the export market.

An interesting sidelight on this development will be the revised method of manufacture. In the case of the aircraft companies in particular, need for high speed fabrication of sheet metals has brought to light many new techniques which are adaptable to the manufacture of household appliances. Multiple hole punching technique has been developed, for example, which is tailor-made for the needs of the stove and range manufacturer. Costs can be sliced significantly on this operation alone. New methods of joining have been developed which will reduce the man-hours required on assembly lines. More efficiently designed motors and compressors have been developed, and in the case of such complex mechanisms as the control sections of automatic washing machines, military devices have required the rapid perfection of such systems so as to insure foolproof operation. This knowledge gained by many manufacturers can and will be put to use in the design and manufacture of these appliances after the war.



EXPORTS

REHABILITATION of war-devastated countries will stimulate American steel exports. Central and South America, with credits in United States dollars, offer good market possibilities for the future

By B. K. PRICE
Associate Editor, STEEL

MARKING off the heavy exports of steel these days as principally an important contribution to the Allied war effort, American steel producers look to the time after the war when export business is going to be much desired in keeping their mills operating as fully as possible. Most see in the immediate postwar reconstruction years some very attractive business ahead; beyond that, the outlook is more obscure.

Rehabilitation requirements of war-devastated countries will be large.

Moreover, such formerly important steel exporting countries as Germany, Belgium, France and Luxemburg probably will not be in position to compete in world markets for several years.

Certain countries or sections, on the other hand, some of which have been good customers of the United States, will offer fewer potentialities. Canada and Australia are examples. In fact, Australia has built up her capacity to a point where she will have tonnage to sell abroad. South Africa has built up facilities conservatively, as has India.

Brazil is developing a steel industry; Mexico is adding modestly to her facilities; and Chile has plans under way for making herself more self-supporting. The Latin American countries as a whole will have a combined capacity of 1,400,000 tons upon completion of certain plants under construction, with 85 per cent in Brazil and Mexico.

Most of these countries, however, consume products in insufficient amounts to justify the installation of facilities for their production. Thus, they will still have to import various products, particularly those which require considerable processing.

Japan, obviously, will not be the customer she was before the war. After the war she will be stripped of her iron and steel properties on the Asiatic mainland, which at best will leave little capacity, even assuming that it isn't bombed to destruction before the country is defeated. She will want far more steel than she will be able to produce, and she will probably get some from the outside. But it appears certain some Allied organization will be set up to regulate her purchases, to make sure that, while her basic economic needs are cared for, she will not have the opportunity to build up another war machine.

England's Postwar Steel Export Prospects Uncertain

England's position in the postwar steel export market is a source of some speculation. Her prewar capacity of 13,500,000 gross tons has been increased, but precisely how much will undoubtedly remain a secret until after the war. However, in the past England has always been essentially an importer of steel—drawing considerably on Belgium and France—and an exporter of fabricated metal products. She, of course, has always exported some steel —tin plate and certain special steels, in particular. But, in general, she has always brought in more steel than she shipped out.

Germany has been an important exporter. Even while building up her huge war machine, she was a formidable factor in foreign trade. She needed credits abroad and needed them badly, and steel was one of the items sold. Steel exporters here recall the government subsidized steel that was shipped out of Germany, particularly to the Latin American countries, right up to the very outbreak of hostilities in Europe.

Germany will have a great deal of rehabilitating to do —not only within her own boundaries, but probably in certain other sections of Europe as well, notably Russia. At the peace table, Russia will undoubtedly call upon Germany to do much toward the restoration of the Russian areas she had ruined. Other countries probably will press similar demands.

France before the war had a capacity of 8,500,000 gross tons and normally exported 30 to 40 per cent. Belgium had 3,000,000 tons and Luxemburg, 1,800,000, and each exported anywhere from 80 to 90 per cent. These countries, according to usually well informed sources, are not expected to assume their former importance in world trade for at least several years.

In the reconstruction years, Russia is expected to draw heavily upon this country for steel and steel fabricated products, as well as from Germany and other sources. It will be not only for rehabilitation, but also to carry on with her prewar industrial program.

Precise status of her steel industry is not known. Large plants in the Ukraine have been knocked out, but the Russians have built a second line of industrial defense beyond the Urals and have sustained a capacity well in excess of the 15,000,000 gross tons they had in 1939.

China will come out of the war almost as poorly equipped as before to supply her needs of steel. Her future needs will be heavier. Vast public works programs are in prospect in China and there will be a great accumulation of civilian needs. China has large natural resources of coal and oil which the present government is intent upon developing.

Under its "good neighbor" policy of recent years, this country has been cultivating more friendly relations with Latin America. As a result, it is believed that after the war shipments of steel and other commodities to Central and South American countries will take a long deferred spurt—deferred largely because the United States and other normal sources have had little to spare. In addition to a substantial accumulation of miscellaneous needs, here again substantial public needs appear in sight—important railroad and sanitation projects in particular. Natural resources are going to come in for more extensive development, with oil explorations in Venezuela and Colombia, for instance, likely to result in heavy tubular buying. American oil interests are already active in these countries. Meanwhile, Latin American countries have built up substantial credits in the United States.

After the war is over, both in Europe and the Pacific, this country should have a minimum exportable surplus of 25,000,000 tons of steel.

Estimate 10 Per Cent Gain in Steel Exports

While no official figures are available on exports for the last year, it is estimated in reliable quarters that shipments of steel abroad were maintained at close to 10 per cent of the country's ingot production. Of course, the great bulk of tonnage was moved under lend-lease with only a modest tonnage, practically all for South America, being shipped otherwise. One notable feature of 1943 exports was a much smaller percentage of ingots and semifinished.

The immediate outlook for the new year is for a substantial decline in lend-lease shipments. This will be particularly true, it is said, of shipments to England, which all along has been by far the principal recipient of such tonnage. Russian shipments may be fairly sustained and in some items actually increased, such as in tin plate, for instance.

Total exports of all commodities last year were greatly in excess of the preceding year. For the first nine months alone, exports of $9,197,000,000 were 14 per cent ahead of the $8,036,000,000 for all of 1942. Imports, it appears, were also ahead of the preceding year, for receipts of $2,438,000,000 for the first nine months were only 11 per cent behind the full 1942 total.

With the great bulk of export shipments moving under lend-lease, and under special licensing arrangements set up by Washington, the Steel Export Association of America, 75 West street, New York, organized in 1928 under the Webb-Pomerene act by a number of leading steel producers engaged in export trade, was disbanded last September. Some steel exporters appear strongly of the opinion that it, or some similar organization, should be set up after the war.

AGRICULTURE

***W**ARTIME limitations on implements, equipment and buildings, plus higher farm income, presages heavy postwar demand . . . More materials may be released for agricultural purposes this year*

By ERLE F. ROSS
Associate Editor, STEEL

ONE year ago farmers were faced with a record demand for their products and inadequate equipment. Before midyear it was recognized the failure to provide for sufficient farm machinery was a short-sighted policy and steps were taken to set up an adequate program. However, the program came too late, for in the meantime supply of steel and other materials had become so critical as to make it impossible for the equipment industry to produce machines in number approaching schedule quotas. Despite this handicap, farmers did establish new output levels, although somewhat short of what had been hoped.

At the beginning of 1944, a somewhat parallel situation exists. Food production goals are greatly increased over 1943. Equipment in the hands of farmers has not been substantially supplemented over a year ago, although the production program is pegged at a level which, if attainable, would go a long way toward reducing the deficiency. However, this year, as last, finds critical materials shortages operating to restrict production. Supply of steel, inadequate last year, is comparatively adequate currently, but other materials and components are now sufficiently crucial as to prevent equipment output quotas from being met.

Produce Many Repair Parts

With the supply of new farm machinery below demand, manufacturers are producing repair parts at exceptionally heavy rates so that farmers can keep existing equipment in operation. What happens during the coming year depends on the trend of the war and the need for metals for direct military items. Early end to the European war would soon ease the materials situation sufficiently to guarantee farm equipment the green light. Even with hostilities continuing, there is a feeling that second quarter will witness a greatly improved materials supply picture.

Crops last year were smaller than in 1942 by approximately 6 per cent, but livestock production was larger and held market volume up to the preceding year. Acre yields of most crops were above average, according to the Department of Agriculture, and, except for 1942, aggregate production was about 5 per cent larger than in any previous year.

Cash farm income in 1943 was estimated at more than $19,000,000,000 or $3,000,000,000 more than in 1942, and established a new all-time high. This income, which was more than four times that in 1932, was uniformly distributed over the country. Government payments, which in the past five years have been a relatively important factor, were estimated to aggregate $755,000,000, up 8 per cent over the $697,000,000 in 1942, but still well below the record of $807,000,000 in 1939, although close to the $766,000,000 in 1940. Reasons cited for the 15 per cent increase in cash income last year are a significant rise in prices and a small increase in sales, the smaller crop volume being more than offset by the larger livestock marketings.

Buying Power Increased

Buying power of cash income increased about 31 per cent, because prices which the farmer paid for goods under the general price stabilization plan rose less rapidly than his income, according to government sources.

Prospects are for a new high mark in farm income in 1944, regardless of the war. Goals established call for the record-breaking tillage of 380,000,000 acres, an increase of 16,000,000 acres over last year. With civilian, military and lend-lease needs still rising, farm prices in coming months will in all probability continue to go higher. Should demand fall—which is unlikely—the government undoubtedly will attempt to provide support to sustain prices at strong levels. Whether it would succeed in this is a moot question, for farmers are displaying a strong opposition to the government's subsidy program.

According to consumption statistics compiled by the American Iron and Steel Institute, agriculture, including implement and equipment manufacture, accounted for only 0.9 per cent of the shipments of steel in the United States in 1942, as compared with 1.8 per cent in 1941, 2 per cent in 1940, and 1.9 per cent in 1939. On a tonnage basis, shipments were 570,000 net tons in 1942, 1,153,678 in 1941, and 919,502 tons in 1940. This was the poorest showing made by agriculture since consumption statistics were first compiled in 1922. Best year was 1928 with 6.34 per cent of the total and 2,255,907 net tons.

Tonnage and percentage of the total most certainly were down sharply in 1943. American Iron and Steel Institute estimates that of the 60,000,000 tons of finished steel produced last year about 480,000 tons, or 0.8 per cent, was delivered to the farm market. Of this amount, something in the neighborhood of 250,000 tons went into implements, if it is estimated correctly that production last year was only about 25 per cent of 1940, because of restrictions on farm machine manufacture and critical materials shortages.

During 1943, farmers' applications to rationing boards for various tools were said to run two to five times available supply. Tractors, combines and cornpickers were in particularly strong demand. This gives some indication of the potential market which will confront manufacturers when they are able to produce without the restrictions imposed by government regulations and lack of materials.

According to a recent census of the Department of Agriculture, the age of tractor-drawn or mounted implements ranged from 3 years for the smaller combines to 9 years for the larger combines, grain drills and grain binders. For horse-drawn equipment, which exists in numbers several times greater than mechanical types, the age was found to range from 11 years for walking moldboard plows to 19 years for grain binders. The implication here is that when new machinery once more is available on unrestricted basis a substantial proportion of this equipment will be replaced. Part will be abandoned because it is overage and obsolete, and part because the trend of recent years has been toward more mechanization. If farmers were free to make purchases today, the trend toward mechanization would be sharply accentuated as an offset to the farm labor deficiency.

As already pointed out, farmers' costs are running higher, but the increase is somewhat less than the rise in income. Hence, spendable income for operating expenses, new equipment, building, or savings will be up more than total income. This gives assurance that farmers will be in a position to make heavy purchases during the coming year, not only for farming equipment, but for general improvements as well, if the materials are available. Among the materials required would be iron and steel and other metals in large amounts. Among the items which farmers would buy are various farm buildings, silos, corn cribs and grain bins—perhaps of the newer prefabricated types making use of galvanized sheets and light structural sections; wire fencing, water systems, irrigation equipment, more extensive electrification, and the like.

The longer this pent-up demand is held back, the greater will be the volume when release comes. If this must await the war's end, it most certainly will be expanded enormously by accumulated savings. As an example, farm building lagged heavily last year because of stringent controls and materials shortages, and each succeeding year in which this situation obtains is merely building up a bigger avalanche.

Until well after war's end, significant changes in design of basic farm equipment are not expected. Modifications and refinements will appear from time to time in keeping with improvements in manufacturing practices and experience with materials. The accumulated demand will dictate continuation of existing models until such time as competition among manufacturers returns to normal. As materials supply eases, new type machines will appear on production lines, such as the mechanical cotton picker, sugar beet harvesters, one-man hay balers, hemp harvesters, and the like. Postwar planning already is far advanced on these items.

Steel and the ferrous metals appear secure in the manufacture of farm machinery, for weight is a prime requisite for efficient operation. Light metals and plastics no doubt will come in for more extensive utilization, but only for minor parts where some special service requirements are to be met or decorative touches added.

CONTAINERS

FABRICATION and end-use of tin-coated steel containers restricted by war expected to be increased in 1944. New electrolytic lines seen an increasing factor. Substitutes not viewed with alarm by canmakers

By **L. E. BROWNE**
Associate Editor, STEEL

UNTIL the supply of tin approaches normal, fabrication and end-use of tin-coated steel containers will continue under restrictive controls with a profound effect on the production of tin plate.

To mesh into this program the steel industry has an investment of approximately $40,000,000 in electrolytic tin-coating lines, most of them new, 28 units in all. Most are designed for light coating, 0.50-pound plate, but at higher speeds; many have not been shaken down by sustained operation and will not be free of operating difficulties for some time.

The problems of the tin plate mill are equalled, probably surpassed, by those confronting canmakers. Much research as to the feasibility of thin coated tin plate in containers for many processed foods falls on the can fabricator, who is developing new methods for surface treatment, seam-closing practice and testing procedure.

Indications are most processed food packs this year will have specific tin coatings assigned for plate used in containers, varying with the type of food, temperature pressure and other factors allowing for a safe margin against spoilage.

Research as to minimum safe coatings continues and with some leading packs expected to be heavier, 1944 tin plate production probably will be greater than the estimated 2,182,507 tons of cold reduced in 1943, compared with 2,440,929 tons, 1942. Black plate last year totaled about 310,699 tons, or 88 per cent of capacity, against 419,176 tons, 1942, or 122.5 per cent of capacity. Electrolytic production, 380,000 tons last year estimated, may reach 800,000 tons in 1944; it was 82,426 tons in 1942.

Hot-Rolled Tin Plate Output Cut

Production of hot-rolled tin plate has practically halted; less than 15,000 tons were produced last year although the rated capacity is 483,620 tons with four potential producers. Six producers in January, 1942, had a capacity of 508,620 tons and 217,021 were rolled that year, or 42.7 per cent of capacity. For some years the output of hot-rolled tin plate has been steadily declining, but 1943 saw practically the elimination of this grade.

Combined production of cold reduced tin plate and black plate was not far from 2,493,206 tons, but should be heavier in 1944.

The extent newly installed electrolytic capacity will play in the expected heavier production in 1944 and in the postwar period is a subject of much conjecture. For many dry pack containers where acid and other corrosion factors are secondary, a place appears assured for 0.50-pound electrolytic plate and some heavier coated plate by that process. Average coating on all grades of tin plate in the past year has been roughly 1.10-pound; consumption of tin was approximately 20,000 tons, less than half that of 1941, the peak tin plate year, and the lowest in many years, except for 1932.

Electrolytic tin coating is greatly stimulated by wartime necessity to conserve tin and has probably been advanced 10 years as regards capacity and investment. While tonnage from these units is increasing, few have had tonnage for capacity operations; output has not been above 40 per cent of capacity. Estimated capacity for electrolytic plate at peak schedules is 2,000,000 net tons. If this were reached, a drastic reduction in hot-dipped output would be indicated, but hot-dipped is not immediately threatened to any such extent.

Canmakers freely predict a return to hot-dipped heavier coated plate after the war unless corrosion resistance of electrolytic is improved to the point enameling and chemical treatment is unnecessary.

Tin plate production will be restricted for the duration by government limitations on the packaging of numerous products in metal, mainly non-food containers, the bulk of which cuts into prospective electrolytic tonnage. Substitutes are stressed for the emergency, mostly glass, paper, various fibers and dehydration, but few are expected to hold on after the war.

Should the electrolytic lines attain the estimated capacity of 2,000,000 tons, the potential production of the tin plate industry will have been increased to 6,325,000 tons, including 3,841,340 tons, cold reduced, and 483,620, hot-rolled. This is far in excess of any previous demand, 3,509,000 tons, 1941, being the peak year.

Within the steel industry there are differences of opinion as to current and future prospects for hot-dipped and electrolytic. Mills experiencing fewer technical difficulties with electrolytic are more favorable; others, still combatting operational and other production problems, are less enthusiastic and some would welcome a complete return to hot-dipping. The duration of the tin stringency will be a factor in this.

As new electrolytic lines have become available for production there has been a lack of tonnage to shake-down all units. At the year end electrolytic shipments were approximately 15 per cent of total tonnage; this year probably better than 30 per cent of the output will be electrolytic.

More cans from the United States will go to Canada this year; the latter has eased restrictions on some products still not permitted here.

With most can fabricating units enamel-lacquering facilities are choke points in production, notably in the case of chemically treated double enamel electrolytic. The need of heavier inventories of light-coated plate earlier in the year is evident. Canmakers are generally dissatisfied with first quarter quotas, claiming 125,000 tons additional are needed for an early start; the carry-over of plate into the first quarter is estimated at around 150,000 tons.

Output Dependent on War Program

Except that output will be heavier this year than last, estimates for 1944 are dependent on war program revisions; some are aiming as high as 2,800,000 tons. A breakdown as to hot-dipped electrolytic bonderized and other grades is fraught with uncertainty, although the trend toward lighter coatings in the interests of tin conservation will continue. Production of 1,500,000 tons of hot-dipped is predicted by some, and, should electrolytic approach 800,000 tons the increase would be a sensational accomplishment in less than two years.

The real issue of hot-dip versus electrolytic will probably be determined after the war and on economic and utility lines; for the duration many factors emanating from the primary need of saving tin are favorable to the lighter plate.

Canmakers working with electrolytic plate have largely overcome problems of solderability, notably by the adoption of a silver-lead solder while progress is also being made with a 5-95 tin-lead solder.

The lubrication of electrolytic plate also requires attention of the canmaker, also external and internal corrosion resistance. Comparing melting electrolytic plate with unmelted plates, either brushed or matte, it was found without exception the melted plate had a better corrosion resistance than the unmelted; tests were made with experimental plates for research purposes with grapefruit juice and milk. The better corrosion resistance, plus improved appearance, increased solderability and more resistance to external rust has caused can manufacturers to favor melted electrolytic plate.

RAILROADS

CARRIERS, hampered by restrictions on use of steel and manpower, offer large market for steel in rehabilitating facilities deteriorated by war traffic. More materials will be made available in 1944

By ERLE F. ROSS
Associate Editor, STEEL

RAILROADS, always a major market for steel products, has been one of the hardest hit essential industries of the war. In spite of curtailed steel allocations, its performance in handling unprecedented traffic, both freight and passenger, created by the war is little short of phenomenal. The achievement of 1943 in moving cargo and carrying passengers at volumes nearly double the load in 1918 is all the more remarkable because it was accomplished with inadequate equipment.

Fortunately for the war effort, the carriers were in relatively good condition at the time of Pearl Harbor. Railroads had been spending millions of dollars for motive power, cars and replacement trackage.

Soon after the beginning of the war, drastic restrictions on the building of railroad equipment were ordered. The sharp increase in traffic soon brought difficulties to the carriers. Early in 1943, the railroads were looking ahead with some optimism to substantial replacements of trackage and rolling stock to take the place of that worn out in 1942. That optimism had sound foundation for WPB had outlined a program calling for 250 steam locomotives and 36 diesels in the first eight months; 100 switching engines and 20,000 freight cars in the first six months; and 330,000 tons of steel for repairs to equipment, 480,000 tons of rails and 288,000 tons of track accessories in the first quarter.

Materials Supply Less Critical

On the basis of this program, and belief it would continue at about the same level throughout the year, the carriers had hopes of receiving at least 4,500,000 tons of steel in 1943.

The record shows, of course, that the railroads received last year less than this amount of steel. Thus, the carriers enter 1944 with equipment in worse condition than at the start of 1943, but with traffic loads likely to exceed the records of that year. Fortunately, however, after months of warning by railroad officials, followed by sharp increase in breakdowns, action was started shortly after midyear to supply substantial numbers of new cars and locomotives, new rails and accessories, and materials for repairs.

Evidence is accumulating that materials supply will gradually grow less critical, and there is every reason to believe that the increased 1944 railroad program, with its definite allocations of steel and other materials, will be carried out without drastic change.

Reflecting the restrictions placed on the construction of rolling stock last year because of the shortage of steel and other materials, Class I railroads put only 20,432 new freight cars in service in the first nine months of 1943, compared with 56,081 reported in the comparable period of 1942.

New freight cars on order Oct. 1 totaled 28,986, compared with 36,437 on order on the same date the year previous.

During the same nine-month period, Class I carriers installed 483 new locomotives, of which 298 were steam, 15 electric and 170 diesel. Through Sept. 30, 1942, they put 575 new locomotives in service, including 232 steam and 343 electric and diesel. New locomotives on order Oct. 1, last year, totaled 1067, including 468 steam, 3 electric, and 596 diesel. Comparable figures for Oct. 1, 1942, were 840 locomotives on order, comprised of 314 steam and 526 electric and diesel.

Postwar Renaissance Likely

Office of Defense Transportation also reported 50 new locomotives on order Oct. 1, last year, and 18 new units installed during the first nine months by other than Class I carriers, making a total of 501 new locomotives installed and 1117 on order.

According to a preliminary estimate of the American Iron and Steel Institute, of the 60,000,000 tons of finished steel produced last year, 4,260,000 tons, or 7.1 per cent, were shipped to railroads.

The increased traffic load and restricted building of new rolling stock in 1943 made imperative that existing equipment be kept operative. Consequently, rehabilitation of unserviceable units was pressed to the fullest degree. With 47,940 freight cars, or 2.4 per cent, awaiting repairs on Dec. 31, 1942, only 42,868, or 2.1 per cent, were in this category on Oct. 15. This was the lowest percentage on record; from 1917 to 1942 the figure had not fallen below 5 per cent, but in 1942 dropped to 3.3 per cent.

Lifting of restrictions on use of steel and manpower for railroad equipment undoubtedly will bring forth a renaissance of railroad equipment building to restore the carriers to a state of utmost efficiency.

WINDOWS of WASHINGTON

By E. C. KREUTZBERG

Much planning for the future in evidence in government and business circles but observers view the immediate postwar period with uneasiness. Policies as developed by Congress to determine the nation's economic course

WASHINGTON

DESPITE postwar economic planning all over the place—by the administration and the various administration agencies, by congressional committees, by important groups of economists and business associations, by individual manufacturers and businessmen, by labor organizations, and by communities throughout the nation—studious observers view the immediate postwar period with uneasiness.

As this is written, Congress is in a position to write a fairly good law to provide for termination of contracts and to make for speedy disposition of government-owned plants, equipment and surpluses so as to pave the way for reconversion to peacetime production activities within a minimum period. As a result of a vast amount of discussion before a number of congressional committees, where representatives of procurement agencies, businessmen and others told their stories, there has been a pretty general meeting of minds as to what policies will be needed to make for smooth reconversion.

Out of these discussions has come the conclusion that a good reconversion control must be implemented substantially as follows:

1 — Government - owned plants, wherever possible, with the exception of those to be held in reserve in case of possible future military needs, should be converted to peacetime production.

2 — Government - owned surpluses should be disposed of to ease living standards, but in an orderly and properly organized manner so as not to shock the economy—as happened after the last war.

3—Contractors should have their plants available for reconversion with the least delay. They should know in advance of termination what government-owned plants and equipment they can buy, and on what terms. They should know beforehand what disposition is to be made of machinery the government wants to keep and where it should be shipped. They should know beforehand what to do with materials and parts in inventories. The aim is to enable contractors, upon receiving cancellation notices, to go to work immediately in clearing their plants for peacetime production without having to wait, possibly for months, while government auditors are making checks.

Settlements Must Be Binding

4—Contract cancellation settlements must be speedy and binding—not subject to review except in cases involving fraud.

5—All legitimate costs chargeable to the government must be allowed.

6—Liberal advance payments must be made to contractors to enable them to get started on their reconversion programs. Loans should be made to contractors—not alone on the basis of their credit positions but rather on the basis of their potential worth as producers and employers.

7—Uniform policies must be employed by all the procurement agencies in handling contract terminations. These should be formulated and administered under the direction of some one individual or central agency. This individual or central agency should have a carefully detailed mandate direct from Congress. There must be no loosely drawn law, like the original Contracts Renegotiation act, under which the administrator can deviate from the national policy as defined by Congress.

Congress now is waiting for a report from Bernard M. Baruch, recently appointed head of a new War and Postwar Adjustment Unit of the Office of War Mobilization. But final legislative action is not expected to be long deferred; it has been brought out that cancellation of war contracts already is in large volume, so that delay in fixing policy may prove dangerous. Just as Congress moved rapidly in improving the Contracts Renegotiation act, so it is expected to move rapidly in taking care of reconversion problems.

One of the factors that makes for a great deal of uneasiness is the lack of a firm, workable national policy with respect to wages and prices. Blame for this must be shared equally by the administration and Congress. Some of the recent developments that provide grounds for worry are the following:

1—The administration's failure to uphold the Little Steel formula in the case

Secretary of State Cordell Hull tells the historic meeting of Congress that the Moscow declaration will hasten an Allied victory and help create a postwar world free of the conflict-breeding power policies of the past. NEA photo

Pictured here is the Senate Postwar Economic Committee as it held one of its important meetings. Left to right front row, are: Sen. Joseph C. O'Mahoney, Sen. Alben C. Barkley, Sen. Walter F. George, Sen. Charles L. McNary, and Sen. Arthur H. Vandenburg. Standing, left to right, are: Sen. Robert A. Taft, Sen. Claude Pepper, Sen. Scott W. Lucas, Sen. Warren R. Austin, and Sen. Carl Hayden

of the United Mine Workers led by John L. Lewis—also its willingness to make an agreement with Lewis while the miners were on strike.

2—The Truman resolution which would over-rule the War Labor Board in its stand in the wage demands of the nonoperating railroad employes—and which seems to have a good chance of passing both houses.

3—Approval by the House, 279 to 117, of a resolution forbidding the use of subsidies in holding down retail food prices—and with indications it also will be approved in the Senate.

4—Increasing "to-hell-with-the-OPA" attitude in Congress, as reflected by demands that Secretary Ickes be given control over coal and oil prices and that food prices be set by the War Food Administration.

5—Claims by industry members of the War Labor Board that this board cannot do a job on wage controls without a law "to require responsibility of unions and to provide additional protection for workers, employers and the public against those who misuse the power presently permitted," and warning by the public members that "this whole question of the responsibility of unions for antisocial acts and of the capacity of government as at present constituted to prevent such acts" must be brought "into the forefront of consideration and discussion."

This is a pretty bad situation to have during a war—in fact so bad that most observers feel that somewhow the inflationary trend must be stopped before it gets out of hand. Many congressmen express belief that if the President vetoes the anti-subsidy provision—there will be overriding of the veto. It is hoped that many of them will feel they showed the farmer and labor that their hearts are in the right spot and thus can pass the buck to the President and not go into the elections with a mark against them.

The administration's latest move is being watched to determine whether it is directed at a firm national policy or whether it is the forerunner of another step in the direction of expediency. A five-man committee of the War Labor Board, headed by Chairman William H. Davis, has been charged by the President with the task of investigating the cost of living. "If the committee finds that inequalities exist it will recommend that prices be brought down, not that wages be raised," says Mr. Davis. That might necessitate the use of subsidies for extensive "rollbacks," a move that would be even more distasteful to Congress than the present use of limited subsidies.

Wage-Price Prospects Disturbing

Indications that the postwar situation as to wages and prices may be full of dynamite also provide grounds for uneasiness. This prospect is worth examining in some detail.

No matter how fast we proceed in reconverting from war to peace, the day of wholesale contract terminations will render millions of workers idle—at many plants making bombers, fighter planes, guns, tanks, ammunition, ships, landing craft, torpedoes and a host of other direct war items—and at best large numbers of people will not find other employment for a matter of months.

Workers in industries not making direct war items would be equally affected. Steelworkers, glassworkers, and bolt and nut producers would be unable to ship their products to the automobile industry until such time as the manufacturers had re-established their assembly lines.

Workers made idle would receive in most cases, unless remedial provisions were made, only such income as would accrue to them under state unemployment insurance systems. Not many companies would be paying severance money for two reasons: one, because the government does not recognize such severance pay as a government cost except in a few cases where the payment of severance money has been a company policy over a long period; and the other, because few companies will be able to afford to hand out severance pay at a time when funds will be badly needed for reconversion.

On the other hand, there is every likelihood that those workers who did have employment would take a cut of 23 per cent or so in their present take-home pay, because of elimination of time-and-a-half pay for a week over 40 hours. With allowances made for unemployment, the immediate postwar payroll would be cut substantially in half.

In the face of this diminished purchasing power, there seems little likelihood that the cost of living will come down. The commitments we entered into at the recent Atlantic City conference to furnish food and other necessaries of life to starving countries of Europe effectually will prevent food prices from receding. The housing shortage will prevent any reduction in rentals.

The immediate postwar period also

40 Years of Proof!

BROAD BROOK COMPANY.
WOOLENS & WORSTEDS.
Broad Brook, Conn. Octr. 19 1904

Sirs. Will you send me particulars of your rolling doors, including the cost of doors, installing them etc.
We want a couple of doors which would be suitable for our boiler room and we would like to know if rolling doors would be durable in such a place and how they would stand snow and ice in the winter. The doors would have to be opened and closed a dozen times a day. The door ways are 10 feet wide by 10 feet high.

Yours truly
Benj S Hanson. Engineer
Box 221
Broad Brook Ct

1904

BROAD BROOK COMPANY

Kinnear Manufacturing Co., Inc.,
30 Rockefeller Plaza,
New York 20, New York.

Attention: Mr. Boyd Cherry, Secretary

Gentlemen:

Thank you for sending us the letter which we wrote you October 19, 1904 signed by Benjamin S. Hanson, engineer.

You will be interested to know that Mr. Hanson is still with us. He was pleased to see this evidence of the good judgment he used in buying the rolling doors from you at that time. These doors are opened and closed a dozen times a day and have been in continuous use in all kinds of weather for the past thirty-nine years. The maintenance cost has been nil. After the installation of the few repair parts we have just ordered, the doors should be good for another thirty-nine years of service. They have certainly proved to be a splendid investment.

Very truly yours,
BROAD BROOK COMPANY
Chester A. Wiese
Chester A. Wiese

CAW:S
c.c. to Mr. W. W. Cossum,
Columbus, Ohio.

1944
its 40th year!

Benj. S. Hanson, Engineer at the Broad Brook Company who instigated the original purchase of the Kinnear Door in 1904, is also still on the job!

40 years of daily service . . . maintenance costs nil . . . and still delivering highest efficiency! 40 years of savings in floor and wall space . . . of extra protection against fire, theft, wind and weather! Here again is dramatic proof of how ruggedness and economy are combined with smooth time-saving convenience in Kinnear Rolling Doors. Many similar records in the Kinnear files tell of such long, low-cost efficiency. The *coiling upward action* of the famous interlocking-steel-slat construction (originated by Kinnear), plus skilled engineering and fabrication by door specialists, are the reasons for the remarkable performance of Kinnear Rolling Doors. They are the right answer to every service door problem! The Kinnear Mfg. Co., 1780-1800 Fields Ave., Columbus 16, Ohio.

Check These Kinnear Rolling Door Advantages

- Convenient upward action plus heavy-duty steel construction.
- Coil compactly above the opening—saving floor and wall space.
- Effectively counterbalanced for smooth, fast, easy operation.
- All-metal protection against riot, theft, intrusion, fire.
- Open out of reach of damage by vehicles, wind, or elements.
- Specially treated, rust-resistant materials—weatherproof, more durable
- Built to exactly fit the opening—easy and economical to install.
- Easily adapted for convenient, time saving motor operation.

SAVING WAYS IN DOORWAYS...

KINNEAR
ROLLING DOORS

What's Ahead?

No. 1 in a Series

Experts are working experimentally on a universal sign language for use during the period of reconstruction following the war. It has a vocabulary of about two thousand words and can be learned in about a month.

★

Reshingling of homes may be entirely eliminated after the war. With plentiful cheap aluminum as one of the benefits of the great disaster, we expect to have aluminum shingles, and the glass industry has already developed a lifetime glass shingle.

★

Radio waves are now being used to spread the layer of tin on tin cans and thinner than it was before the war.

★

The Diesel engine is close to its long-sought ideal of one pound per horse power. This may indicate that this thrifty engine, already scheduled to power our postwar trucks, may also be suitable for our pleasure cars.

★

Little by little new ideas combine to make flying more practical for tomorrow's civilians. One of these is a simple device for night landing which uses two lamps aimed toward the ground. The beams of these lamps are focused so that they come together to form a single spot of light on the ground when the plane is at exactly the right height for "setting down."

★

A new fuse for artillery shells is said to be so sensitive that it will explode the shell on hitting a raindrop.

★

The use of aluminum can reduce the weight of a freight car from forty-five thousand to fifteen thousand pounds with a corresponding increase in capacity.

★

Factories have been built with heating pipes permanently laid in the solid concrete floor. The method seems to be practical, economical and suitable for the heating of our homes.

★

In spite of the war, the Dutch have been able to produce a new hybrid plant, a cross between the carrot and the beet called the "wobbie".

To supply a Pacific coast shipyard with 152′ one-piece keels for Navy minesweepers, giant trailers are being used that haul 60 tons of Douglas fir logs of this length.

★

Experiments are being made with artificial teeth held in place by magnets.

★

It is expected that vast amounts of magnesium will be used after the war, and it is encouraging to know that our supply is large and beyond the reach of the enemy. Although there is only fourteen one-hundredths of one percent of magnesium in sea water, there are four and one-half million tons in a cubic mile.

★

Fifty thousand patents, formerly the legal property of our enemies, are now available to American industry.

★

The electron microscope will now measure particles as small as one-millionth of an inch.

★

The Civil Aeronautics Administration expects us to have half a million private and commercial airplanes by 1950.

★

A new synthetic textile filament, the finest yet produced by man or nature, is so small that it takes twenty thousand miles of it to weigh a pound.

Automobile tires are now being checked for invisible flaws by passing high-frequency sound waves through them.

★

Plastic bearings for machinery will require no lubricants for moderate speeds and loads, and in many cases water has been found to give sufficient lubrication for even high speeds and heavy loads.

★

"Facsimile", a method of printing a miniature newspaper by radio in individual homes, was tried experimentally before the war began. By this method the printing is done during the night and a newspaper, complete with illustrations and advertising, is ready at breakfast time.

★

There is a very good chance that we may have television in full color and three dimensions. It may also be possible to store up television broadcasts to be re-run later.

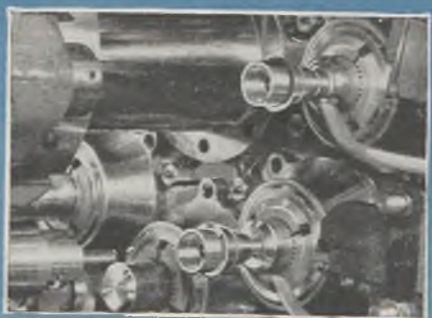
★

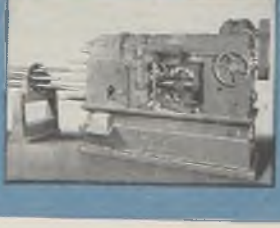
A micro-hardness tester is now made that can test a single microscopic grain of metal.

★

Shipwrecked sailors will soon have the benefit of a tiny searchlight no bigger than a walnut that is visible for 60 to 70 miles and good for 100 hours of use.

★





is sure to reflect considerable turbulence in labor agitation. Labor leaders can be expected to exert every effort to keep their unions from breaking up. A lot of talk probably will be heard about "unconscionable" profits made by the corporations during the war and there probably will be attacks on "labor haters". One of the things that surely will be pushed after the war by leftish labor leaders is the demand that industries run under the direction of committees to be composed of equal representation by labor, management and the public—the assumption being that labor and public representatives would join hands.

Only now are the administration and Congress giving signs that they are thinking about this phase of the immediate postwar problem. The administration has recommended that Congress take favorable action on substantial benefits to discharged soldiers and sailors. The American Federation of Labor has made two suggestions: One, that wages be adjusted so that workers would take home as much pay for 40 hours' work as they now receive for a 48-hour week; also, that the social security system be revised so as to give more unemployment compensation to workers rendered idle through termination of their war jobs. Some thought is being given to the suggestion that contractors be encouraged to give liberal severance compensation by allowing them to charge such severance payments against the government as one of the cost items.

Employment Must Be Provided

The problem of how to provide for workers thrown out of employment because of contract termination is a difficult and complicated one. It can be solved and it is gratifying to observe that its seriousness now is recognized in practically all responsible quarters.

There also are signs that another need for a prosperous economy in the long future is better understood. That is the need for encouragement to private individuals and groups and institutions to invest their funds in industrial ventures through the profit incentive. Even the American Federation of Labor has suggested to Congress that some method of taxing business must be developed so as to enable business to make a substantial profit for its shareholders. It has been brought out again and again in congressional committee hearings and conferences that the present tax burden makes it impossible for a vast number of companies to accumulate the reserves they need for the future, let alone the payment of satisfactory dividends out of current income. That was one of the things the House Ways and Means Committee had in mind in refusing to grant the corporation tax increases asked by the Treasury Department.

This better understanding of business and industry also applies to the administration, which has been greatly impressed with the manner in which industrialists have carried out their war production assignments. Recently President Roosevelt called a committee of representative manufacturers to the White House to talk over "all matters concerning the participation of business and industry in the war". Following the meeting a White House announcement stated such meetings would be "held from time to time" and that President Roosevelt would welcome a discussion of business problems whenever members of the committee desired it. Previously the President had been holding periodic meetings of this kind with heads of farmer organizations and labor unions.

Wartime Washington overflows with pedestrian traffic. Crowds surge beyond the curb at intersections. NEA photo

Greater Co-operation Evident

In other words, government baiting of business and industry seems to have run its course.

It is only the immediate postwar period that is arousing current uneasiness. That is the period when huge numbers of workers will be idle, when there will develop problems in connection with switches in population, when there will be a lot of discontent and turmoil.

As to what will happen after that, prevailing opinion is on the optimistic side. It is not yet certain just how long this changeover period will last. It will take months—in the automotive industry current opinion is that the first automobiles can be produced from the new assembly lines within three to six months and that it will require a few months more before top production is reached. Such predictions are based on the assumption that government-owned machinery and inventories will be removed from the plants promptly.

Not all the workers released from war jobs, of course, will be long idle. Plans already exist that can be put to work at a moment's notice and provide jobs for a large number of people. Many idle workers will be required on reconversion work at industrial plants. Many will be absorbed on public work projects. Some will be employed in rehabilitating the railroads. Others will get back into service types of business which they had to leave during the war.

In planning for postwar business, manufacturers are doing so on the "ambitious" side. For example, Packard Motor Car Co., which made 45 cars a day normally, plans to make 65 after the war. General Electric Co. bases its postwar plan on the estimate that the national production two years after the end of the war will be in the neighborhood of $135,000,000,000 on the basis of 1941 prices and it has made allowance for expected normal growth in its business. These are typical of similar postwar plans under which substantially all manufacturers expect to operate expanded capacity as compared with their prewar output.

Considerable public work will be released when demobilization day comes. A survey now in progress by the American Road Builders Association reveals that 32 states have highway and bridge construction programs aggregating $4,580,000,000, including about 100,000 miles of highway and some 11,000 bridges. These same states have completed plans and are ready to go ahead immediately with projects coming to $1,169,000,000; they are ready to receive bids and award contracts.

This favorable picture is further enhanced, as far as manufacturers of all sorts of roadbuilding equipment are concerned, by the fact that most of such equipment now being produced is being shipped abroad for use in military areas. There is little likelihood any of it ever will come back. On the other hand, the market will be expanded because much equipment owned by counties and municipalities has been sold to the Army and will have to be replaced.

That sort of news, of course, means a great deal to manufacturers of diesel and gasoline engines, steel and malleable foundries, makers of forgings, antifriction bearings, welding equipment and many other machines, parts and materials, as far as the postwar era is concerned.

In general, there is much optimism about future demands for consumer goods, including consumers' durable goods. It commonly is assumed the American plane of life will be higher than in the prewar period. Just how this hope will work out remains to be seen. But it does represent sentiment, not only among government officials and members of Congress, but of business, industrial and labor leaders. It certainly represents the view of the Committee for Economic Development, and the National Association of Manufacturers and the Chamber of Commerce of the United States.

The outlook for various types of durable goods for industrial use is considered bright. In particular, a large market is seen for equipment required by the chemical industries. Considerable progress has been made in the chemical field during the war and the industry will provide much new employment in peacetime. For example, the petroleum industry will not be just a producer of fuel oils and gasoline. It will be primarily a chemical industry. In its experience in making materials for synthetic rubber, many lessons have been learned as to what can be done with raw petroleum by chemical processes.

The conditions that will affect certain other types of capital goods cannot be forecast at this time. One big question is: What volume of machine tool sales can be expected? While the machine tool manufacturers have been gloomy over the outlook—most of them have plans for manufacturing products other than machine tools after the war—actually the postwar situation may not be nearly as bad as they fear. There has been much talk about keeping key machine tools under grease, if necessary, in order to have them available for use in case of a future military emergency. The suggestion has been made that a large portion of the machine tool surplus be sold to other countries to enable them to round out their economies.

Construction of housing is an activity scheduled for great volume. Current opinion is that Congress will put the government behind the program so as to get it launched without delay when labor and materials become available.

The plight in which the aircraft manufacturing industry, along with its thousands of suppliers, will find itself when peace comes is not only a great worry to executives in that industry but also to administration authorities and members of Congress. In Congress there is a firm intention to save this industry from chaos but no really effective formula has been worked out. There have been quite a few expressions from members of Congress over the many applications now before the Civil Aeronautics Board for rights to operate new air routes to serve all small cities and rural areas and tie in with the trans-

(*Please turn to Page* 378)

Leading figure in the administration's postwar planning is Bernard M. Baruch, head of the War Industries Board of World War I and now chief of a new War and Postwar Unit in the Office of War Mobilization. Mr. Baruch was among the first to offer plans for effective and centralized control of the present war effort—at a time when it was just muddling along. At first, his plans were regarded somewhat superciliously by ambitious new dealers; but time proved his suggestions sound and the administration belatedly called him into official service. NEA photo

What part will machine tools play in helping to take

<u>this</u> HILL 609?

In the barren wastes of Tunisia stands a lonely promontory. It had no name—until, in a brief hour of history, the courage of men immortalized it with a number . . . 609.

We, too, have yet to conquer a barren promontory—barren of hope, of light, of the freedom men are fighting for. This hill is held by poverty, armed with ignorance, intolerance and fear. It is our own Hill 609, in Detroit, in Harlem, in Los Angeles—in a thousand places here at home.

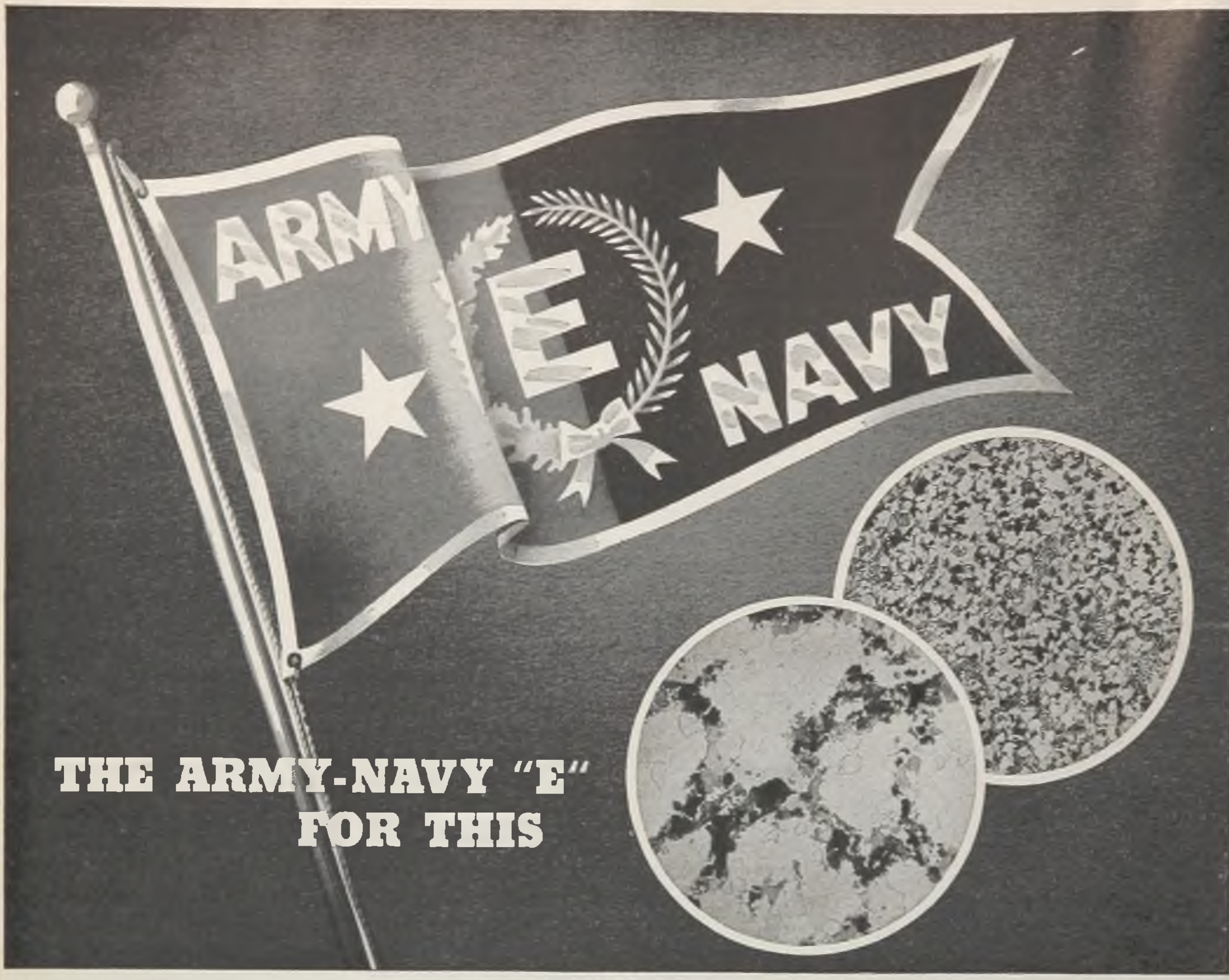
What part will machine tools play in taking *this* Hill 609? The whole part. Machine tools at work. Machine tools building a better standard of living than even we have ever dreamed of before.

For there is scarcely an essential to better living—from the windows men look through to the most intricate and wonderful machines that help them to think, to search and see light — that does not stem from a handful of basic machine tools.

And one of these—the internal grinding machine—is essential to the creation of literally *everything* that will make for a better living after this war.

BRYANT

BRYANT CHUCKING GRINDER COMPANY SPRINGFIELD VERMONT, U.S.A.



On September 5th, 1942, our Mine and Mill at Climax, our Research Laboratory at Detroit and our Conversion Plant at Langeloth, Pennsylvania, were given the Army-Navy Production Award. Since then the award has been twice renewed. The two-starred flag we fly represents a full year of contribution to the war effort recognized by the Army and Navy.

Winning the award by the laboratory began in 1931. It was then that it was founded to meet our needs for authoritative information about molybdenum—containing ferrous materials.

Pearl Harbor intensified our work with producers of war equipment—work that is aided considerably by the accumulated data and experience gained in over ten years of concentrated research.

We are particularly proud to be among those companies whose laboratories are entitled to fly the Army-Navy "E".

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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MIRRORS of MOTORDOM

By A. H. ALLEN
Detroit Editor, STEEL

Record military production achieved in 1943. Reconversion to fore as armament demand slackens. Gradual swing to peacetime work expected. Progress seen evolutionary rather than revolutionary

WITH its major contribution to the greatest outpouring of arms, aircraft and mobile combat and transport equipment the world has ever seen, the motor vehicle and parts industries can take full measure of satisfaction. Dollar volume of military production for 1943 reached $8,754,800,000, or two and one-third times the wholesale value of all cars and trucks produced by the industry in 1941.

Monthly production in terms of dollar value for 1942 and 1943 are shown in an accompanying tabulation, covering approximately 1000 companies in the motor vehicle and parts industries. The figures are adjusted to discount the effect of intercompany shipments, with totals for November and December estimates.

Classified according to type of production, the industry's job for 1943 breaks down into 40 per cent aircraft, 15 per cent tanks and tank destroyers, 26 per cent military vehicles, 8 per cent guns, 7 per cent marine equipment, 3 per cent ammunition and 1 per cent miscellaneous. At yearend these ratios were changing to throw greater emphasis on aircraft and military vehicles, at the expense of tanks, guns and ammunition. In fact, over the year, schedules on tank production were trimmed by 40 per cent, principally as a result of cancellation of British and Russian orders.

1943 Peak Production Year

Barring a decided worsening of the military picture, 1943 will go down in history as the peak year in production for war. It was a year of concerted expansion of facilities and of a shakedown of other facilities to a mass output basis. The chips were down, and the military pipelines of equipment and supplies were clamoring for stuffing. By December, the lines to the battlefronts were fairly well filled; in fact, for some plants the war to all intents and purposes was over. Numerous small arms ammunition plants, for example, were being closed and their machinery stored. Reductions in expenditures for armament and equipment by Army procurement officers were expected to pour 8¼ billions back to the Budget Bureau by the end of the current fiscal year. In other words the trimmings from armament schedules announced in November were close to what the entire automotive industry produced for the full year.

So it becomes apparent that the current year will slip below its predecessor in terms of military production. The emphasis will continue on aircraft, and the automotive industry will come in for its share in view of the high percentage of aircraft work it is now shouldering. A second important phase will be military and civilian trucks, schedules on which have been jumped enormously. Throughout 1943, the automotive industry produced pretty close to 80,000 trucks a month, or something under 1,000,000 in all. These included everything from jeeps, "ducks", ambulances and staff cars, on up to the heaviest military and civilian trucks, with precious few of the latter. In mapping out schedules for 1944, planning agencies, both civilian and military have added a load of around 150,000 heavy-duty six-wheel drive military trucks, plus about 123,000 civilian trucks in all sizes.

AUTOMOTIVE INDUSTRY WAR PRODUCT DELIVERIES

(Covering approximately 1000 companies in the motor vehicle and parts industries, and adjusted to eliminate effect of inter-company shipments)

	1942 Monthly	1943 Monthly
Jan.	$165,300,000	$598,600,000
Feb.	191,400,000	609,400,000
March	254,700,000	653,700,000
April	291,100,000	671,600,000
May	313,200,000	702,700,000
June	383,800,000	747,700,000
July	427,200,000	784,000,000
Aug.	452,900,000	801,800,000
Sept.	485,300,000	782,300,000
Oct.	540,700,000	823,000,000
Nov.	539,600,000	800,000,000*
Dec.	645,800,000	780,000,000*
Total	$4,691,000,000	$8,754,800,000

*Estimate.

New plant facilities are being required to handle this extension of heavy truck manufacturing, since the truck industry has never approached anything like the assembly schedules now planned. Particularly in respect to axles, transmissions and engines is the bottleneck acute, but various steps are under way to provide these components in sufficient quantity.

All truck production activity will clear through the Army's Tank-Automotive Center in Detroit, organized by Ordnance last year to provide a centralized and localized direction in Detroit for its tank and tank destroyer program. The cutback in tank schedules has made this agency the logical choice to supervise the new military and civilian truck program. It likely will be August or September before much progress is made on the enlarged civilian truck schedule, despite steady deterioration in the nation's truck fleet.

Three Constrictions Passed

Three successive constrictions were passed through by automotive plants in their unprecedented conversion to war production. They can best be identified by the three words—machines, materials and manpower. It can now be said that the advance worry over all three was far worse than the trouble itself. True, there were delays in receipt of vital machinery here and there, confusion reigned for awhile in connection with priorities on materials, and late last year the War Manpower Commission was making all sorts of dire warnings about the critical manpower situation. Actually, however, nearly all production schedules were met if not easily surpassed. By November, the materials picture had eased to the point where one restriction after another was being lifted by the WPB. Aluminum and magnesium were becoming plentiful. Ferroalloys were easier. Open-hearth carbon steel ingots were piling up at steel mills.

As far as manpower is concerned, the WMC steadfastly has refused to face the situation realistically and is predicting astronomical shortages in war plants some time this year. Neither industry nor labor supports these contentions, and the acceleration of contract terminations late in 1943 made the supposedly oncoming manpower shortages even more doubtful.

Realizing that industry may be anywhere from six months to a year ahead of the situation at the battlefronts, motor plant executives began to examine closely the matter of war contract terminations last fall. The Automotive Council for War Production organized a Contract Termination Committee, with J. H. Marks of Packard as its chairman. At an early meeting of this group, four things were seen as matters requiring quick determination:

1. A uniform policy on the part of the government in all its branches with respect to termination.

2. Refunding of money promptly to contractors for work in process and materials inventories to permit them to proceed with the reconversion of plants.

3. Disposal of materials and work in process to release plant space for reconversion.

4. Disposal of machinery and equipment installed for war contracts.

Early experience of some automotive companies in settlement of claims of terminated contracts has been unfortunate. Part of the fault lies with the companies' own failure to understand the problem; part with the government's inexperience. Basically, however, the trouble traces from a lack of any ground rules and policies.

Problems divide into two major divisions, one embracing matters of public policy, and the other the mechanics of getting termination claims approved and paid. In the first group are such items as severance wages, expenses of plant reconversion, policy of selling material as scrap when in fact it is not scrap, and the policy of dealing with facilities owned by the Defense Plant Corp. but installed in the contractors' war plants.

As to the mechanics of settling termination claims, there are seven important angles:

1. How to get plants cleared of war production equipment and back into civilian production with the least possible delay.

2. How to get quickly into normal channels money that would be tied up on termination of a given contract.

3. How to deal with subcontractors, as well as sub-subs, and conversely, how subcontractors should deal with prime contractors. Extremely complicated contractual relationships have grown up in war production, many companies being both prime and subcontractors.

4. How to get a fair allowance for costs incurred, and perhaps some profit.

5. How to be reimbursed for the costs of terminating contracts, and how to determine such costs.

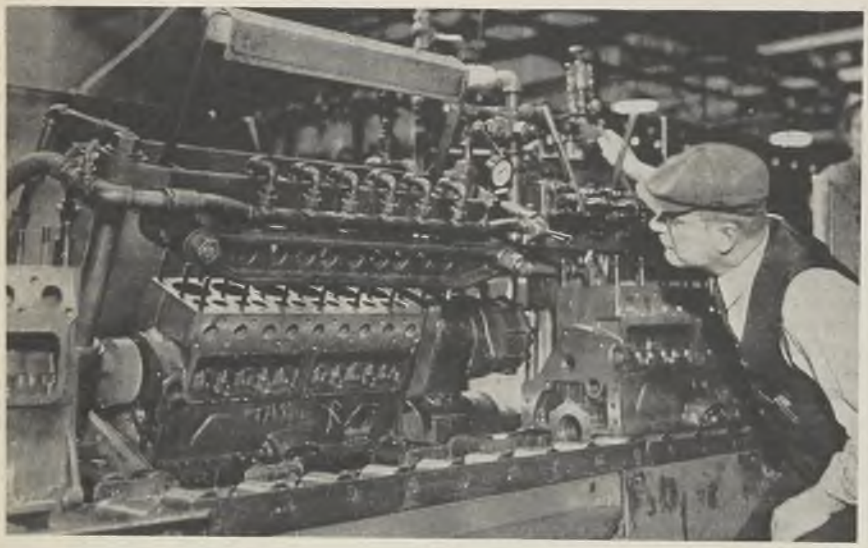
6. What to do about so-called common items of material and equipment, or material applying to several different contracts, not all necessarily terminated.

7. How to avoid interminable auditing of costs.

Insistence of the General Accounting Office upon the right to approve or reject termination settlements in abrogation of negotiated settlements arrived at with contracting officers posed a dilemma for industry, since the GAO indisputably holds the power to adjust and settle claims by virtue of an act of Congress; yet at the same time under the First War Power act and subsequent executive order, procurement officers also hold power to make, amend, modify and settle contracts.

A careful consideration of this apparent impasse by attorneys consulting with the automotive industry on the matter finally convinced them that contracting officers, in modifying contracts, were not actually making any settlements and therefore were not transgressing upon the power of the GAO. They recognized the review right of the latter agency when finally war contracts are completely terminated and not merely modified or scaled down.

Certainly all industry is going to have to familiarize itself with termination procedure, and will have to organize capable departments to handle this activity. In building up such organizations, the accompanying chart (page 250) of steps to be taken before and after contract terminations have been effected, by both prime and subcontractors, may prove to be helpful. It is reproduced by courtesy of Mr. Marks and the Automotive Council for War Production.



This cylinder block gets this special high-pressure water test at one inspection point on the engine line at a Plymouth plant, Detroit. Hydraulic apparatus drives water into the block at more than 10 times the pressure it ever gets in actual use. Then it tips the block to permit minute inspection to guard against foundry flaws or sand holes

Two years of new car drouth have imposed no serious burdens as yet on the nation's passenger car and truck resources. Registrations of both hit a peak in 1941 at 34,383,167, excluding half a million publicly owned and tax-exempt vehicles. This dropped 5 per cent to 34,582,242 in 1942, and a survey made by *Motor* as of Aug. 1, 1943, showed a further 3 per cent drop to something over 30 million vehicles. As of the first of this year, registrations probably will show a decline of 10-15 per cent from the 1941 high with the rate of car retirement accelerating steadily. Estimates have indicated at minimum essential total of 20,000,000 cars and trucks, so the country is still some distance from this low point.

Shortage of Mechanics and Parts

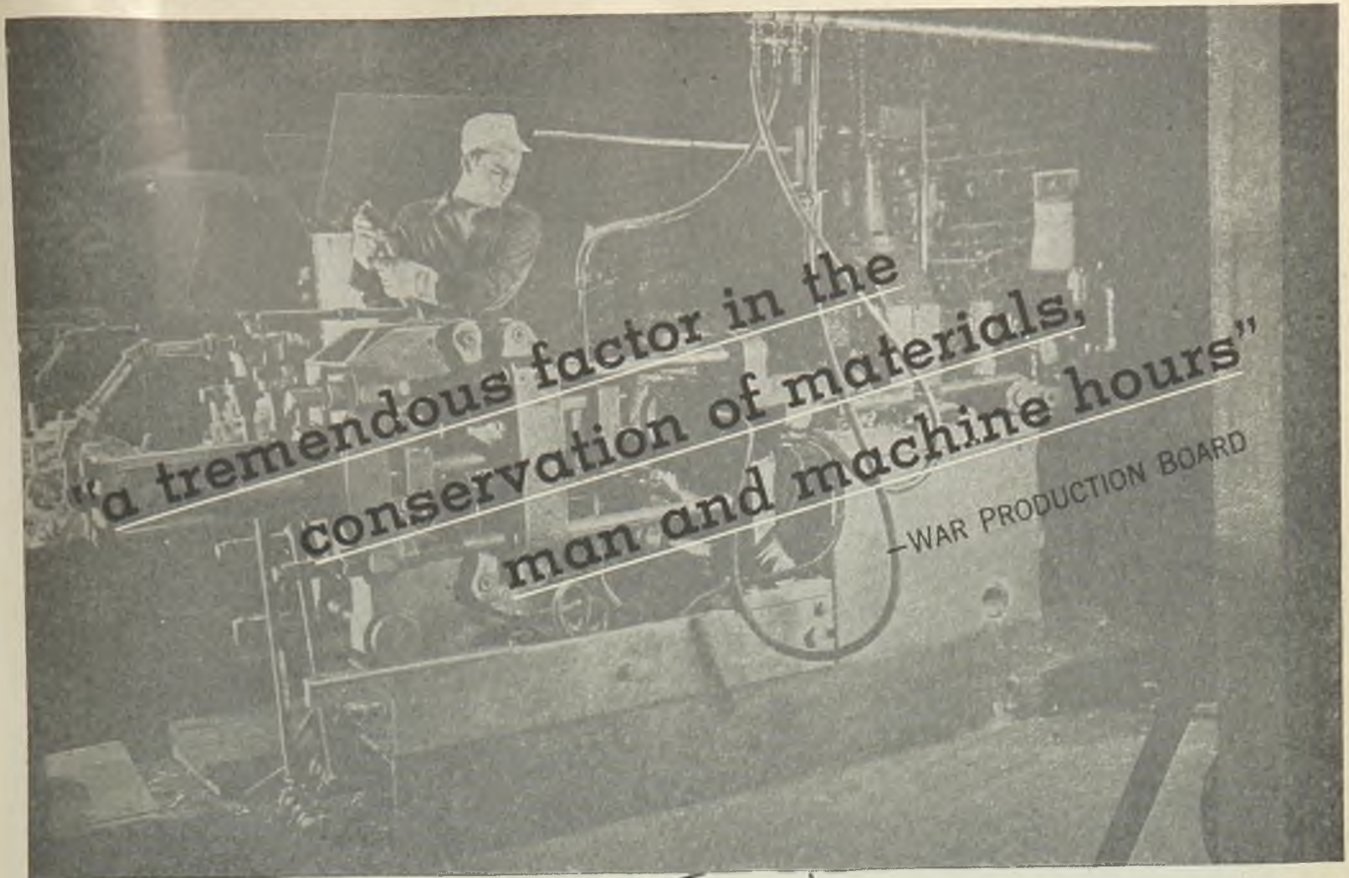
However, service demands of cars and trucks still in operation are mounting seriously. Service facilities are jammed everywhere, and the shortage of both mechanics and replacement parts makes the problem more acute.

To build up the nation's transportation reservoir to its previous level of better than 34 million vehicles and to forestall a snowballing rate of car scrapping, some whacking good car production years are in the offing. Leading producers have already drawn up their reconversion plans generally on the basis of production at a rate of 150 per cent of the peak level of 1941, which would mean an annual rate of 7,500,000 cars and trucks. Highest total ever achieved by the industry was in 1929 when United States and Canadian plants assembed 5,621,715.

More conservative estimates are looking for several years of production at a rate of something like 6,500,000, feeling that an immediate over-concentration on production might deplete the market too soon and lead to the early onset of another depression in car production.

It is a good gamble that 1944 will see some production of new cars, whether the war terminates or not. Look at it this way:

Already military production is falling off precipitately. This can lead to only one thing—unemployment—which is universally No. 1 on the list of things to be


"a tremendous factor in the
conservation of materials,
man and machine hours"
—WAR PRODUCTION BOARD

avoided in the industrial future of the United States. With the armed forces manned virtually to their ceilings, this unemployment can be disposed of in two ways—persuading women workers to retire to their homes, or reconverting some plants to civilian production. Civilian production requires essentially two things —machines and materials—granting that the manpower is available. For a major section of the machine industry, the war is already over and its facilities stand ready to supply the needs of reconversion. The materials picture, if not now, shortly will be so eased that surpluses of everything will become available. The only thing needed to compound these elements into resumption of automobile production is the willingness on the part of government and the WPB to face the situation realistically, even though the fighting fronts are still busy. There is nothing unpatriotic about making the maximum use of the industrial plant this country has created in the last three years; in fact it would be treasonable to allow the machines and men to be idle.

If these assumptions prove sound, then the immediate questions are: What of the postwar automobile? What of its materials? What of its design? What of its construction?

These matters were examined briefly in these pages one year ago, and the story today is essentially as it was then—3-6 months required for conversion of the plants to building a "reasonably exact facsimile" of the last of the 1942 models, perhaps without the conservations and substitutions which had been effected then; subsequent models to be based on "evolution rather than revolution"; iron and steel the basic materials, etc.

Presents Conclusions on Postwar Auto

STEEL examined the postwar automobile in somewhat more detail in its issues of April 12, 19, 26 and May 3, 1943, presenting a series of articles based entirely on this subject. Reprints of this series are available to anyone requesting them. The forecasts made at that time become the more interesting now inasmuch as they coincide to a major degree with the conclusions reached by a symposium of 81 leading engineers in the automotive and fuels industries, whose opinions were weighted and correlated by A. T. Colwell, vice president, Thompson Products Inc., Cleveland, in a paper presented before the Society of Automotive Engineers in that city in November. Summarized, these conclusions are as follows:

1. Only one fact is certain: Immediately after the war 1942 models will be built. By far-sighted policy, automobile companies have saved their dies and tools. Possibly the number of models will be curtailed. Production will start 4 to 6 months after receiving the go-ahead, and some production may be resumed before the European war ends. With Germany defeated, production may start quite heavily. It is likely that there will be large surpluses of material on hand which cannot all be used against Japan. The policy may be to move some government equipment out of plants and turn the usable surplus material to rapid conversion.

Predicts Gradual Changes

2. No new models will be on the market for at least 18 months, and then changes will be gradual, not radical. By its acceptance, the public will actually design the cars, as it always has.

3. Oil companies would like to market two grades of gasoline after the war—premium and regular. Over 1,500,000 farm tractors must be supplied, and a third grade must be available for them and for other equipment demanding it. The hope is that eventually two grades will satisfy all demands. Over 20,000,000 older cars on the road will need slightly higher-octane fuel.

4. Octane numbers will gradually increase in the future, as fast as engine development can use them. Any development to increase power without increasing detonation tendencies might affect the rate of increase of octane numbers.

5. Compression ratios will go upward. This will be forced by sales promotion, competitive conditions, and limited engineering gain. Even though the returns are diminishing, progress can and will be made. One important factor for higher compression is that at low load, where automobiles operate mostly, the economy gain is greatest. In the present state of the art, ratios above 8:1 are not foreseen for the immediate future. Gasoline must probably be rated for pre-ignition as well as knock, at higher ratios.

As ratios increase, straight-eight engines must adopt a more compact design to avoid excessive deflections in the engine structure. This may develop into types and shapes more difficult to manufacture and more costly per cubic inch of displacement, raising horsepower cost somewhat.

Designing for higher-octane domestic fuels which may not be available throughout the world would complicate the export situation.

6. The trend in future car design will stress economy rather than performance, but without a radical change in performance, medium size, and comfort, unless economic conditions force a lower-cost car to maintain volume production.

May Sacrifice Performance

7. The medium-sized car will aim at 25-30 miles per gallon, but may sacrifice some performance.

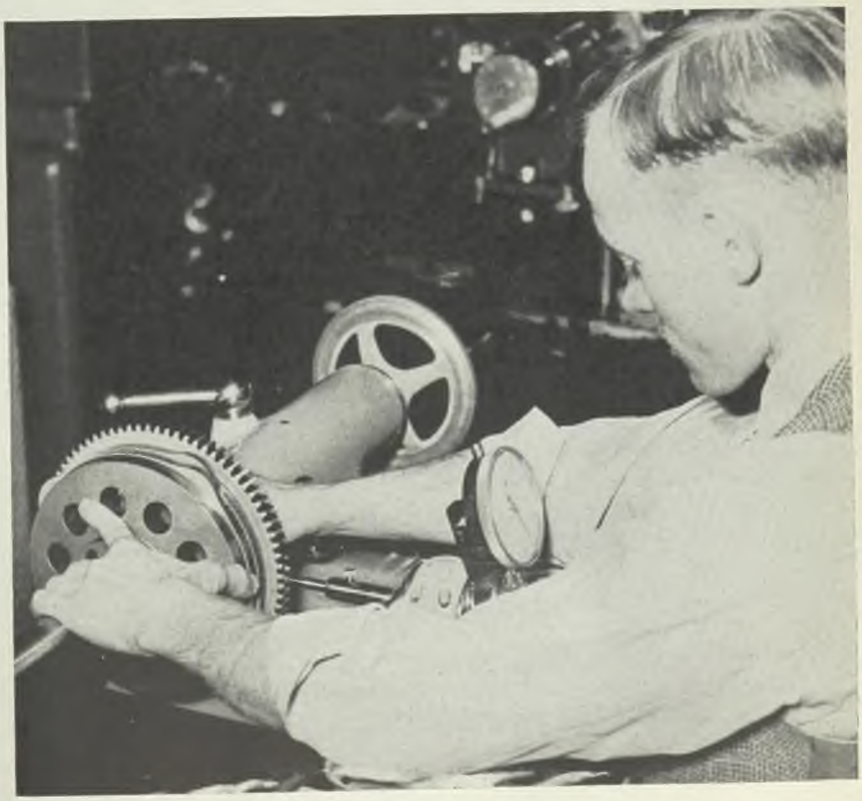
8. Cars will be lighter, light metals being used where cost permits, and parts engineered with the lightness trend.

9. The European-type, small car is not foreseen, but a smaller car with four-cylinder engine is likely to become more popular to meet certain economic conditions.

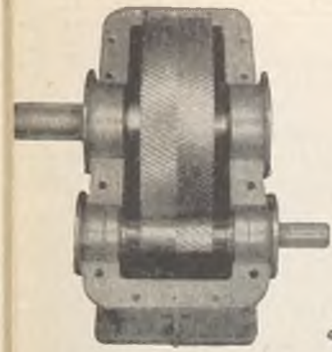
10. Some cars may be marketed in two models, one for performance, one for economy.

11. Engine size and displacement will not change much with present-weight cars. Engines will be lighter within economical limitations. Engine speeds will

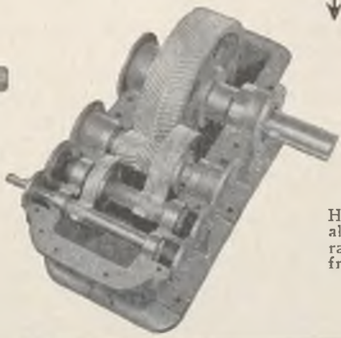
(*Please turn to Page* 250)



A Buick inspector checks the parallelism of gear teeth on a set of finished gears prior to assembly into the engine



Double and Triple Reduction Continuous-Tooth Herringbone Gear Reducer
(Triple reduction illustrated below)
With offset shaft. Available in 24 sizes in a ratio range of 10 to 350:1 and from .63 to 380 h.p.

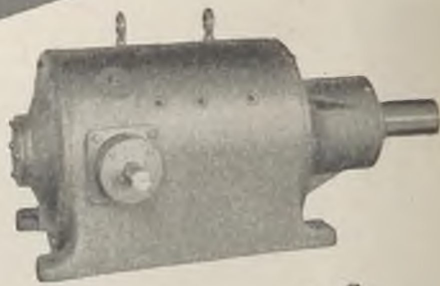


Single Reduction Continuous-Tooth Herringbone Gear Reducer
Available in 14 sizes, in a ratio range of 2 to 10:1, and from 1 to 1230 horsepower.

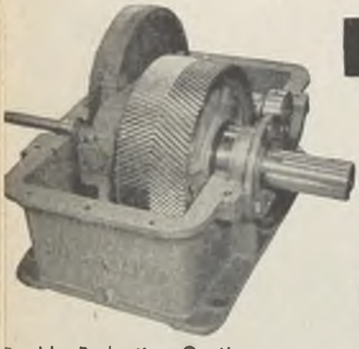
PLANETARY REDUCERS

Planetary Gear → Speed Reducer
Horizontal drive. Available in 35 sizes in a ratio range of 10 to 1200:1 and from ¾ to 75 horsepower.

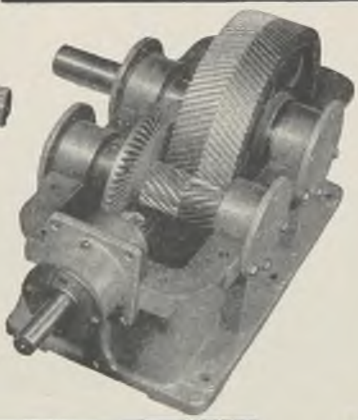
Right Angle Spiral Bevel Planetary Gear Speed Reducer
Horizontal drive. Available in 33 sizes in a ratio range of 8 to 1100:1 and from ½ to 75 horsepower.



HERRINGBONE REDUCERS



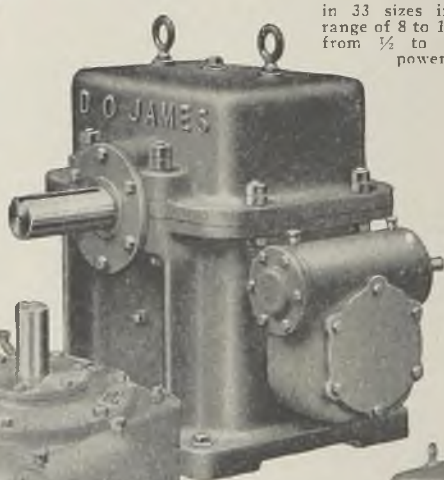
Double Reduction Continuous-Tooth Herringbone Gear Reducer
With straight-line drive. Available in 12 sizes in a ratio range of 10 to 75:1 and from 1 to 500 horsepower.



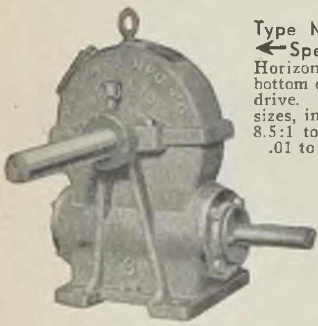
← Right Angle Spiral Bevel Herringbone Gear Reducer
Available in 11 sizes in a ratio range of 6 to 45:1 and from 1 to 250 horsepower. Horizontal and vertical drive. (Horizontal drive illustrated.)

Right Angle → Spiral Bevel Planetary Gear Speed Reducer
Vertical drive. Available in 33 sizes in a ratio range of 8 to 1100:1 and from ½ to 75 horsepower.

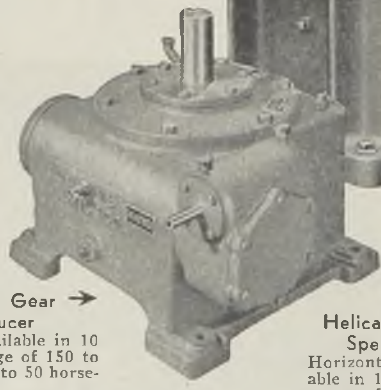
WORM GEAR REDUCERS



Double Worm Gear ← Speed Reducer
Horizontal drive. Available in 10 sizes in a ratio range of 150 to 8100:1 and from ⅛ to 50 horsepower.

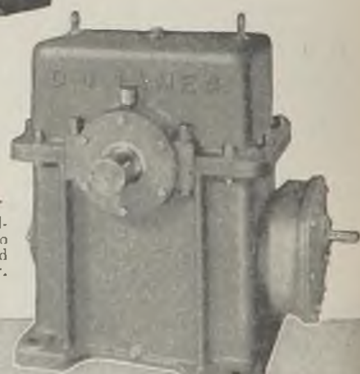


Type M Worm Gear ← Speed Reducer
Horizontal drive, worm bottom or top, or vertical drive. Available in 48 sizes, in a ratio range of 8.5:1 to 240:1 and from .01 to 42 horsepower.

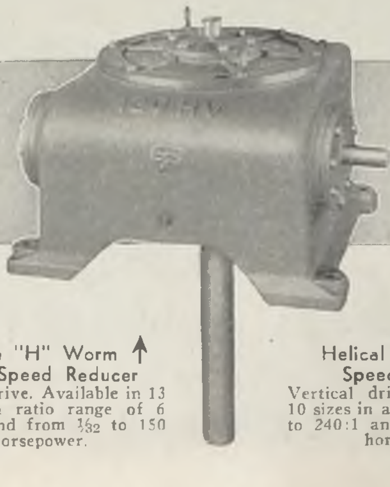


Double Worm Gear → Speed Reducer
Vertical drive. Available in 10 sizes in a ratio range of 150 to 8100:1 and from ⅛ to 50 horsepower.

Helical Worm Gear Speed Reducer →
Horizontal drive. Available in 10 sizes in a ratio range of 60 to 240:1 and from ¼ to 66 horsepower.



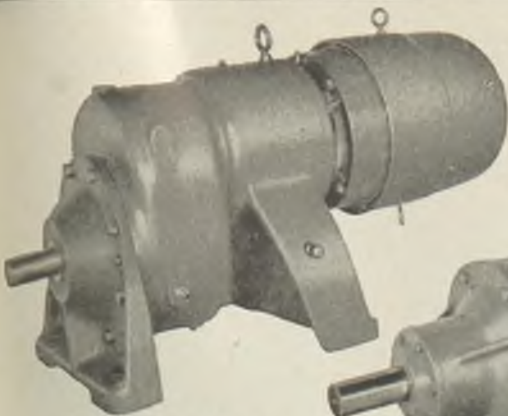
Type "H" Worm Gear Speed Reducer
Horizontal drive. Worm bottom or top. Available in 26 sizes in a ratio range of 6 to 65:1 and from 1/32 to 150 horsepower.



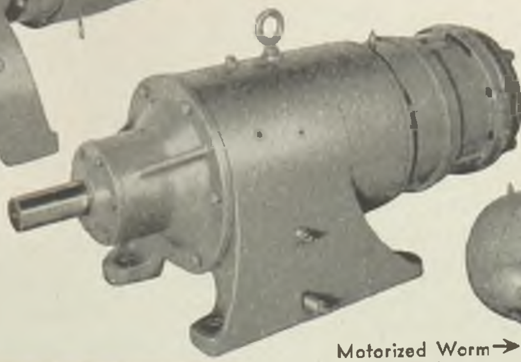
Type "H" Worm ↑ Gear Speed Reducer
Vertical drive. Available in 13 sizes in a ratio range of 6 to 65:1 and from 1/32 to 150 horsepower.

Helical Worm Gear → Speed Reducer
Vertical drive. Available in 10 sizes in a ratio range of 60 to 240:1 and from ¼ to 66 horsepower.

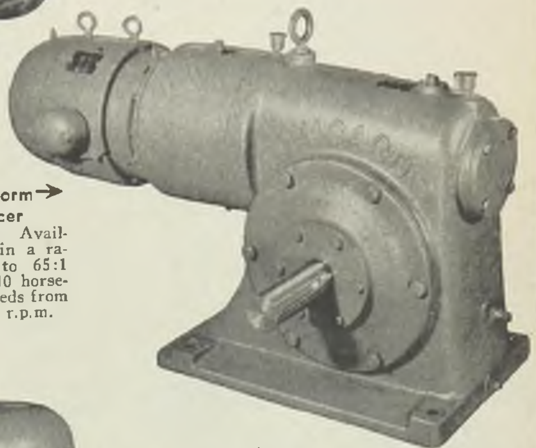
Your power saving requirements are capably handled by an organization making every type of gear reducer.



Motorized Helical Reducer
Horizontal drive. Available in 8 sizes in a ratio range of 1¼ to 9:1 and from ¾ to 50 horsepower. Driven speeds from 1458 r.p.m. to 128 r.p.m.

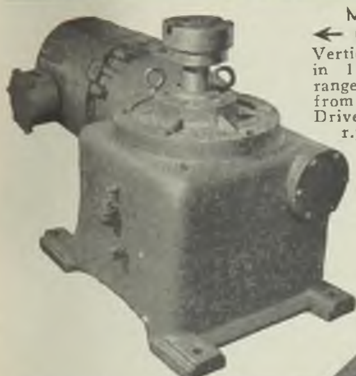


← **Motorized Planetary Reducer**
Horizontal drive. Available in 35 sizes in a ratio range of 10 to 1200:1 and from ¾ to 75 horsepower. Driven speeds from 172 r.p.m. to .74 r.p.m.



Motorized Worm Gear Reducer →
Horizontal drive. Available in 11 sizes in a ratio range of 6 to 65:1 and from ⅛ to 30 horsepower. Driven speeds from 310 r.p.m. to 25 r.p.m.

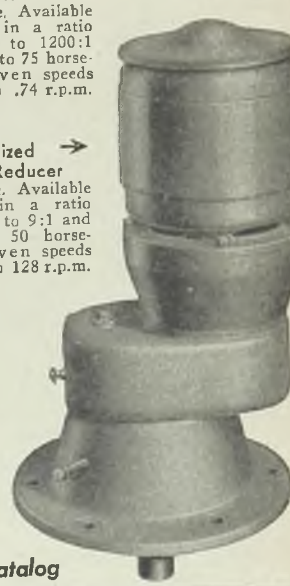
MOTORIZED REDUCERS



← **Motorized Worm Gear Reducer**
Vertical drive. Available in 11 sizes in a ratio range of 6 to 65:1 and from ⅛ to 30 horsepower. Driven speeds from 310 r.p.m. to 25 r.p.m.

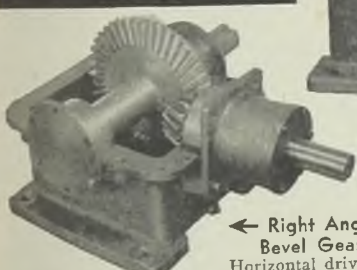
← **Right Angle Spiral Bevel Gear Reducer**
Vertical drive. Available in 14 sizes in a ratio range of 1:1 to 6:1 and from .3 to 275 horsepower.

← **Motorized Planetary Reducer**
Vertical drive. Available in 35 sizes in a ratio range of 10 to 1200:1 and from ¾ to 75 horsepower. Driven speeds 172 r.p.m. to .74 r.p.m.



Motorized Helical Reducer →
Vertical drive. Available in 8 sizes in a ratio range of 1¼ to 9:1 and from ¾ to 50 horsepower. Driven speeds 1458 r.p.m. to 128 r.p.m.

BEVEL GEAR REDUCERS



← **Right Angle Spiral Bevel Gear Reducer**
Horizontal drive. Available in 14 sizes in a ratio range of 1 to 6:1 and from .3 to 275 horsepower.

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(*Concluded from page 247*)
not be raised appreciably. Lighter cars will allow the use of smaller engines.

12. Automatic transmissions will receive great attention. Their use on any class of car will be governed by the question: "Does it pay?"

13. Supercharging will be used on heavy-duty vehicles but not on automobiles in the immediate future. New developments may alter this opinion, particularly if power and not economy should become the dominating factor.

14. Fuel injection will be used on some heavy-duty vehicles, but is not contemplated on passenger-car engines.

15. Pressure-cooling will be widely used.

16. The following engine-parts changes are predicted with higher compression:

Crankshaft—stiffer.

Bearings—improved, aircraft type; thin, soft-metal coatings plated on suitable backing material—will necessitate clean oil; possibly more bearings used, one between each cylinder.

Valves—better material, better cooled; sodium-filled on heavy duty, perhaps on some automobile engines.

Piston rings—big development needed; aircraft practice of chrome-plating likely.

Pistons—aluminum, designed for better cooling, controlled expansion.

Spark plugs—development needed to follow engine changes.

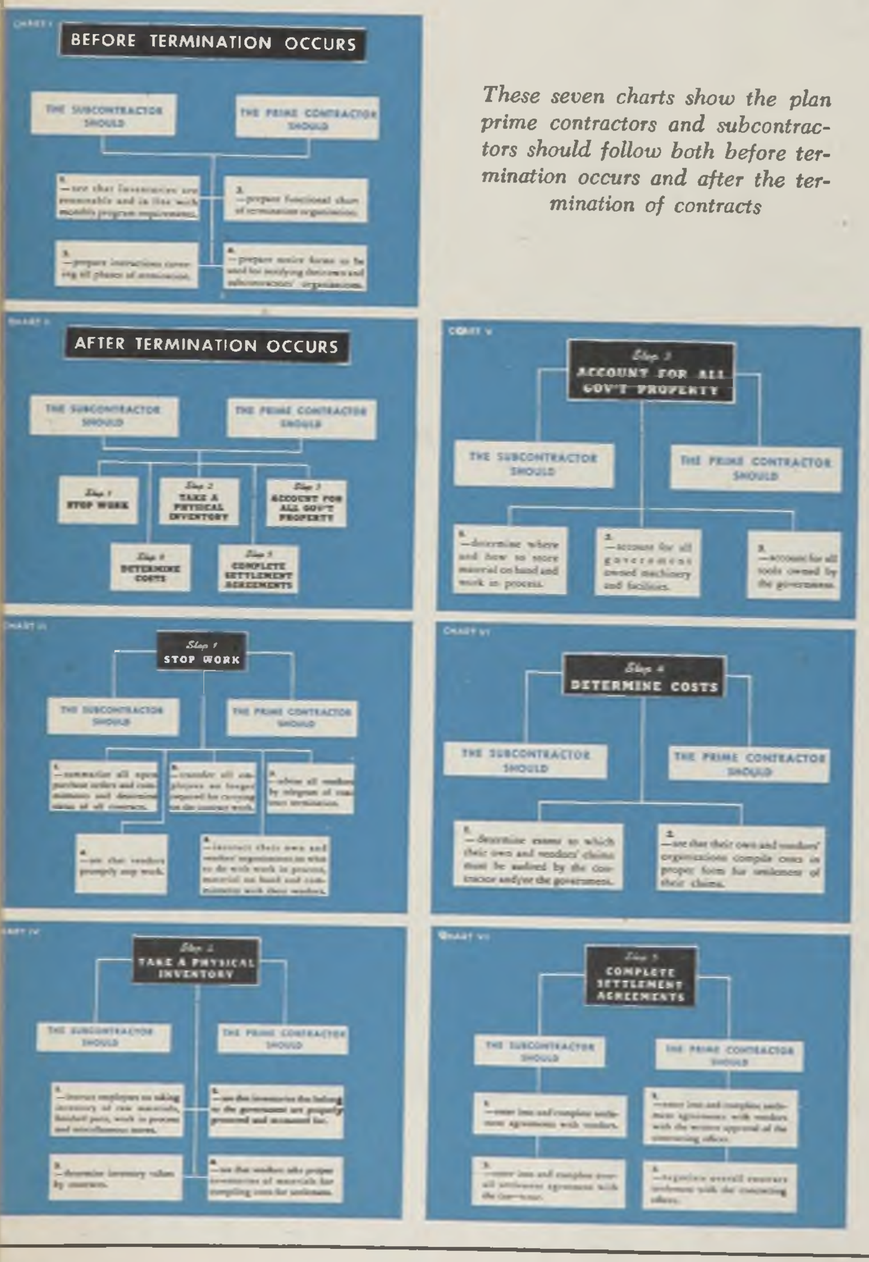
Fuel system—keep lines cooler, perhaps aircraft system of pressure on line to prevent vapor lock.

Combustion chamber—design to reduce tendency toward pre-ignition and roughness.

Higher compression pressures and temperatures will require improved lubricants with better characteristics, such as higher viscosity index, less sludging and oxidation, and more resistance to breaking down under the increased pressures and temperatures.

Engineers are optimistic over the possible future developments—they feel that some time will be required to swing from war work to car design and progress. This progress will be gradual and evolutionary, rather than by radical changes in design—the automobile industry has attained its stature by this method of evolution.

With an unlimited budget, most extraordinary cars could be produced, but engineers must strike a compromise on cost, performance, economy, comfort, size, long life and dependability, low maintenance and simplicity. The American automobile industry has been the most progressive in the world—no one doubts it will continue to be so.



These seven charts show the plan prime contractors and subcontractors should follow both before termination occurs and after the termination of contracts

Tandem "Jeeps" Allow Hauling of Heavy Guns

The pulling power of the four-wheel drive "jeep" has been increased 100 per cent by development of a "magic link" which enables two scout cars to pull four times the load previously hauled by one vehicle.

The new device, according to its designer, Delmar G. Roos, vice-president in charge of engineering for Willys-Overland Motors, "links two jeeps together back-to-front as a single pulling unit enabling them to haul artillery pieces weighing as much as 4000 pounds where the previous maximum load for a single scout car was 1000 pounds."

Owing to the small dimensions of the jeep, he points out, heavy guns can now be hauled into positions that were previously inaccessible because of the bulk of the prime movers required for their transportation.

A single jeep is designed to pull a load of approximately 1900 pounds, Roos explains. Linked together, two jeeps can pull a load normally moved by 2½ ton trucks.

The coupling device itself is engineered to get the maximum combined pulling strength from the two cars used.

In addition to serving as a prime mover, the jeeps, once the gun has been placed in position, can be unhitched and pressed into service as reconnaissance vehicles or ammunition carriers, according to Mr. Roos.

Road Builders' Meeting Consider Postwar Plans

The forty-first annual convention of the American Road Builders' Association will be held at the Edgewater Beach hotel, Chicago, Feb. 1-3. Three major problems to be discussed are: The present highway transportation crisis caused by highway material and manpower shortages; the association's postwar highway plan; and the postwar construction equipment problem. Heavy attendance is expected.

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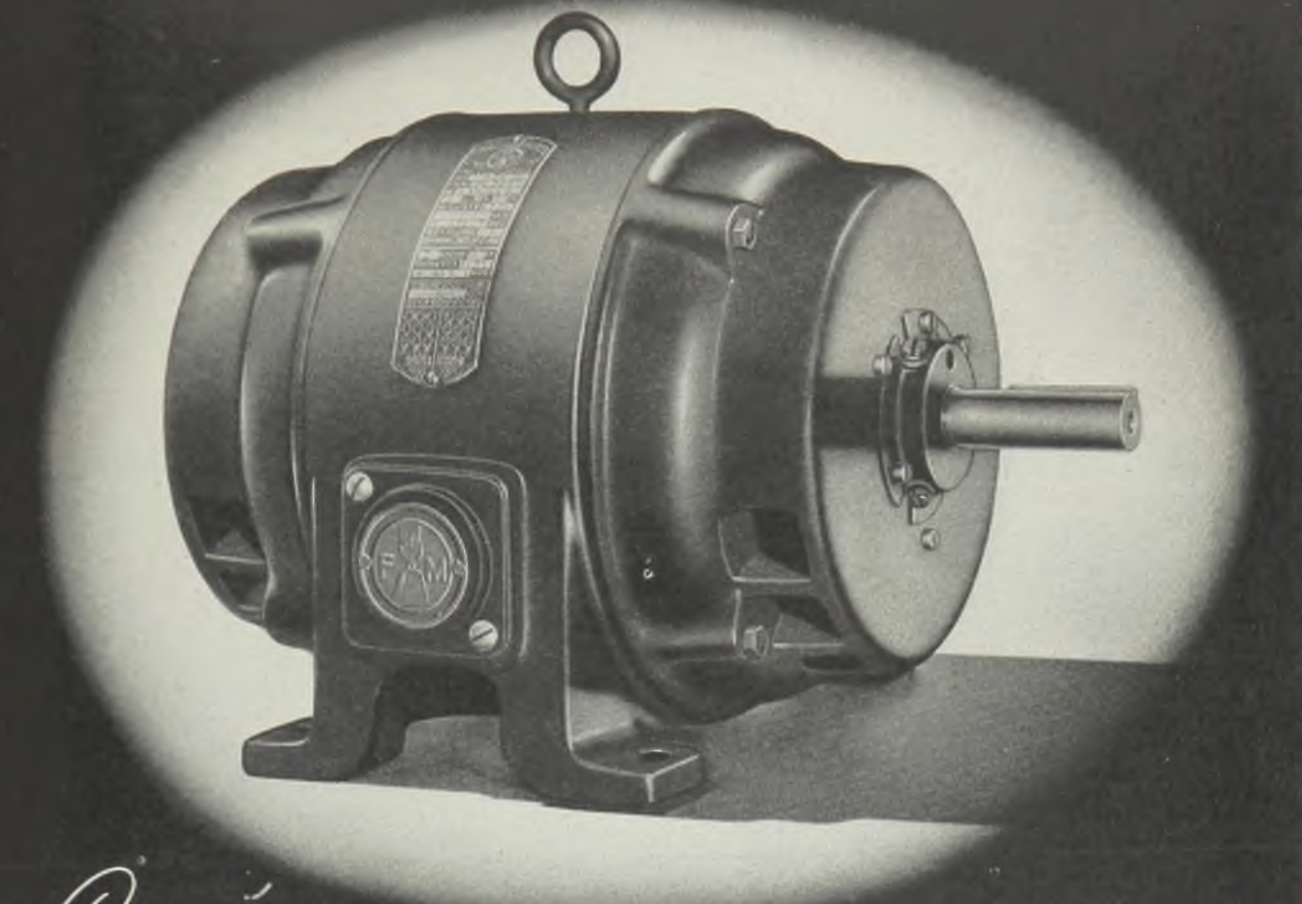

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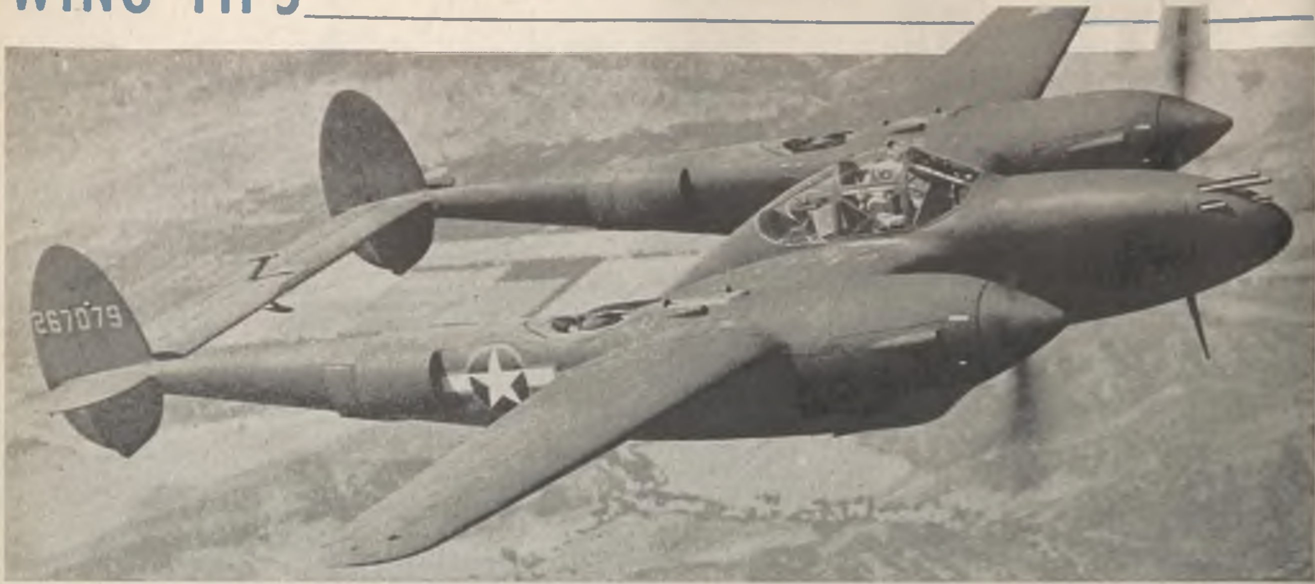


Monthly plane output now more than twice that in all of 1939. Important strides in production efficiency achieved in 1943 in face of progressively serious manpower problems. Postwar contraction to be severe

MIRACULOUS though the production accomplishment of the aviation industry appeared one year ago when looked at in retrospect, it was as nothing compared with the acceleration which war demands provided in 1943, when volume passed the 12 billion-dollar mark, or nearly triple the 1942 total, and unit output really hit the stratosphere at around 86,000 compared with 49,000 in 1942.

Considering that in 1939, total airplane production was only 3700, valued at $325,000,000, this record is without parallel in the history of any industry. In 1940, the industry built 12,000 units valued at $575,000,000; in 1941, the increase was to 19,800 airplanes, valued at $1,650,000,000; and in 1942 to 49,000 valued at $4,250,000,000. Dollar volume included engines, propellers and spare parts, as well as completed airplanes.

Even more significant than the enormous step-up in total numbers of planes over the past year was the steady increase in unit weights, reflecting the trend toward a greater proportion of heavy bombers. Monthly summaries show the following progress:

	Total	Av. Unit Wt., Pounds
January	5,000	NR
February	5,500	NR
March	6,201	NR
April	6,403	7,550
May	7,015	7,441
June	7,058	7,566
July	7,373	7,568
August	7,612	7,803
September	7,598	8,081
October	8,362	7,977
November	8,789	NR
December	9,000*	NR
	86,000*	7,712

*Estimated. NR—Not released.

Thus, the aircraft industry is now producing each month more than twice the number of planes built in the entire year of 1939, and with average unit weight perhaps twice the figure for five years ago. To do a job of this stature, there has been necessary the highest degree of subcontracting and mutual co-operation from all other branches of industry. The automotive industry alone, for example, estimates its share of aircraft production for 1943 will come close to 3½ billion dollars, representing nearly 40 per cent of its total war production. In the third quarter of 1943, aircraft production by the automotive industry amounted to approximately $952,600,000, or 2 1/3 times the volume for the same period of 1942.

Production Efficiency Increases

The aircraft manufacturers could not have achieved their present level of output except for important strides in the direction of production efficiency, in turn the result of job simplification, improvement in methods, exchange of information between companies, and a general "shakedown" in production work which at the start was unfamiliar and untested. The Aircraft War Production Council from its West Coast headquarters supplies some interesting figures on the progressive improvement in man-years of production required to build three different type of airplanes:

	B-24	P-38	B-25
1940	444	232	97
1941	70	37	26
1942	25	15	12
1943	17	11	11

Further figures, giving pounds of production per employe per year, also attest to improved production methods and better labor utilization—these for West Coast companies only:

1940	206 pounds
1941	343.5 pounds
1942	716.7 pounds

As of July, 1943, monthly production in terms of pounds per employe had risen to 86.8, the equivalent of an annual rate of 1041.6 pounds. This means that the average employe is now producing at a rate five times the 1940 level. Part of this improvement is due to the progressive increase in average unit weight of planes built, but the bulk of it accrues from improved efficiency.

It was fortunate for the West Coast companies (and the same thing holds true in greater or lesser degree for other producers) that production efficiency has been so stepped up. In December, 1940, they had 87,000 employes, one year later 177,000, and in December, 1942, 280,000. Then the curve flattened out. For the first seven months of last year, employment in Pacific Coast plants of prime aircraft contractors increased only 4.4 per cent, while in the latter part of this period some plants actually saw a contraction in employment.

Donald W. Douglas, president, Douglas Aircraft Co., said in September that a theoretical projection of the employment curve at his Santa Monica plant would show no employes by the end of 1944!

Labor turnover continues to be a headache at the large aircraft plants. In Southern California plants, for example, it was running last fall at a rate of 19,000 per month. They take with them time, effort and training at an average cost of $200 each, or a total monthly waste of close to $4,000,000. Most of those leaving their jobs are women who have been in aircraft work one year or less. The following analysis of August, 1943, quits in West Coast plants shows termination according to length of employment:

Left jobs within	Per Cent
15 days	8.2
One month	14.1
Two months	15.5
Three months	7.8
Six months	5.7
One year	1.9

In a study made of 100,000 employes who left their jobs, nearly half were forced to do so for personal reasons of one kind or another.

Hand-in-hand with turnover is the

Douglas Dauntless dive bombers, nemesis of enemy ships and submarines, line the edge of the flight deck of an escort carrier ready to take off on their relentless search for undersea raiders

problem of absenteeism or chronic lay-offs. No cureall has appeared for the trouble, but a study of 200 nonsupervisory production employes reflects the picture. Half of this group is classified as absentees, those who had been absent at least 15 days out of 132 regular working days in a six-month period. The other half is termed attendants, or those not absent once in the period studied. The two groups were matched for plant, sex, job, shift, seniority, etc. Here are the facts determined:

Chronic absenteeism is more prevalent among women than among men. Men comprise 77 per cent of all nonsupervisory production workers and only 68 per cent of all absentees. Women comprise 23 per cent of all nonsupervisory production workers and 32 per cent of the absentees.

Those with members of their family in armed service are 58 per cent of the absentees and 36 per cent of the attendants. Average age of absentees was 31; of attendants, 37. Losing weight during the test period were 32 per cent of the absentees, 3 per cent of the attendants. Reporting themselves tired when starting work were 27 per cent of the absentees and 12 per cent of the attendants.

The aircraft industry's manpower problem is not one of numbers of employes so much as it is one of types of employes, principally direct, productive employes. As pointed out by Dr. T. C. Coleman, vice president of Northrop, most applicants for jobs these days want to be executives, clerks or expediters. Generally speaking, the industry has its quota of indirect or nonproductive employes and is concentrating on direct workers. However, it does not look with favor upon the labor draft and hopes to obtain the necessary personnel by voluntary means.

One idea being examined is extending the procedure of "labor pooling" within plants, so that employes who may encounter a slack period of an hour or several hours in one department may be transferred to another department on a temporary basis.

Pressure on West Coast Continues

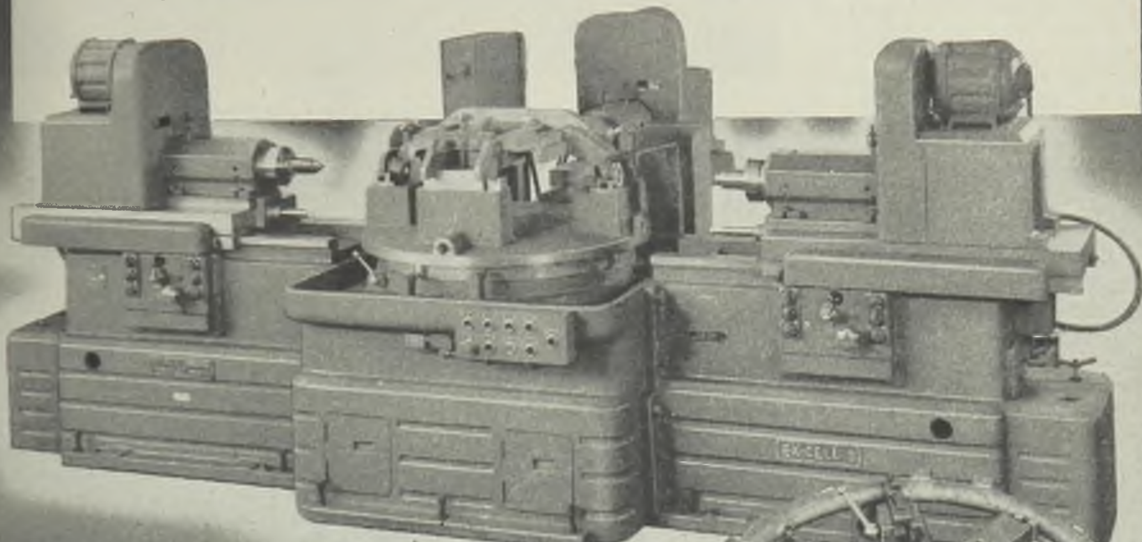
Certainly the manpower problem of the West Coast companies—Boeing, Douglas, Consolidated Vultee, Lockheed, Northrop, North American and Ryan—is not going to ease up much, even assuming an early end to the European phase of the war. Shifting of emphasis from the Atlantic to the Pacific coasts will make conditions even more acute than now. Docks, railroads, warehouses will be pressed to the breaking point to keep up the volume of shipments. More and more troops will pass through embarkation points. Housing will continue short. Transportation shortages through further gasoline restrictions will become worse. And in the face of all of this, the pressure on aircraft assembly plants will be unrelenting.

A word about the trend of military aircraft design and technical improvements. Until five years ago, extremely limited funds were available for aeronautical development in this country. When war appeared imminent, the call went out for an unprecedented number of all types of military planes then existent. Some then in operation were admittedly not on a par with the enemy's—a fact which made necessary an immediate engineering problem of redesign never before undertaken on such a large scale. In the fulfillment of this assignment, it was appreciated that every design would not prove successful. Extensive experimentation must precede the perfection of all high-performance aircraft.

The period of experimentation is now virtually at an end. The design cycle has reached the point where some models are being eliminated in order to concentrate on the production of the most successful types. The balance between design and production is now here, so that further development and improvement of combat aircraft will take place at a more nearly normal pace.

A major factor in improvement of American fighter planes, to quote an OWI report on military aircraft released in October, is the increased horsepower of the liquid-cooled Allison engine and the successful use of the Packard-built Rolls-Royce Merlin engine, coupled with the development of two-stage two-speed superchargers for light, single-seat fighters. In June, 1941, the V-1710 Allison passed the 150-hour Air Corps test with a rating of 1325 horsepower. Since then, there have been further refinements in this 12-cylinder liquid-cooled unit, and it now turns up power in the same bracket as the Merlin 61 and the new Daimler-Benz 605 (if not actually ahead of these two engines) which have been reported as about 1500-horsepower. The new 3420 engine is now in production, with 24 cylinders pushing out 3200 horsepower or more.

Constant improvement being made on models already in use, plus the addition of entirely new airplanes, naturally slow down the rate of production, but previously listed production figures do not appear to reflect any serious slowdowns on this score. At any rate, a power plant change recently made in a fighter model involved changes in tooling and con-



Preassembly of skin and stringers before positioning and fastening in the center wing section jig speeds up production time at the Willow Run plant. Workmen rivet the preassembled section after it has been lowered into position

sequent interruption of production with unavoidable loss of as many production hours as would have been consumed by the manufacture of 300 planes of the older model.

On the other hand, some models of planes have been allowed to progress too far in the production program before the discovery was made that they did not fulfill combat requirements. The Curtiss P-40 fighter plane, the only one of its type in production when the Japs struck at Pearl Harbor, now has reached the limit of its development possibilities, and this year will be produced only in limited quantities, for operational training and for replacement in specific theaters.

The Bell P-39 Airacobra fighter is being supplanted by a new model with low drag wing and a two-stage supercharged engine which will make it efficient at any altitude up to 40,000 feet. Like the P-39, the new plane will be equipped with cannon and machine guns. Incidentally, about half of the total production of P-39s has gone to Russia where the model has proved particularly effective as a ground-strafing tank-buster.

The North American P-51, originally a low and medium altitude fighter, now is fitted with a highly supercharged Packard Rolls-Royce which moves the ship up into the 400 miles-an-hour 40,000-foot ceiling class.

The hottest ship in the fighter class, once little more than a production man's headache, is the Lockheed P-38, which has distinguished itself on all fronts as a high-altitude fighter, long-range bomber escort, dive bomber, skip bomber, and photographic reconnaissance. Its production schedules in recent months have been expanded five-fold, with Consolidated Vultee plants at Nashville, Tenn., and Vultee Field, Calif., joining in the program.

In the medium bomber field, the North American B-25 is being joined by a new devastating attack bomber which is described by the Wright Field Materiel Command as "three or four years ahead of the Douglas A-20." The new model will be an all-purpose plane equipped with a powerful cannon and with interchangeable noses for various types of operations. The Martin B-26 medium bomber is being tapered off in line with the Air Forces policy of concentrating on fewer models. Changing demands of tactical operations also entered into the decision to use trained Martin personnel and factory space for production of the more urgently required bomber types.

One of the latter, about which fragmentary details have been released (it even made the Blondie radio program the other night) is the B-29, a Boeing design which is scheduled for entry into combat by spring and doubtless will take over the job of super long-range bombing hitherto the exclusive business of the B-24 Liberator and B-17 Flying Fortress. However, there will be no slackening of production of the latter types. Newest models of both are equipped with new defensive armament in the form of nose turrets with machine guns. External bombracks can increase the potential bomb capacity of the B-17 to 20,800 pounds; nevertheless this plane has a slightly smaller bomb capacity at long range than the B-24. The latter is the bomber being built by Ford Motor Co. at Willow Run, Mich., where the announcement was permitted Nov. 20 that over 1000 completed bombers had been flown from the plant, in addition to an appreciable number of "knockdown" shipments made to assembly plants in the Southwest.

Navy and Marine Planes

The preceding summary of military planes has been all army, and of course naval and marine aviation arms require their contingents of single and multi-engine craft, though perhaps not in the variety used by the AAF. Chief among the Navy patrol bombers are three flying boats and two land planes. The latter are the counterpart of the Consolidated B-24, known as the PB4Y and the Vega B-34, called the PV-1 by the Navy. Flying boats are the two-engine and four-engine Consolidated Catalina and Coronado and the Martin PBM Mariner. Little has been heard of the Consolidated P4Y or Corregidor model since the announcements early last year that it would be built at a New Orleans plant.

Navy fighters include the Grumman F4F Wildcat and F6F Hellcat, also the Vought F4U, F3A and FG1 Corsair. Navy dive bombers are led by the Douglas SBD models, torpedo bombers by the Grumman TBF Avenger.

In addition to the combat craft, there are scores of special purpose airplanes being built for the services, for reconnaissance, for scout-observation work, for cargo and troop transport, for hospital service, for various phases of pilot and crew training.

Looking to the future of the aircraft industry, it becomes immediately apparent that the day is not far off when today's billions dished out by the armed forces for aviation equipment will be no more. Already the Army has trimmed $2,086,069,000 from its airplane program by modifications and deferment. Proportional cuts may come from the Navy. Conservative officials of aircraft companies see at best a production level of perhaps 10 per cent of the present pace. That would mean about 8000-10,000 planes a year, with dollar value something like $1,500,000,000. Where does this leave the 100 prime contractors and their 26,000 suppliers and subcontractors, to say nothing of their 1,000,000-odd employes?

Well, there are two things to be done about it. One is for the principal producers to keep on building aircraft for the military and commercial airlines, scaling down operations to the volume of business possible. The other is to switch all or part of the aircraft plants to some other type of production which is in demand. The government, through the Defense Plant Corp. will have something to say about disposal of facilities. After all, it has a stake of $2,700,000,000 in the 534 war plants built for aircraft, engines and parts, which is ten times the private investment in the aircraft industry.

Let's take a look at some of the billions which are pouring into the industry's till. The Harvard School of Business Administration has made a study of 11 companies which in 1942 accounted for 75 per cent of total airplane business. Out of total sales of $2.91 billions these companies paid out as expenses (under cost-plus-

(*Please turn to Page* 260)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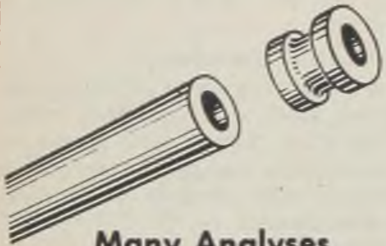

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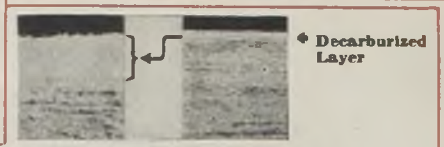
The Rockrite Process is adaptable to many grades and analyses of steel (and other metals) which are difficult or impossible to cold-draw to size. Beryllium alloys are readily handled, as are aluminum and alloys of aluminum and copper.

The Rockrite Process

Rockrite is a complete departure from the long used cold-drawing process of sizing tubes. It is the modern method wherein semi-circular, grooved dies rock back and forth over the tube compressing the metal against a mandrel which controls the inside diameter.



Decarburization

Decarburization in Rockrite Tubing is definitely minimized. It can be worked down to such a thin layer, by the tube-sizing operation, as to be negligible. In the Rockrite Process very large reductions in tube size and corresponding reductions in the decarburization thickness are not only possible, but practicable . . . and easily accomplished.

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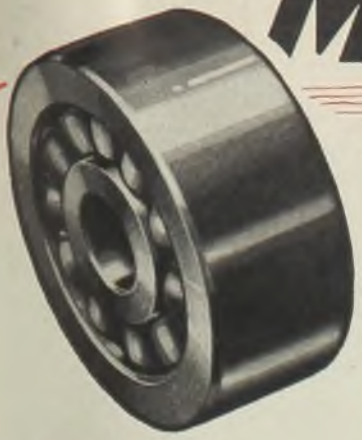

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Ball-bearing races are being machined 60 per cent faster from Rockrite SAE-52100 Seamless Steel Tubing than is possible from cold-drawn tube stock. Compared with bar stock, this increase is 90 per cent.

These records are possible because Rockrite tubing is more concentric, has less ovality and a better structure than has been considered possible in seamless steel tubing sized by other methods.

Rockrite tubing can be machined at higher speeds without boosting tool maintenance. It permits fast reaming to replace slow boring. In many cases the use of Rockrite tubing in six-spindle machines permits machining two pieces per cycle — with light even cuts that make practicable the use of form tools for surface turning.

Records such as these open up whole new fields for the use of tubing in the production of cylindrical or ring shaped parts. Rockrite tubing sets new standards of comparison between the relative costs of bar stock and tube stock for such uses. The new economies now possible make it imperative that old cost studies be reviewed and re-analyzed. The results may have a most profound effect upon post-war economies.

Inquiries from designers of post-war products are cordially invited and any information given us will be held in the strictest confidence.

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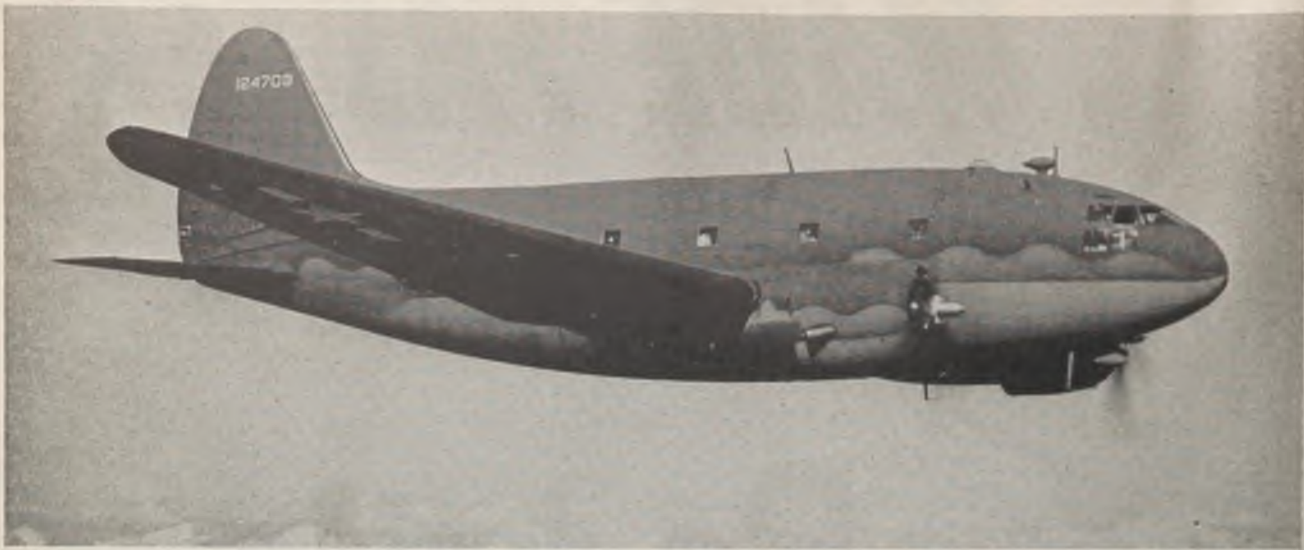


Giant Curtiss C-46 Commando, the largest twin-engined transport plane in the world, is shown in flight. It has a wing span of 108 feet and is powered by two 2000-horsepower engines

(Concluded from Page 256)

fixed-fee contracts) $2.611 billion, leaving a profit before taxes of $299 million. Renegotiation and taxes took $221 million leaving total profit of $78 million, or 2.7 per cent of sales.

What happens to these profits? Seventy-seven per cent went back into the business, against 23 per cent into dividends. This compares with the average of ten large industrial corporations outside the aircraft field, which returned 36 per cent of profits into the business, with 64 per cent in dividends. Even so, the aircraft conservatism on dividends has not preserved the working capital position of the industry, which in 1942 was only 28 per cent of company owned inventory, against 146 per cent for general industry.

Since so-called "profits" have been reinvested in inventories, the question arises, "What will happen to these inventories when the war ends?" Ralph S. Damon, until recently president of Republic Aviation Inc., and now head of American Airlines, has some interesting observations on this score:

"We are told the government probably will reacquire all the materials bought by us in furtherance of contracts placed with us by the government. But what does this mean? We have had to stockpile all kinds of airplane parts and materials in anticipation of further government orders. Otherwise, our total production would have been nowhere near its present level. Because of this, we had no alternative to exercising our judgment—as aircraft builders—in deciding what quantities to purchase of all sorts of materials, even though definite orders covering such inventory accumulations had not been placed. That is going on today. It must go on unless we want the aircraft builders to bog down.

"But what are we going to do with these inventories which are not covered by government contracts? There is no assurance the government will buy them back from us after the war when many sections of the public, quite rightly, will be demanding microscopic scrutiny of war contracts. Certainly there is no contractual obligation upon the government to do so.

"Then who will pay for them? To us they will be useless. They will not be adaptable to peacetime aviation. They have been produced, or are in process of production, to meet the needs of the military type of plane which is called upon to perform a very different function from that performed by the peacetime plane. We shall have no use for them and no place to sell them except in the scrap market. To us they will be merely that—plain scrap, a net loss.

Foresees Possible Net Loss

"What, then, of our wartime profits? It is possible that because of the eventual shrinkage in the value of our inventories, we shall come out of the war with a net loss.

"Some people imagine our inventories consist mainly of metal in the form of ingot and sheet. If that were the case we would have much less to worry about, although we would expect our metals to be of smaller value after the war than they are today. We might be able to absorb that sort of loss. It might not break us. But our inventories do not consist mainly of metals in crude form. Less than 20 per cent of our total inventory is of that type. The vast majority consists of semi-finished and finished parts which cannot be adapted to peacetime use. The gravity of the situation is, therefore, obvious.

"It is added to by what ought to have been a comforting factor. Much of our activity today still consists of cost-plus-fixed-fee work performed for the government. In this respect, we have no primary responsibility for the inventories. They belong to the government, and it is the government which finally is responsible for them.

"But we are in the position of custodians who, because of the immensity of the pressure of war work, have no clear picture of the amount of government-owned property in our hands. We cannot tell what proportion of our inventory is actually our own. Nor can we tell exactly how much of the government-owned property in our hands has properly been accounted for. For all we know, the government, at some date after the war, may call upon us to make good the value of deliveries of materials which, at some time in the past, have been partly manufactured in readiness for installation, only to be scrapped when plane designs were suddenly changed. Military necessity made such changes imperative and made it impossible for us to keep a perpetual inventory and a perpetual cost-accounting system. Hundreds of changes in designs took place, many of them on planes which were supposed to have been "frozen", and overnight we found ourselves having to scrap large quantities of government-owned property which, since then, have been lost in the shuffle.

"That is the price which has to be paid for all-out production on the scale required by our armed forces. But perhaps it is a price which we alone shall be called upon to pay—an imposition which we shall have to tolerate.

"We do not impute to any government department, or to any head or employe of a department, the wish or intention to burden us in this way. But the facts are that this danger does face us. We may be called upon to pay for materials which have been scrapped, or remelted, or have simply been lost in shuffle through no fault of ours.

"Such risks as these constitute part of our reconversion and postwar problems. They are factors likely to demand the pulling out of our pockets of large sums of ready cash—of ready cash which we simply do not possess today. We claim it to be self-evident that we should be allowed to use some of our alleged earnings to make provision to cover ourselves against such risks."

Industry at Grips with War and Reconversion Problems as Year Turns

INTENSIFIED output of planes, artillery, trucks, landing barges, and other war materiel; constant shifting in military requirements with its accompanying problem of maintaining a high level of employe morale; uncertainties over contract termination policies, and some shifts to civilian goods output highlight prospects for 1944.

In the year just ended, orderly production under control of skillful management attained such high output levels that 1943's war needs were in most cases adequately satisfied. Though the War Production Board's requirements for 1944 output are heavy, they probably can be filled through moderate intensifying of the production pace in force as the year terminated.

Increase in production for 1943, as shown by the Federal Reserve Board's production index below, closely paralleled that recorded in the preceding year. The average

monthly index figure for 1942 was 199, or 22.2 per cent over that of the previous year, compared with 237 for the first ten months of 1943, or 19.0 per cent above the 1942 average. October figure of 245, latest official figure available, represents a gain of 13.9 per cent over the comparable month of 1942. About 70 per cent of the nation's productive capacity was focused on war goods output during the year, balance being employed on essential civilian items.

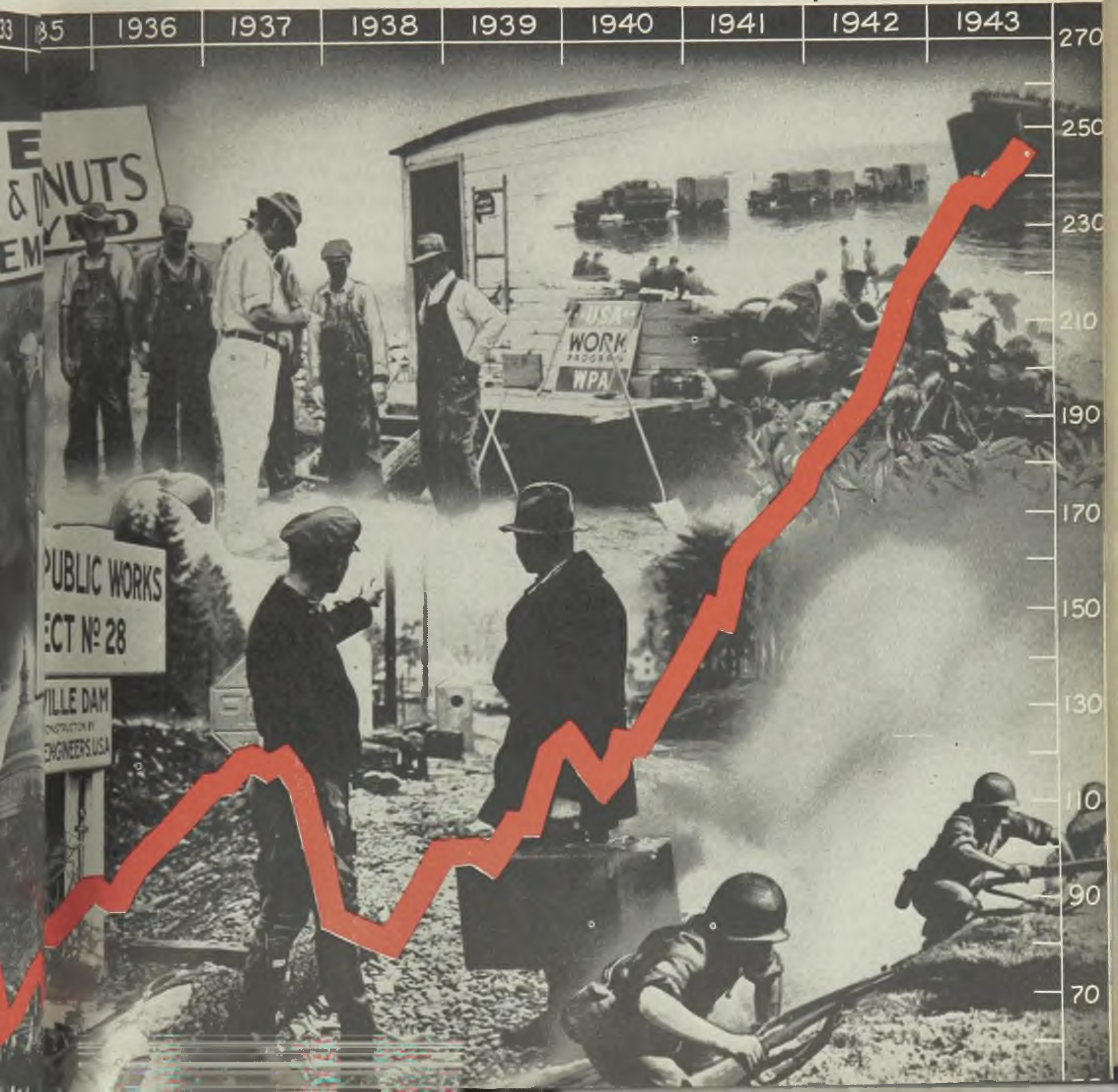
It seems clear the productive ceiling has been reached. Industry's main task is to maintain the present levels by sustaining employment and utilizing every appropriate program for avoidance of production slumps. Collapse of Germany would lessen demands for certain war materiel and probably alleviate the labor shortage.

War expenditures continued to rise throughout the past year. An all-time record was established by November expenditures, $7,794,000,000, compared with around $6,000,000,000 a month during 1942 and $153,000,000 just before the European war broke out.

Critical metals were increasingly available as 1943 drew to its close and will continue that trend. Supplies of alloy steels will be plentiful, with limited carbon steel stocks increasingly easy, and war needs for tin, lead, nickel, zinc, chrome, mercury, and tungsten should be adequately met. Tight copper supply will probably be eased during the year.

Production of steel in 1944 will continue at high levels, but the year's total may fall slightly below that of last year. Shifts in military requirements, and also the difficulties of getting some civilian goods production under way, may hamper production. Expectations are, however,

Production index by Federal Reserve Board



that several years of heavy steel output are in prospect based upon the demand which has accumulated for civilian goods.

Industrial production is expected to continue climbing moderately, with likelihood that the collapse of Germany will mark its peak.

Manpower demands for 1944 will be heavy for both industry and the armed services. Close to a hundred cities are still experiencing fairly serious labor shortages. Closing of ordnance plants, and steady flow of returned servicemen into industry's ranks, have helped prevent a more critical labor drought, and current indications suggest that the manpower shortage will continue to lessen as we go farther into 1944.

Transportation shows promise of becoming the year's most serious industrial problem. Railroads, trucks, busses, and passenger automobiles are all definitely showing the heavy war load strain with little servicing and parts replacement. Most tragic evidence of this overstraining of the transportation system was the continuing series of main-line railroad wrecks which began last summer, but each transportation group has suffered similarly as full service was exacted without adequate maintenance and replacement.

It is hoped the 1944 civilian truck output program will do much to avert serious breakdown in highway freight transportation. Priorities for new freight cars, locomotives, and replacement equipment promise gradual improvement in the railroad situation, although the lines will need all available assistance under the increasingly heavy pressure anticipated.

This year's construction volume is expected to total about $3,860,000,000, which is 51 per cent of the construction put in place during 1943, and 29 per cent of the volume for 1942. The past year's amount of construction showed an almost unbroken downward trend.

Output of electric power can be relied on to set new records in the coming year as it did in 1943. Since January of 1941 electric power production has established a steadily climbing trend line which seemingly has no altitude ceiling.

Production "know-how," which served to increase workers' individual productivity in the period last year when labor shortages were so critical, continues to be an invaluable factor in the war output picture. That built-up knowledge of processes and materials will likewise serve industry effectively on the production problems to be confronted in 1944.

Predictions of industrial trends in the new year must all center upon the dominant question: When will Germany crack? Certainly there will be plenty of tough problems for industrial management to solve. But, despite the uncertainties confronted by management through failure of the government to establish firm, practical policies on contract termination and other vital problems, higher output levels will continue to be achieved until military victory is won. Industry is putting its house in order as best it can under difficult circumstances for the day when reconversion from war to peace will present critical new problems.

CHARTS
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Federal Reserve Board's Production Index

(1935-39 average = 100)

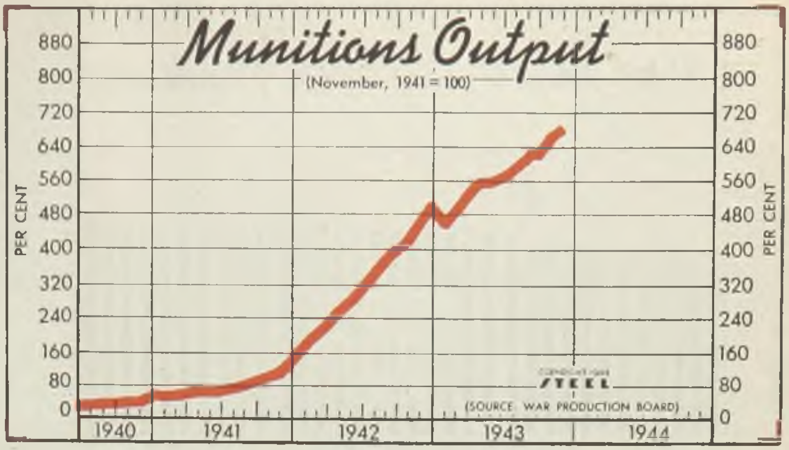
	1943	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926
Jan.	227	181	143	122	101	85	116	94	83	72	58	64	78	100	108	94	96	93
Feb.	232	183	147	117	101	84	118	92	85	75	57	63	79	100	108	95	97	93
Mar.	235	186	152	114	101	84	120	93	84	79	54	62	80	98	108	96	99	95
Apr.	237	189	149	114	98	82	120	98	82	79	58	58	80	98	110	95	96	94
May	238	191	160	118	99	81	121	100	83	80	68	56	80	96	112	97	97	94
June	236	193	164	123	103	81	119	103	84	79	78	54	77	93	113	98	96	95
July	239	197	166	123	106	86	120	104	84	73	85	53	76	89	114	99	95	95
Aug.	242	204	167	126	106	90	119	106	87	72	82	54	73	86	114	101	95	96
Sept.	243	208	169	129	115	93	115	108	89	70	77	58	70	85	112	101	94	98
Oct.	245	215	172	132	122	96	107	110	92	71	73	60	68	83	110	103	92	98
Nov.	...	220	174	136	124	100	96	113	94	72	69	59	67	81	105	105	92	97
Dec.	...	223	176	140	124	101	87	116	95	77	70	58	66	79	100	107	93	97
Avg.	...	199	162	123	108	89	113	103	87	75	69	58	75	91	110	99	95	96

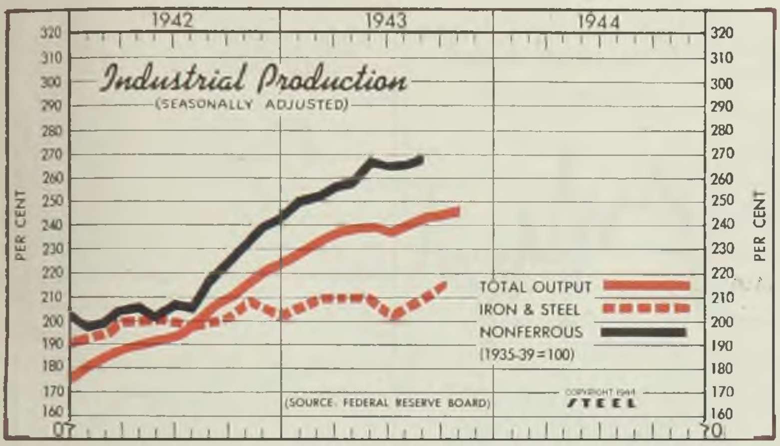
Munitions Index

(November 1941 = 100)

	1940	1941	1942	1943
Jan.	..	41	166	452
Feb.	..	45	182	477
Mar.	..	52	213	519
Apr.	..	60	247	549
May	..	57	276	547
June	..	59	309	560
July	23	64	339	587
Aug.	22	72	372	610
Sept.	22	83	387	619
Oct.	27	91	403	647
Nov.	34	100	448	665
Dec.	50	133	497	...

Figures for 1943 have been revised.

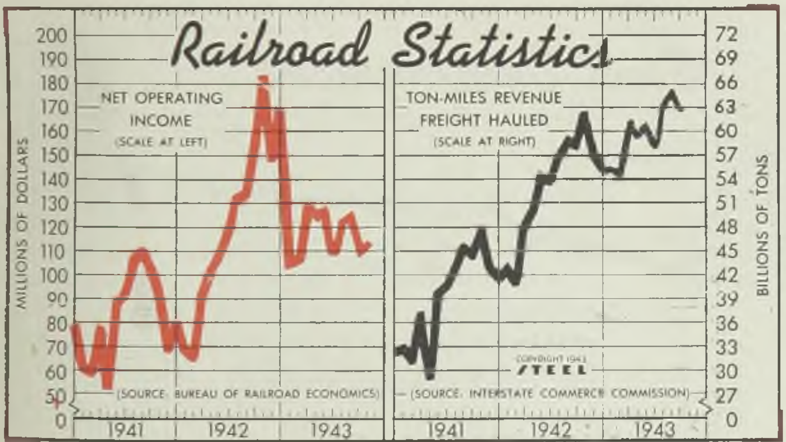




Federal Reserve Board's Production Indices

(1935-1939 = 100)

	Total Production 1943	Total Production 1942	Iron, Steel 1943	Iron, Steel 1942	Nonferrous 1943	Nonferrous 1942
Jan.	227	181	204	192	250	197
Feb.	232	183	208	194	252	199
Mar.	235	186	210	200	256	204
Apr.	237	189	209	199	257	205
May	238	191	208	200	266	200
June	236	193	201	198	264	206
July	239	197	203	196	264	205
Aug.	242	204	209	197	267	216
Sept.	243	208	213	199	284	223
Oct.	245	215	214	207	...	230
Nov.	...	220	...	204	...	239
Dec.	...	223	...	200	...	242
Avg.	...	199	...	199	...	214

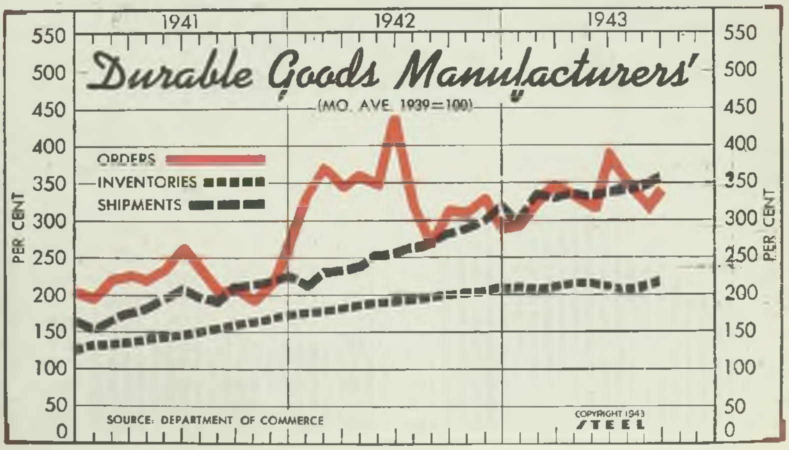


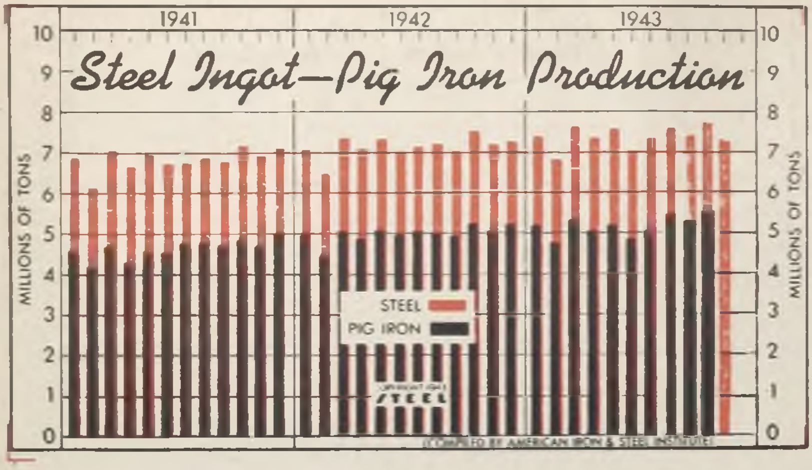
Statistics of Class I Railroads

	Net Operating Income 1943	1942	1941	Ton-Miles Revenue Freight 1943	1942	1941
	(millions)			(billions)		
Jan.	$105.3	$66.8	$62.0	55.1	43.0	32.9
Feb.	106.1	64.4	58.5	54.4	40.8	31.1
Mar.	129.6	90.6	80.6	61.2	48.3	37.2
Apr.	127.1	101.6	52.6	59.1	50.0	29.0
May	128.2	109.7	88.6	62.1	54.2	39.7
June	109.7	118.7	93.3	58.0	53.9	40.7
July	120.6	133.6	106.3	63.7	57.0	42.8
Aug.	124.6	135.9	111.3	65.1	58.6	45.5
Sept.	110.2	154.6	104.4	62.5	58.2	44.3
Oct.	113.1	184.7	94.1	....	62.2	47.7
Nov.	.....	148.9	68.9	....	57.0	42.6
Dec.	.....	170.9	79.3	....	55.0	41.3
Avg.	.....	$122.9	$83.3	....	53.2	39.6

Manufacturers Durable Goods

	Orders 1943	Orders 1942	Shipments 1943	Shipments 1942	Inventories 1943	Inventories 1942
Jan.	293.5	333.9	298	214	211.3	179.2
Feb.	326.6	373.4	337	232	209.6	180.8
Mar.	349.2	344.4	330	235	210.7	183.4
Apr.	329.8	362.1	338	239	213.5	186.6
May	313.0	348.4	338	254	213.5	190.2
June	392.7	439.5	343	256	211.8	193.2
July	338.7	321.8	346	264	211.4	195.8
Aug.	325.0	269.4	348	270	213.3	198.0
Sept.	341.1	314.5	356	283	214.7	200.9
Oct.	.....	312.1	...	289	.....	204.1
Nov.	.....	334.7	...	300	.....	207.7
Dec.	.....	291.1	...	320	.....	210.1
Ave.	.....	337.1	...	263	.....	194.2





Iron, Steel Production

(Net tons—000 omitted)

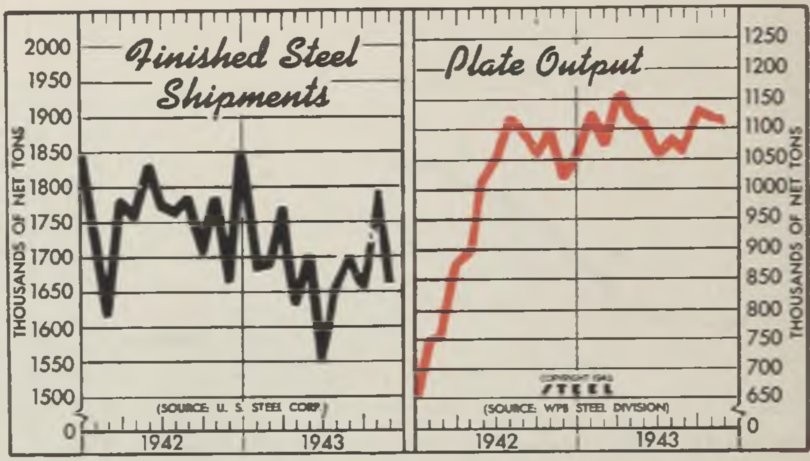
	Steel Ingots 1943	Steel Ingots 1942	Pig Iron 1943	Pig Iron 1942
Jan.	7,424	7,112	5,194	4,983
Feb.	6,826	6,513	4,766	4,500
Mar.	7,670	7,392	5,314	5,055
Apr.	7,374	7,121	5,035	4,896
May	7,545	7,383	5,173	5,073
June	7,027	7,015	4,836	4,935
July	7,376	7,145	5,023	5,051
Aug.	7,562	7,228	5,316	5,009
Sept.	7,489	7,058	5,226	4,937
Oct.	7,786	7,580	5,324	5,236
Nov.	7,357	7,180	....	5,083
Dec.	....	7,305	....	5,201
Total	..	86,030	....	59,959

Steel Shipments†—Plate Production‡

(Unit 1000 Net Tons)

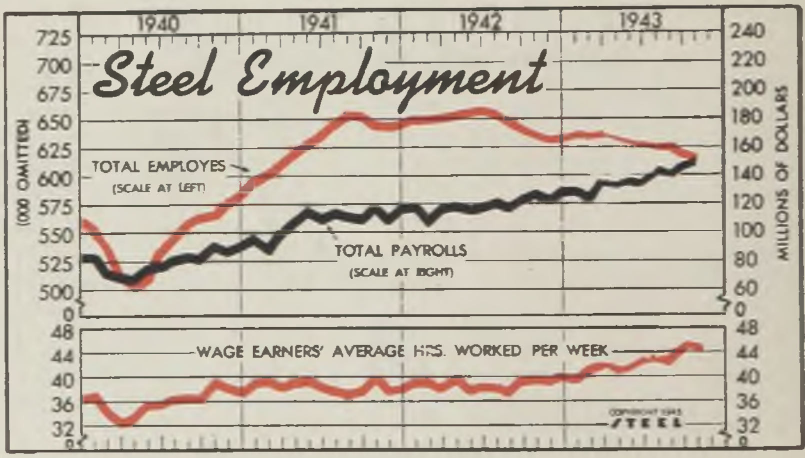
	Shipments 1943	Shipments 1942	Plate Output 1943	Plate Output 1942
Jan.	1685.9	1738.9	1135.4	754.8
Feb.	1691.6	1616.6	1072.0	758.7
Mar.	1772.4	1780.9	1167.7	878.7
Apr.	1630.8	1758.9	1121.0	895.9
May	1706.5	1834.1	1114.9	1012.2
June	1552.7	1774.1	1069.3	1050.9
July	1661.0	1765.7	1089.0	1124.1
Aug.	1704.5	1788.6	1061.0	1097.9
Sept.	1664.6	1703.6	1161.0	1061.8
Oct.	1794.9	1787.5	1147.1	1101.4
Nov.	1660.5	1665.5	1141.1	1013.0
Dec.	.	1849.6	..	1060.0
Total	......	21,064.2	....	11,809.7

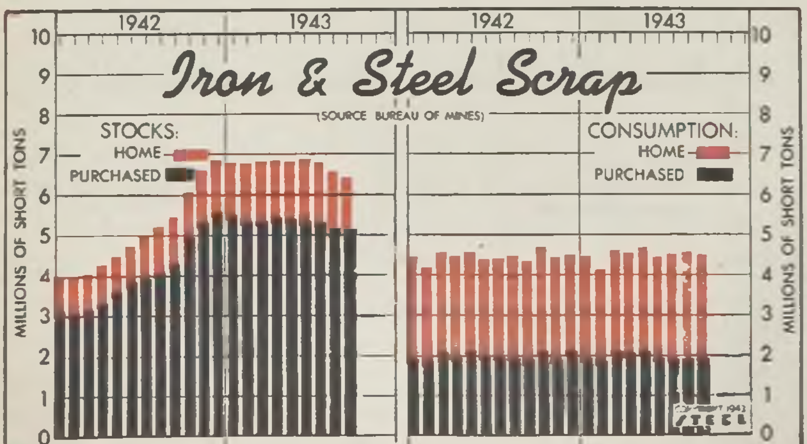
†U. S. Steel Corp. ‡War Production Board.



Steel Employment

	Employes—Number (000 omitted) 1943	Employes—Number (000 omitted) 1942	Total Payrolls (Unit—$1,000,000) 1943	Total Payrolls (Unit—$1,000,000) 1942
Jan.	637	651	129.7	118.8
Feb.	635	651	122.8	106.5
Mar.	637	653	136.5	117.0
Apr.	634	654	136.3	118.5
May	632	656	137.4	117.4
June	631	659	138.2	118.0
July	627	655	142.8	120.7
Aug.	625	647	139.9	118.7
Sept.	620	641	143.8	124.8
Oct.	615	635	144.9	126.6
Nov.		632	.	122.8
Dec.		633		129.3





Iron and Steel Scrap

Bureau of Mines

(Gross Tons—000 omitted)

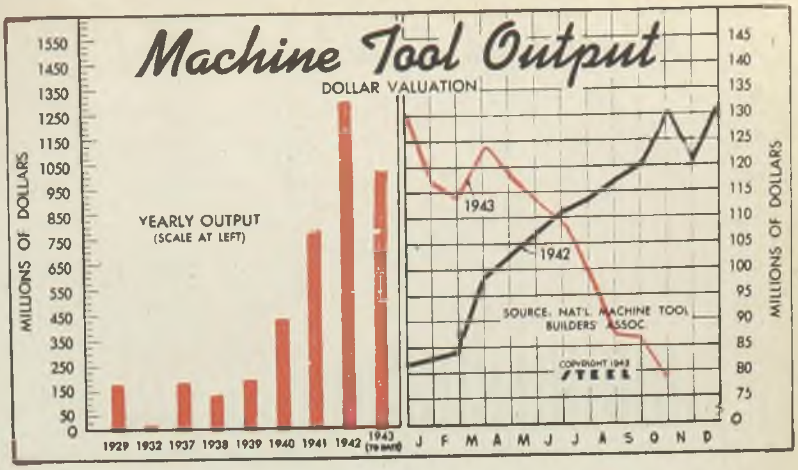
	Consumers' Stocks 1943	Consumers' Stocks 1942	Total Consumption 1943	Total Consumption 1942
Jan.	6.877	4,100	4,492	4,425
Feb.	6.871	4,073	4,178	4.204
Mar.	6.850	4,101	4.787	4.661
Apr.	6.918	4,324	4,642	4.603
May	6.905	4.602	4,723	4,665
June	6.916	4.859	4,493	4,464
July	6.860	5 087	4.670	4.470
Aug.	6,778	5.279	4,686	4,478
Sept.	6,613	5.545	4,657	4.424
Oct.	....	6.260	....	4,770
Nov.	....	6,742	....	4.401
Dec.	....	6,930	....	4,497
Total	....	61,902	....	54,062

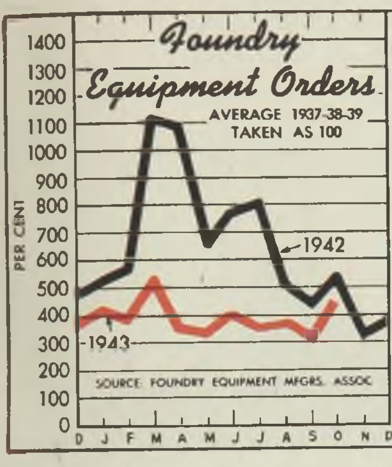
Machine Tool Output

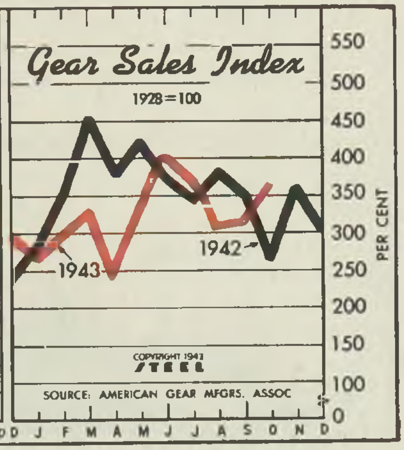
(000 omitted)

	1943	1942	1941
Jan.	$117,384	$83,547	$50,700
Feb.	114,593	84,432	54,000
Mar.	125,445	98,358	57,400
Apr.	118,031	103,364	60,300
May	113,710	107,297	60,800
June	108,689	111,090	69,070
July	97,428	113,596	63,019
Aug.	87,405	117,342	70,069
Sept.	85,842	119,883	74,906
Oct.	78,300	130,008	84,178
Nov.	.	120,871	81,320
Dec.	.	131,960	81,435

Year	
1942	1,321,862
1941	812,462
1940	450,000
1939	210,000

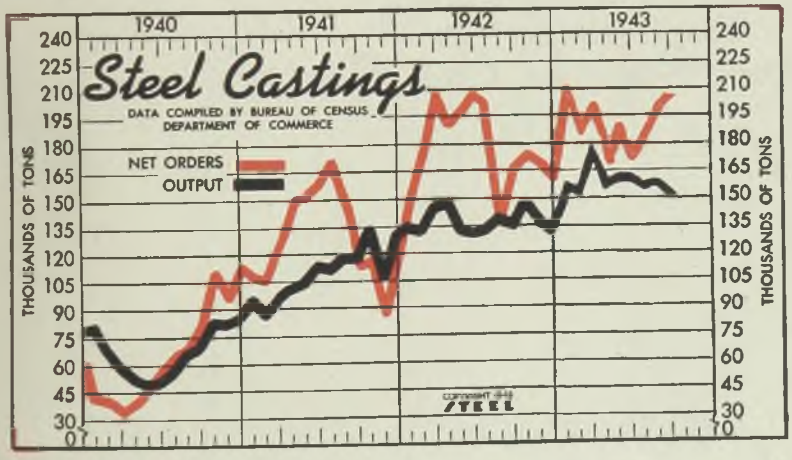






Foundry Equipment and Gear Sales

	Monthly Average (1937-38-39=100)		Index (1928=100)	
	1943	1942	1943	1942
Jan.	429.8	532.7	268	288
Feb.	399.5	567.9	303	353
Mar.	562.7	1122.4	334	455
Apr.	362.7	1089.3	240	378
May	348.9	653.6	342	421
June	413.6	774.0	401	373
July	379.4	800.8	374	344
Aug.	390.4	510.8	312	380
Sept.	346.6	446.4	320	351
Oct.	436.6	540.6	368	263
Nov.	.	338.8		359
Dec.	.	382.5		300
Average	....	646.7		355



Commercial Steel Castings

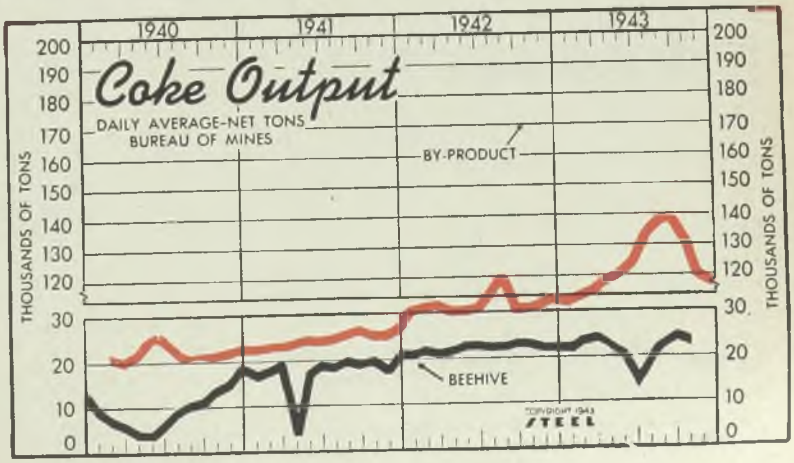
(Net tons in thousands)

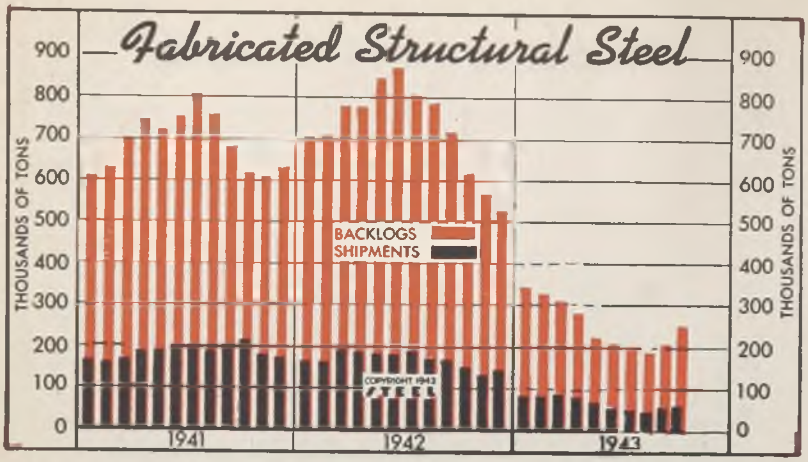
	Orders		Production	
	1943	1942	1943	1942
Jan.	213.1	150.5	154.7	134.8
Feb.	191.2	179.9	151.5	133.7
Mar.	202.7	211.1	176.5	146.5
Apr.	165.8	191.2	161.4	149.6
May	192.5	199.6	163.8	131.5
June	171.7	208.9	163.9	132.0
July	187.2	202.3	158.7	135.7
Aug.	200.6	141.2	158.8	139.2
Sept.	208.5	177.5	153.3	139.8
Oct.	....	179.5	....	152.1
Nov.	....	173.8	....	140.4
Dec.	....	172.3	....	143.9
Total	....	2,187.3	....	1,679.2

Coke Output
Bureau of Mines

(Daily average—Net tons)

	By-Product		Beehive	
	1943	1942	1943	1942
Jan.	174,044	168,508	21,440	20,874
Feb.	175,107	168,414	23,991	21,771
Mar.	175,051	167,733	24,369	21,032
Apr.	175,857	168,960	22,932	21,843
May	174,240	170,187	21,270	22,571
June	168,735	170,593	14,055	22,487
July	169,936	170,400	20,009	22,300
Aug.	176,396	171,443	23,102	22,333
Sept.	178,090	172,110	23,637	23,106
Oct.	175,492	172,211	23,495	23,148
Nov.	..	173,029	......	22,106
Dec.	....	173,163	......	22,000
Average	....	170,549	......	22,122





Fabricated Structural Steel

(1000 tons)

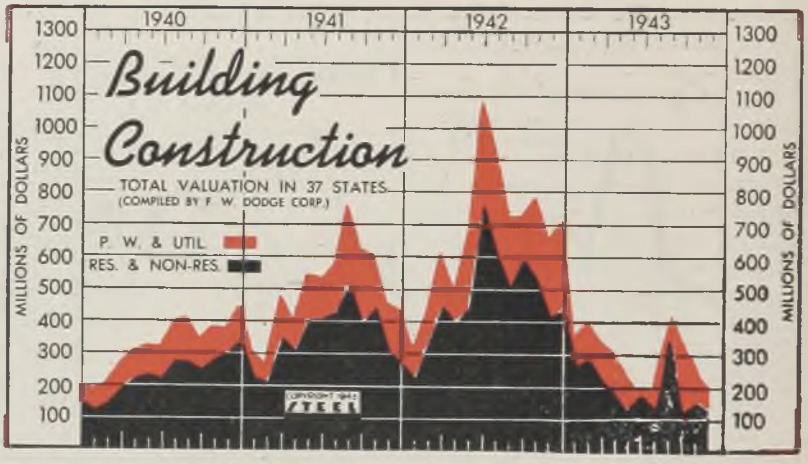
	Shipments 1943	Shipments 1942	Shipments 1941	Backlogs 1943	Backlogs 1942	Backlogs 1941
Jan.	48.8	167.8	164.6	339.1	704.4	601.5
Feb.	32.8	164.6	161.4	321.0	706.7	624.2
Mar.	30.7	191.3	170.2	299.8	777.7	697.2
Apr.	50.5	187.2	189.8	272.5	772.4	741.9
May	31.8	184.2	191.9	220.6	843.8	718.9
June	79.3	182.7	200.5	207.1	869.8	747.4
July	55.4	189.9	203.0	201.3	808.6	802.7
Aug.	36.9	173.9	189.3	195.6	783.5	754.5
Sept.	61.0	169.8	204.1	208.1	716.0	678.5
Oct.	55.4	152.9	217.7	274.0	617.7	614.4
Nov.	.....	130.4	182.6	.....	566.6	602.9
Dec.	.....	145.3	176.1	.....	523.5	626.0

Source: American Institute of Steel Construction. Figures for 1943 cover members' reports only; for other years they are estimates for entire industry.

Construction Valuation In 37 States

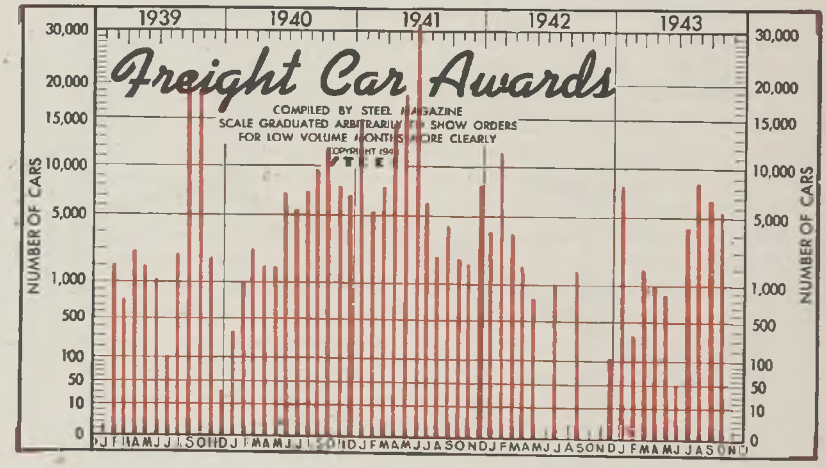
(Unit—$1,000,000)

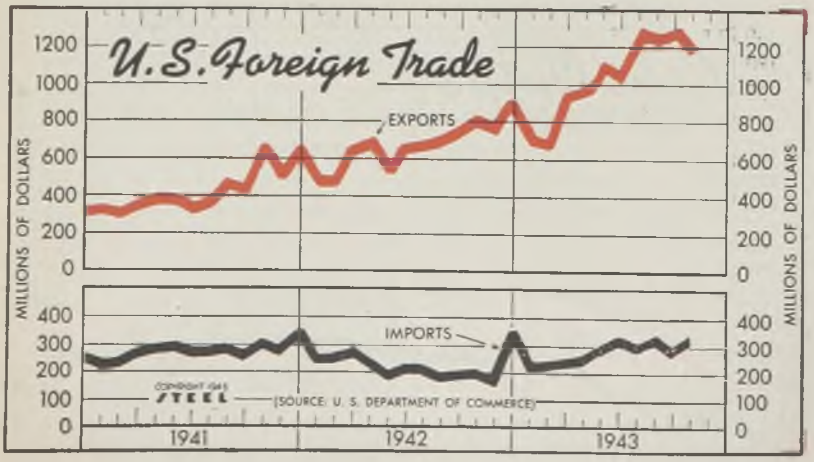
	Total	Public Works-Utilities 1943	Public Works-Utilities 1942	Residential-Non-Res. 1943	Residential-Non-Res. 1942
Jan.	350.7	85.8	90.8	264.8	226.0
Feb.	393.5	112.9	95.9	280.5	337.6
Mar.	339.7	123.0	159.7	216.7	451.1
April	303.3	127.7	101.7	175.6	397.0
May	234.4	95.8	227.7	138.6	445.8
June	229.6	73.3	436.4	156.3	753.8
July	183.7	50.0	327.3	133.7	616.4
Aug.	413.7	73.4	213.1	340.3	507.9
Sept.	300.1	175.1	129.6	125.0	593.6
Oct.	213.6	63.5	246.2	150.0	534.2
Nov.	184.4	59.0	241.0	125.4	413.2
Dec.	.....	.....	271.0	.....	437.7
Total	.....	.....	2,540.4	.....	5,714.3



Freight Car Awards

	1943	1942	1941	1940
Jan.	8,365	4,253	15,169	360
Feb.	350	11,725	5,508	1,147
March	1,935	4,080	8,074	3,104
April	1,000	2,125	14,645	2,077
May	870	822	18,630	2,010
June	50	0	32,749	7,475
July	4,190	1,025	6,459	5,846
Aug.	8,747	0	2,668	7,525
Sept.	6,820	1,863	4,470	9,735
Oct.	5,258	0	2,499	12,195
10 mos.	37,585	25,893	110,871	50,474
Nov.	.....	0	2,222	8,234
Dec.	.....	135	8,406	7,181
Total	.....	26,028	121,499	65,889





Foreign Trade

Bureau of Foreign and Domestic Commerce

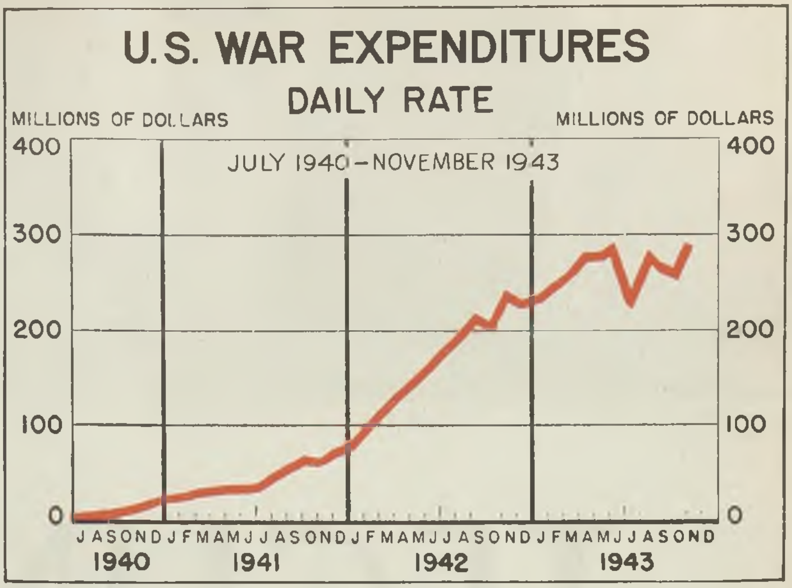
(Unit Value—$1,000,000)

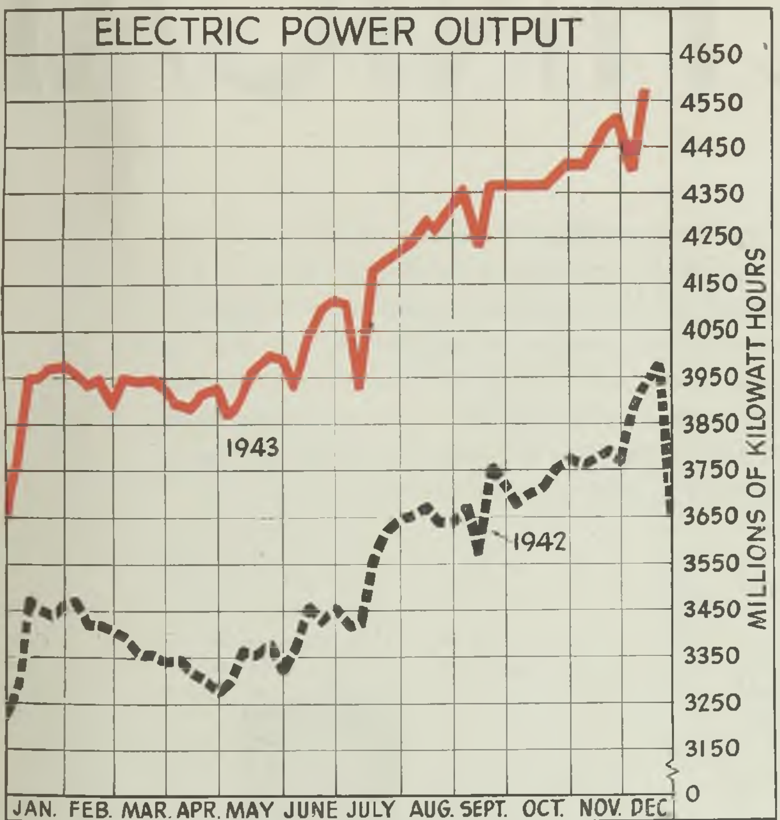
	Exports 1943	Exports 1942	Exports 1941	Imports 1943	Imports 1942	Imports 1941
Jan.	751	479	325	228	253	229
Feb.	732	478	303	234	253	234
Mar.	984	611	357	248	272	268
Apr.	963	695	385	257	234	287
May	1,069	525	385	281	191	297
June	1,004	618	330	302	215	279
July	1,251	627	359	300	214	278
Aug.	1,205	694	455	315	184	282
Sept.	1,233	718	417	280	196	263
Oct.	1,185	776	666	329	199	304
Nov.	...	750	492	...	174	260
Dec.	...	853	651	...	356	344
Total	....	7826	5126	....	2743	3345

War Expenditures

(millions)

	1943		1942	
	Monthly Expenditures	Daily Rate	Monthly Expenditures	Daily Rate
Jan.	$6,254	$240.5	$2,193	$81.2
Feb.	6,081	253.4	2,401	100.0
Mar.	7,112	263.4	3,025	116.3
Apr.	7,290	280.4	3,461	133.1
May	7,373	283.6	3,824	147.1
June	7,688	295.7	4,213	162.0
July	6,746	249.9	4,708	181.1
Aug.	7,529	289.6	5,163	198.6
Sept.	7,212	277.4	5,459	218.4
Oct.	7,105	273.3	5,722	211.9
Nov.	7,794	299.8	6,112	244.5
Dec.	....	....	6,125	235.6
Tt'l.	....	Av.	Tt'l. 62,406	Av. 169.1





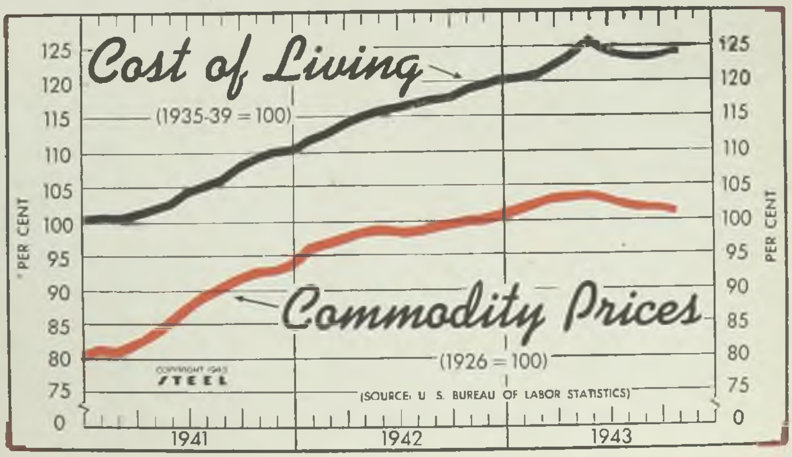
Electric Power Output

(billion kilowatt hours)

	1943	1942	1941	1940
Dec. 25	....	3,656	3,234	2,623
Dec. 18	....	3,976	3,449	2,911
Dec. 11	4,567	3,938	3,431	2,862
Dec. 4	4,560	3,884	3,369	2,838
Nov. 27	4,403	3,766	3,295	2,796
Nov. 20	4,478	3,795	3,205	2,695
Nov. 13	4,483	3,776	3,304	2,752
Nov. 6	4,414	3,762	3,326	2,720
Oct. 30	4,415	3,775	3,339	2,734
Oct. 23	4,415	3,753	3,299	2,711
Oct. 16	4,382	3,717	3,273	2,687
Oct. 9	4,359	3,702	3,315	2,665
Oct. 2	4,359	3,683	3,290	2,641
Sept. 25	4,359	3,720	3,233	2,670
Sept. 18	4,359	3,757	3,232	2,629
Sept. 11	4,229	3,583	3.281	2,639
Sept. 4	4,351	3,673	3,096	2,463
Aug. 28	4,322	3,640	3,224	2,601
Aug. 21	4,265	3,674	3,193	2,571
Aug. 14	4,288	3,655	3,201	2,606

Wholesale Commodity Price—Cost of Living Indexes

	Commodities (1926=100)			Living Cost (1935-39=100)		
	1943	1942	1941	1943	1942	1941
Jan.	101.9	96.0	80.8	120.6	112.0	100.8
Feb.	102.5	96.7	80.6	120.9	112.9	100.8
Mar.	103.4	97.6	81.5	122.8	114.3	101.2
Apr.	103.7	98.7	83.2	124.1	115.1	102.2
May	104.1	98.8	84.9	125.1	116.0	102.9
June	103.8	98.6	87.1	124.8	116.4	104.6
July	103.2	98.7	88.8	123.8	117.0	105.3
Aug.	103.1	99.2	90.3	123.2	117.5	106.2
Sept.	103.1	99.6	91.8	123.9	117.8	108.1
Oct.	103.0	100.0	92.4	124.4	119.0	109.3
Nov.	.....	100.3	92.5	....	119.8	110.2
Dec.	.....	101.0	93.6	.....	120.4	110.5
Ave.	.....	98.8	87.3	.....	116.5	105.2



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TECHNICAL

FROM industry's 1943 war record emerges a picture of some technical accomplishments which go into the making of a production miracle. Full mobilization and co-ordination of facilities and maximum utilization of available materials yield so abundant a harvest of metal products, machines and equipment as to tax storage space. While the whole story of new developments cannot yet be revealed, technological advances mentioned in these pages point to momentous changes in postwar methods and processes, suggest further improvements that may be expected

R. H. Harrington, research metallurgist, General Electric Co., Schenectady, N. Y.:

"New alloy compositions find applications during wartime only on either of two conditions: The new alloy will perform satisfactorily where no standard alloy will meet the required conditions regardless of efficiency, or, the new alloy will effectively replace a scarce material. Thus several new alloys, particularly those of copper, aluminum and zinc bases, will not enter general production fields until after the war ends.

"However, two years of wartime production have had the impetus of 10 normal years in developing efficiency of production fabrication and production heat treatment. Thus an old aluminum alloy, containing zinc and magnesium, was improved by additions of chromium and titanium so that artificial aging, without the usual solution treatment, develops good general properties; this helped to alleviate an early bottleneck in the heat treatment of aluminum castings. In order to conserve beryllium in the standard 98 copper-beryllium alloy, certain former uses of this alloy can be adequately served by ternary copper alloys containing 0.2 to 0.4 per cent beryllium as well as by age-hardened, cold-rolled brasses and bronzes.

"The 'lost wax' method of casting, long in use by jewelers, has found a most important field in war-production casting where the use of standard patterns is difficult or impossible. A new type aluminum alloy may be cast centrifugally.

"New alloys will continue to appear but will have to possess either unusual properties or marked economies. The future will see a continuity of refinement and precision in production fabrication from the melt to the operating part with the emphasis on making higher grade products from lower grade materials. 'Everything tailor made.'"

W. B. Coleman, president, W. B. Coleman Co., Philadelphia: "We have now

been at war for two years. In the first year, we were engaged in choosing substitutes; in the second, we moved ahead with production.

"The National Emergency steels have proved so successful in production that some grades are definitely here to stay. Often, entirely satisfactory substitute compositions appear and are used under force of circumstances, while under ordinary conditions such compositions might not even be tried. Many companies have had to conduct certain research work on steels in order to find out temperature-time characteristics for their particular work.

"In connection with the new steels that have been brought forth, the most outstanding accomplishment during the

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PROGRESS

year has been the progress made by the use of boron in conjunction with ferrous metals. We are finding that small amounts of boron, such as a few thousandths of 1 per cent, impart some phenomenal properties. Thus, the element can really be considered a trace element in steel. Increased physical properties have been noted and machinability has been improved.

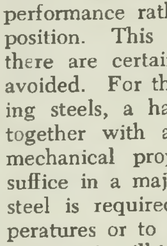
"Use of boron in cast iron has advanced considerably during the past year, especially in its application to the manufacture of cast iron rolls. At present, boron is being used in nonferrous metallurgy and we should hear of some interesting uses where boron occurs in higher percentages."

G. K. Herzog, metallurgical engineer, Electro Metallurgical Co., New York: "There were no technological developments of outstanding importance in the ferroalloy industry during 1943. There were, however, some interesting trends. In the cast iron industry the use of the so-called 'inoculants' of both the graphitizing and the hardening types continued to increase at an accelerated pace. The high chromium and chromium-nickel heat and corrosion-resistant steels more than held their own, resulting in a greatly increased consumption of low carbon ferrochromium. Columbium has so firmly established its position as a stabilizer of the austenitic chromium-nickel steels that during the year its use had to be limited to those wartime applications where no other element would quite meet requirements.

"At least part of the credit for maintaining the exceedingly high rate of alloy steel production must be given to the National Emergency steels which make such efficient use of the alloys they contain that they serve acceptably in many applications. The realization that where hardenability is the main or sole criterion of serviceability one alloying element could to a large degree be substituted for another made it possible to use the more plentiful alloys in place of those in which there was a critical shortage.

"One of the major developments in the steel industry is the current trend toward specifying steel on the basis of performance rather than chemical composition. This is as it should be, but there are certain pitfalls that must be avoided. For the heat-treated engineering steels, a hardenability specification together with a few specifications for mechanical properties would probably suffice in a majority of cases. When a steel is required for use at high temperatures or to resist corrosion, the best measure is still its chemical composition."

Henry C. Boynton, consulting metallurgist, John A. Roebling's Sons Co., Trenton N. J.:



"Right now, mechanized precision control is one of the most important factors contributing to progress in the wire industry. For example, steel melting is 'eyed' by instrumented observers; hot mills are regulated by optical pyrometers and finished rods scrutinized through binoculars; patenting, and annealing and oil tempering all receive the strictest attention as to temperature, rate of quenching, time of draw, etc.; the atmospheres of many of the furnaces are conditioned; pickling and other forms of scale removal and surface conditioning are all under the closest inspection for temperature, strength of acid, time of pickling, time and temperatures of baking, drying, etc.

"Wire drawing is just as closely supervised. Instead of occasional bundles being tested, in highest grade wire every bundle is tested front and back, often cut in the middle to attain uniformity, mile after mile. Further treatment of wire, like galvanizing and tinning, is getting the same close attention as earlier developments.

"Mechanized precision control plays a leading part in the following trends: Higher speeds in wire drawing and patenting are still upward; rolling better rods with surface almost free from seams, slivers, overfills, etc.; pickling rods after the first heat treatment and then giving them very little acid thereafter; alkaline salts, not embrittling, are increasing in use; less but better lime is being employed; continuous heat treating of many of the finer wire sizes in strands; increased use of zinc coated wire for numerous grades, particularly for aircraft needs, then wire drawing after zinc is applied — 'Bruntonizing'; growth in application of oxides and phosphates to replace the 'sull' coat; use of more electronic devices to count, control and regulate all kinds of wire operations —one example is the timing of welding cycles.

"A new field for music wire has been opened up. Sound waves are transformed into magnetic impulses which are impressed upon a small (.004-inch) moving wire. When the direction of wire is reversed, the whole book can be put on one small spool of wire. This apparatus is now used in aircraft work. It may sometime supplant the fragile disks and wax cylinders now used."

Alvin J. Herzig, chief metallurgist, Climax Molybdenum Co., Detroit: "War inevitably demands a re-evaluation of the national expenditure of time and ability. It is significant that in this war we have, as a nation, placed considerable emphasis on the processes of science. It is axiomatic that in this war metallurgical research has had a responsible part in the national effort.

"Actually, many of the institutions which were devoted to metallurgical technology prior to the war anticipated the increased demands of the war years. Important fundamental research projects, inaugurated earlier, were tapped to the limit of their productivity and new projects were started. Fundamental and far-reaching changes in commercial metallurgical operations have resulted. Additional projects will have matured in time to make direct contributions to the prosecution of the war. Many of them, however, will have been only partially completed at the war's end. The postwar program of metallurgical research is obviously to complete the full function of research, namely, the use of all existing knowledge to gain new knowledge.

"The postwar problems of research are precisely the same as its war problems because there is only one set of true facts in ordered knowledge. The question is not, then, 'Is research prepared for the postwar problem?' but 'Will the nation see fit to delegate responsibility to research in the postwar period as it has during the war with confidence in the methods that have contributed substantially to the war effort?' "

K. R. Beardslee, vice president, Carboloy Co. Inc., Detroit.: "Although there is every indication that the use of cemented carbide for cutting tools will continue to expand, it is not impossible that this tremendous demand for carbides may actually be dwarfed in years to come by another use—the 'substitution' of cemented carbides for steel in parts exposed to wear due to abrasion or corrosion. A contributing factor is the extremely low cost with which carbides can be produced.

"Use of cemented carbides to eliminate effects of wear had aroused some interest before the war. For instance, carbide nibs for wire-drawing dies, permitting closer tolerances and greater uniformity and better finish; carbides for tipping lathe centers, for fish-rod guides, for brinell balls, for plug gages, ring gages, drill-jig bushings, metal forming dies, etc.

"When copper shortage made it necessary to substitute steel for brass as a cartridge case material, the conversion would have ben impossible, practically, without carbide dies and their ability to withstand the terrific abrasive action incident to deep drawing these cases.

"In 'replacing' steel with carbides where wear is a problem, the major questions are the selection of the best process for economically producing the carbide liner, insert or part to the desired shape, and the best method of attaching the carbide to the material to be insured against wear.

"Extrusion of relatively long and complicated carbide shapes, a recently perfected Carboloy process, is extending the field of applications. An even more recent development—the 'hot press' method of simultaneously sintering and forming large or thin wall parts—will also undoubtedly prove of value. The process enables production of carbide sections larger or thinner walled than those which can be handled effectively in existing sintering furnaces.

"It has become customary to think of brazing as the only means of attaching cemented carbides to other materials. Indications are, however, that resistance welding can be used for attaching carbides to other materials. Moreover, there is no reason why even simpler attaching methods—use of screws and studs—cannot be employed in many cases, the carbide part, if desired, having the attaching holes formed in it prior to sintering."

Howard Scott, section engineer, Metallurgical Section, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.: "Special purpose alloys of high cost and low production volume are playing a small but vital part in implements of war and further developments in this field are expected to influence postwar industrial progress. New and unique techniques are required for the production of these alloys.

"In the field of metal testing, attention might be called to improvements in equipment for high-temperature testing. Compact creep test units are now in operation which draw a continuous creep-time curve from start of test to rupture, and operate at temperatures up to 1600 degrees Fahr. Reproducible fatigue tests are being made at temperatures up to 1500 degrees Fahr. in reversed bending at 120 cycles.

"Substantial progress has been made in the art of making high-density articles from powdered metals. Fundamental experimental work indicates the possibility of securing hi h density in iron compacts with practical pressures and sintering conditions. Progress here, as well as in other rapidly developing means for shaping metals, foretells a reassessment of metal forming processes when peacetime production is resumed."

H. W. Highriter, chief metallurgical engineer, Vascaloy-Ramet Corp., North Chicago, Ill.: "Last year saw the use of carbide materials continuing upward. More shops used carbide than in any year of cemented carbide history. More operators now are conversant with the operation and method of handling carbide tools than ever before. As a result their uses and applications have become almost infinite in variation.

"With the wider use of carbide it became evident that in order to achieve efficiency in carbide manufacture and lower manufacturing costs, some standardization of available blank sizes would have to be made. The War Production Board instituted a series of discussions, culminating in the establishment of uniform sizes of blanks. These blanks embrace what is, for all practical purposes, a range sufficiently varied to make almost any tool.

"High speed milling has grown, with the employment of large negative rake angle and a trend toward the use of fewer teeth in the cutters.

"In the field of dies, the demand for small sizes of wide-drawing dies has been reduced, but the use of carbides for the manufacture of cartridge cases, shell nosing and bullet manufacture has continued strong. The use of the tougher grades of carbides in cold-heading dies has been extended."

Charles Hardy, president, Hardy Metallurgical Co., New York: "The outstanding feature of the application of powder metallurgy in 1943 is the adoption of this art in the manufacture of parts for the war effort. The number of different parts made by powder metallurgy now exceeds three hundred. Whether it be gun, motor, projectile, bomb, bombsight, diesel engine, airplane or 'walkie-talkie', therein are found a number of these parts. In many a shop there are gages, tools and dies which were compressed from metal powders.

"What is the reason for this great development? In days of manpower shortage, raw material shortage and the necessity for speed, powder metallurgy finds a field where its advantages can be fully exploited. Qualities of the process are best delineated as follows:

"*Speed* — A part was needed quickly Screw machines were scarce, manpower

not available, copper very much restricted. Five hundred and twenty parts per minute were produced by compression of metal powders, without loss of material and eliminating machining entirely.

"*Machining*—A certain machine part could not be produced at a cost of less than $1, as it required grinding in various positions. The part was compressed from metal powders and delivered at 9 cents.

"*Raw material shortage* made it essential that scrap make a rapid re-entry into circulation. Certain parts made in the orthodox manner create as much as 40 per cent or more of scrap. Wherever the application of powder metallurgy is possible, tieup of material is avoided, and except for dusting and very small handling loss, no material is wasted.

"In advancing the war effort, metal powders have found other large scale applications, such as in the chemical, synthetic rubber, and pharmaceutical fields, and their use is still spreading."

J. T. Jarman, chief metallurgist, Allis-Chalmers Mfg. Co., Milwaukee, Wis.:

"All producers and consumers of alloy steels have had a liberal short course of education in the use of alloy steels during this emergency. Unquestionably, as a result of this experience, the consumer will be more critical of potential alloy costs and tend to shift material to the alloy steel having the minimum percentage addition consistent with the physical properties desired.

"The most popular postwar alloy steels, whether they are modifications of the old SAE types or our present NE steels, will be the cheapest by reason of heavy consumption and selection by major industries — automotive, aircraft and farm equipment. Whether it be immediate post war or later, the tide must turn to the economical lower alloy consumption. This should stimulate considerable research for wider use of specialty steels in the stainless and heat-resisting groups and also for new applications.

"Many new avenues of research in conservation and increased life of tool steels have been opened to view. Prominent are the coolants for improved tool life. A number of specialized cases have come to our attention where the results were highly commendable but too sensitive to variables for the average shop. Theoretical concepts from these tests indicate that considerable activity and

(*Please turn to Page* 398)

MATERIALS HANDLING

UNIVERSAL shortage of manpower among war industries and great expansion of Army and Navy supply branches throughout the world account for the extraordinary activity in the materials handling equipment industry during 1943. Palletizing of war goods, new types of special conveyors for ordnance, stabilized hoisting, innovations in electric trucks and growing interest in diesel-propelled transfer cars are outstanding developments

George E. Stringfellow, vice president and division manager, Edison Storage Battery Division, Thomas A. Edison Inc., West Orange, N. J.:

"The outstanding advance in materials handling methods during the past year has been the progress made by the supply agencies of our armed forces in the 'palletizing' of war goods.

"There are a great many commodities, such as subsistence and clothing, that in the past have customarily been packed for shipment in relatively small boxes or cartons which had to be handled one at a time whenever they were to be loaded into a freight car or warehoused.

"By combining these boxes or cartons into larger unit loads on pallets so that they can be handled by industrial truck, a ton or more at a time, the supply services are speeding up the flow of materials to the fighting fronts. Not only are they saving time and manhours in the handling work itself, but they are reducing the dock time of ocean carriers and loading time of rail freight cars."

E. W. Schellentrager, vice president, Atlas Car & Mfg. Co., Cleveland:

"Perhaps the most significant trend which has been noticed during the past year is the great interest in self-propelled transfer cars for blast furnaces and steel plants, arranged for diesel propulsion. Some of the largest transfer cars ever constructed are now being built, and the industry as a whole has evidenced a very strong interest in such equipment because it will eliminate troublesome electric conductors, and greatly broaden the field of operation of the transfer car. By the end of 1944, this trend should become extremely significant.

"Detailed improvements have been made in automatic scale dials for coke weighing, so that these are now practically 100 per cent foolproof and protected against any kind of maladjustment or improper operation. The use of mechanically tipped, enclosed, mercury switches has proved to be the most dependable and satisfactory arrangement for this service.

"Another development which has attracted considerable attention is the use of self-charging, battery-operated transfer cars. These units provide a most economical method of handling miscellaneous pipes, bars, sheets, etc. in capacities greater than can be economically handled on rubber tires. These cars operate on track rails and eliminate the usual objection to battery operation in that they have self-contained automatic chargers built into them, so that the bat-

tery can be put on charge at any time the car is standing idle simply by plugging into the available power supply at the plant."

F. J. Shepard Jr., treasurer, Lewis-Shepard Co., Watertown, Mass.: "The acute shortage of labor has made necessary the use of more efficient means of handling materials, and the resulting demand for power fork trucks, portable elevators, hand-lift trucks, and skid platforms has risen to a new high. This demand is coming not only from heavy industries but from all types of plants, warehouses and distributors, as the necessity to 'multiply' is universal, with no relief in sight at least for the duration.

"We anticipate that the materials handling industry will experience a sharp postwar demand for its products due to the increased wage scale that will remain in effect for common labor. This class of workers has enjoyed the largest percentage increase in wages, which makes it imperative that efficient management provide equipment that will increase their output in the moving of materials.

"The demand for materials handling units by the armed forces and essential industries has taxed output to the utmost, and the industry has not converted to the production of munitions. This will obviate the necessity of any postwar changeover."

F. E. Moore, president, Mathews Conveyer Co., Ellwood City, Pa.: "Elements of the conveyor industry are fortunate to have maintained a high position in the classification of essential manufacturing and in not being induced to convert to the manufacturing of ordnance. Expanded engineering and manufacturing facilities have been devoted totally to the production of conveying equipment for handling war materials. This is not to infer that the problems have not been different than those encountered in peacetime operation.

"Work with the Chemical Warfare Service, and the handling of armor plate, aircraft tubing, steel and brass shell cartridge cases, shell forgings and finished bombs and shell, has required the development of very special conveying machinery. The engineering phase has been unusually heavy. Some in the industry have had to do many things which had not been done before, and the time was always short in which to do them. However, the experience can be applied in the handling of peacetime products.

"So far as postwar problems are concerned, it seems logical that since there should be no real reconversion problem, the industry shall be in a favorable position to give prompt service to those manufacturers who must reconvert. Our main postwar problem will be to secure a volume of engineering and manufacturing contracts which will keep our expanded facilities busy under peacetime conditions."

C. B. Cook, vice president, Elwell-Parker Electric Co., Cleveland: "In the power industrial truck industry in 1943, each manufacturer has been producing his utmost. He has not been completely suited to the lack of manpower. At the same time, however, materials were more plentiful.

"Machine tool manufacturers have absorbed some of the surplus demand in this field by manufacturing truck parts on a large scale, it being deemed expedient to place the assembling of these trucks, as well as the machining, in their hands.

"The pallet unit load idea has been sold more generally than ever before. More goods are being handled on pallets than at any time before, during peace or war. Trucks have been shipped abroad to work in warehouses and all of the quartermaster warehouses here in the States are fitted with this type of equipment. Electrified hand-lift, hand-steered trucks have been produced in quantity, both in the pallet and fork types to handle the loads in small installations nearer the point of product use.

"It is believed that pallets will be used so generally after the war that new standards for handling will have been established and that the major portion of all goods will be handled by means of power trucks."

J. Breslav, J-B Engineering Sales Co., New Haven, Conn.: "One of the most recent new methods in materials handling has been in a duplication of the skid method of handling by the use of overhead cranes. Instead of placing the material on skids, the material is placed in containers or racks. These racks are so designed that they may be stacked. They thus act either as a means of transportation or primary storage. The method is particularly adapted to the handling of long pieces such as tubes and bar stock, but is also used where a large number of small pieces can be put in a long rack for speed in handling. Racks may be designed for use in handling by the crane only, or in combination with a lift truck.

"Although the development has been chiefly in the handling of long material, a combination system may be adopted whereby the floor transportation is done by lift truck, especially across yards and in low buildings, and high piling is done by the crane with the grab. The method thus does not imply replacement of lift trucks but co-operative handling using the proper device for this job either the lift truck or the crane."

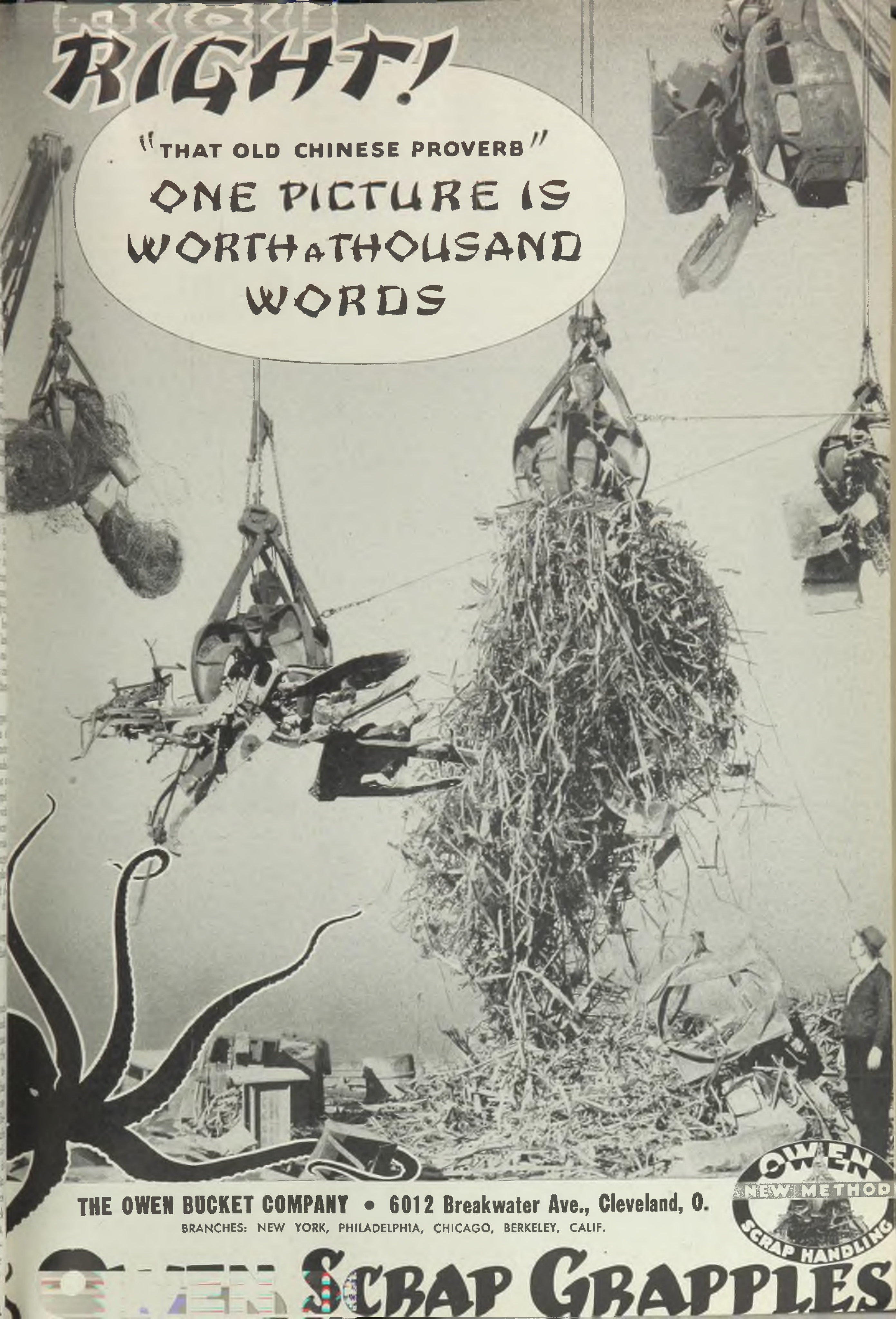
Adolf Larsen, vice-president, Gerrard Steel Strapping Co., Chicago: "War needs have emphasized old and new uses for round steel strapping as well as the containers which they reinforce. Wood has played a large part in filling these needs. Reports from Pacific and Afro-European fronts indicate that subsistence items are protected principally with corrosion-proof galvanized round steel straps that keep packages intact in jungles or arctic cold.

"Experiments with new types of wood boxes with pug-nose or builtup cone-shaped ends of five plies of wood for 'free drops' from planes to troops in the field have been made by the Army Air Corps. Rigidly protected by such straps, these boxes, weighing about 100 pounds apiece, are dropped from planes flying at 150 miles per hour from 1000 feet and lower flying altitudes. Boxes land on the cone-shaped ends, bounce end-over-end, but the steel reinforcement and their peculiar construction keeps them intact.

"Medical supplies have been dropped repeatedly and successfully. Cans of rations, ammunition for 37 millimeter guns, and rifle and machine gun loaded ammunition belts, as well as gasoline in special containers, were also dropped. These consignments were planned with the idea of saving parachutes and boxes from loss or damage. Average breakage is only 0.5 per cent. Advantages also include greater accuracy in placing such deliveries, and lower flight altitudes, reducing chances of enemy observation.

"Postwar possibilities suggest delivery of air express and mails at intermediate points or in inaccessible regions."

D. L. Darnell, Baker Industrial Truck Division, Baker-Raulang Co., Cleveland: "The most important development in the industrial truck industry in 1943 has been an explosion-proof fork truck designed for the safe handling of ammunition and which is now being built in production quantities by two manufacturers. While this truck was developed particularly for war needs, the new design will offer safer equipment in hazardous locations where there may be explosive mixtures of gases or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dust or where the trucks may be required to operate in the vicinity of explosives or other highly inflammable material.

"Again, as in 1942, the technological advances in the industry have been relatively limited because of the pressure to deliver the maximum number of standard models to the Army, Navy and war industries. Advances have therefore been limited to the refining of these standard models and to changes which will better adapt them to quantity production.

"It is believed that the industry does not face any basic conversion problem. Possibly the greatest change will be a higher degree of standardization in design. Advances along this line will result in giving the postwar buyer more for his money."

F. M. Blum, crane division, Harnischfeger Corp., Milwaukee, Wis.: "Apparently in the year 1943 we have seen the peak of overhead traveling crane production. The curtailment of new building for war projects bears with it curtailed orders for cranes. Although cranes have been unheralded as a weapon of war, they are doing their part in the production of tanks, planes, and guns and are in no small part responsible for the way the armament quotas are being met and exceeded.

"The immediate problem of the crane industry for 1944 will be to keep these cranes operating in order to hold armament production quotas.

"Many war plants were compelled to purchase used crane equipment which was not adapted for the service in which it is now operating, and although a splendid job is being done, performance could be improved by modernizing the existing equipment or replacing it with faster crane trolleys or with cranes specifically designed to handle material more efficiently."

A. F. Anjeskey, Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, O.: "The aircraft industry probably has forced manufacturers of our type of equipment to solve materials handling problems not encountered in other industries. This led to the development of long-span multirunway cranes, and it is apparent that such equipment is being considered for other types of industrial plants.

"In 1943 there was further application of the so-called stabilized hoisting unit for painting large planes, particularly of the cargo type, and before the end of the year such installation will be in operation in one large plant making this type of plane. It is expected that a considerable saving will be effected due to the fact that these planes, having a total surface of approximately 7500 square feet, will be spray painted at much lower cost because of the elimination of platforms, ladders, etc. This application also should lend itself to the painting of other large surfaces such as box cars and other bulky objects which cannot be painted with operators standing on the floor.

"The rapid stride that has been made in welding is causing many manufacturers to consider manufacturing machinery out of steel sections welded together, and this is creating a demand for welding positioners and carrying devices capable of moving the arc welder over the parts to be welded. The stabilized hoist lends itself to such applications, and soon there will be in operation one installation of a single leg gantry crane on which is mounted a stabilizing hoist with a platform suspended to the hoist which carries welding heads, wire reels, etc. This application will permit continuous welding at speeds of 4 to 80 inches per minute."

J. G. Bucuss, manager, strapping division, Acme Steel Co., Chicago: "War has forcibly impressed upon industry the importance of problems which exist beyond the production line. In days of peace, an improperly packed or reinforced shipment resulted in the filing of a damage claim and perhaps an interchange of letters. Carriers paid claims and commerce went on as before. Today, shipments which are damaged in transit may mean the needless loss of lives of allied soldiers, a lost battle, lost critical material and manhours of labor. Products must be packed right to reach the fighting zones.

"Packing specifications of the armed services have been revised to meet the unusual situations found in loading and in unloading cargo at arctic and tropical bases, many without docks and without proper handling facilities. In packing food, ammunition, planes, tanks and other items, space must be conserved to permit maximum loading with limited facilities. This too, has focused attention on shipping practices. From this war will come lessons to be used in the packing of the multitude of peacetime products for domestic and export delivery.

"Lighter containers made stronger, bundling to eliminate outer wraps, skid and pallet loading and the bracing of carload ladings are the principal developments in which flat steel bands have participated. Packing operations are speeded up as faster strap-applying equipment becomes universally employed. Unloading too, will be faster, as the mere snipping of the steel bands prepares the loads for the receivers. Thus, handling costs will be lowered."

Arnold Hooper, Blaw-Knox Co., Pittsburgh: "In the steel plant, bucket performance is frequently restricted because of limited crane headroom. In the design of structures and crane runways, the operating headroom required by the proper bucket should be carefully observed.

"Consultations between the plant engineer and the crane and bucket manufacturer in the early stages of a new project, usually result in the allowance of adequate clearances for the particular size, weight, and type bucket required for efficient operation and minimum crane duty. This is most important where open-hearth crane time is required for removing slag and refuse from the pits in back of the furnaces and in the open hearth stock house.

"Adequate headroom is also required for single line hook-on type buckets handling sand in the steel foundries, where the clearance is frequently limited above a sand slinger or sand bin."

Samuel Wunsch, secretary, Silent Hoist Winch & Crane Co., Brooklyn, N. Y.: "Materials handling is a fundamental operation in all industries, and especially so in the predominantly heavy industries of war production, with which we are yet as much as ever concerned. In common with many other operations, materials handling has increased tremendously in volume and extent and there is also the common manpower problem of replacement of skilled operators lost to the armed forces, plus the large increase in additional operators required for the greater volume.

Materials handling, with particular reference to the handling and transporting of the one-at-a-time heavy and bulky loads by industrial tractor-type boom cranes, is especially concerned with the skill of the operator as exemplified. in two fundamentals, speed and safety. Employment of new and inexperienced operators requires certain basic features to be provided in the cranes; for mobile cranes, these include unobstructed vision; ease of all operations; always-in-gear design and automatic braking for hoisting and lowering, boom swinging and boom topping; automatic power cut-off and stop when the boom reaches extreme position of swing to either side and maximum position of boom topping; self-stabilization when handling loads at the sides."

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is it possible to build a rat?

IN the answer to this extraordinary question is a curious story. For two scientists once posed that very question to themselves . . . and the answer was Yes!

They actually built a machine with the power to "learn" by experience and "remember" what it had learned—a mechanism capable of simulating the rudimentary behavior of a rat. Comprised of solenoids, gears and relays, it traveled a grooved track forked by 12 dead-end side-tracks—equivalent to the blind alleys which a living rat encounters. Set to take the dead-end forks, as if by an inner compulsion, this robot rat literally learned by experience to avoid the frustrating blind alleys, in a perfect mechanical analogue to the conditioned reflexes of the brain.*

To build a machine that would reproduce *all* the behavior of a rat "would require a mechanism probably as large as the Capitol at Washington"—*but it could be done!*

For we're at the beginning of an amazing new technological age. Already there are many kinds of thinking machines in our incredibly mechanized world, helping to speed production, cut costs and build better products. And intimately a part of this whole story is the science of machine tool engineering.

Today, Jones & Lamson engineers are working with the leading manufacturers in virtually every industry, helping them to plan production *now* for the machines and the products of tomorrow.

They are at your service, too.

* *In "The Advancing Front of Science" by George W. Gray, a memorable chapter on thinking machines reports this story in full.*

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Manufacturers of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

Profit-producing Machine Tools


"Our War Bonds mean more Steel when we're rollin' with LEWIS!"
ARMY E NAVY
23130
And more steel means more War Bonds for most of the men in the mills. They're getting bigger tonnage, better finish, fewer rejects and less time out for roll change when Lewis Rolls are in the stands.
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Also manufacturers of ROLLING MILL MACHINERY for the iron, steel and non-ferrous industries
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LEWIS ROLLS

Your SCRAP is needed to help bridge this GAP!

Winter has closed the Great Lakes to navigation. The huge ships which carry iron ore from the Lake Superior mines are tied up at their docks—winter-bound and helpless. Yet the war goes on with its insistent demand for planes, tanks, guns, trucks and thousand and one other things made of steel.

Scrap has been vital since the start to give the mills enough material to carry out their tremendous war production programs. It is doubly important at this season when nature halts the transport of the bulk of newly mined ore. And this year—with our armies gathering their forces for the knock-out blow—it is more urgently essential than ever.

Do your part to bridge the gap that winter has imposed—do your part to help make the knock-out blow count—by seeing to it that collections of scrap on your premises move regularly to your scrap dealer or Scrap Collection Depot.

Save Wastepaper, Too!
Containers for packaging war materials are made of wastepaper. A serious shortage of new containers exists. Help speed Victory by collecting and shipping your wastepaper as you do your scrap.

THE STANDARD TUBE CO.

Detroit STANCO Michigan

Welded Tubing — Steel Forgings

BUY WAR BONDS

JOINING

AMONG recent significant contributions to the war effort by the fastener industry are improved rivets and riveting devices for reaching inaccessible points in aircraft assembly, threaded fasteners with smaller diameters permitted by use of alloys, further refinement of spring fasteners necessary for assembly of combat equipment and the adaptation to bolt-making machinery of parts formerly machine made by other methods

George A. Tinnerman, president, Tinnerman Products Inc., Cleveland: "The production of aircraft fasteners has had the tendency to raise the quality and position of all fastener manufacturing. While many fasteners used in aircraft will not be used in postwar commercial production, the beneficial effects of training and methods employed during war production will reflect in improved qualities of standard commercial fasteners.

"In the case of Speed Nuts, thorough research and a careful check of performance under all conditions of combatant service for military aircraft has brought about many changes in manufacturing practices that will be carried on into the postwar period. The general effect will be to improve vastly the life of automobiles, refrigerators, stoves and other assemblies at no increase in the cost of materials.

"The application of Speed Nuts for aircraft assembly has greatly reduced the quantities of steel formerly required.

"All manufacturing will automatically remain on a much higher plane in the postwar period as a result of the knowledge and education all manufacturers have gained from their experience in war production."

Dorothy M. J. Tracey, vice president and general manager, Tomkins-Johnson Co., Jackson, Mich.: "Today's demands spotlight the question 'How to get greater efficiency from present equipment and personnel.' One answer has been to eliminate manual effort in hundreds of operations, or simplify machine control and actuation of equipment by the use of air and hydraulic cylinders. Such cylinders are being widely used for power movement in any direction, and in any mounting, improving operation of clutches, valves, materials handling equipment, brakes, presses, shears, hoists, damper regulation, assembly fixtures and other operations.

"In the aircraft industry, where riveting is a major operation, thousands of rivets of various types and sizes are driven every hour. Improved equipment makes it possible for the operator to set more rivets in a given time, with less chance of damaging the material being riveted. The single-squeeze action is considered ideal for upsetting or driving aluminum alloy rivets used in aircraft building. Aluminum rivets subjected to a multiplicity of blows tend to become work hard and thus susceptible to fatigue failure. It is therefore desirable to drive rivets with the least possible number of blows—and thus, where the type of work permits, squeeze-action riveting is recommended."

Theodore F. Smith, president, Oliver Iron & Steel Corp., Pittsburgh: "It really does not require much imagination to understand the importance of conventional fasteners that go to make up the machines of war. A combination of elements was required to overcome some production problems. The development of a rivet for reaching inaccessible positions is an outstanding example. Special hot and cold-forged parts have been developed to meet certain requirements and speedier schedules. In keeping with the advances of materials and lighter design, threaded fasteners have improved. Through the use of alloys, smaller diameters have been employed to do the work of larger sizes. Improvements have been found in heat-treating applications to produce tougher and stronger products. Threading techniques have advanced to include closer tolerances and precision work.

"Among other contributions to the war effort by the threaded fastener industry, is the adaptation, to bolt making equipment, of parts formerly made on machines by other methods. This development has resulted in better products, higher production, and less cost per unit, aside from releasing critical manpower and machines.

"All these new advances are permanent and will find their way into the creation, designing and engineering of entirely new products. The designer of tomorrow must be aware of the economy of such methods, lest he lose something of value. The simplicity and flexibility of threaded fasteners which are removable will continue to be an important factor in the production, equipment and services of the future."

E. J. W. Ragsdale, chief engineer, railroad division, Edward G. Budd Mfg. Co., Philadelphia: "When we burst into war production we were told, 'the sky is the limit'. That helped in at least one phase of the conversion.

"When we try to return to peacetime production, the fat will have been rendered by renegotiation. We will have to scrape the bottom of the barrel and maybe ask for a refill.

"New equipment will be needed and, even more, ingenuity, if we are to keep men and women at work at anything like present wages.

"This requires planning now. Often this is misinterpreted as a dangerous overconfidence in the war prospects. It would be equally dangerous if our attitude should be that peace will solve everything. Our statesmen are considering peace as well as the war. That is proper. Industry does not have to be so dual-minded. The men in industry who are responsible for planning are not the same individuals who are hammering out production. The planners have mostly done their work toward production. It is timely that they should now engage their effort towards the next step."

WELDING

DEVELOPMENTS in welding technology pace mushroom growth of arc, gas and resistance welding applications. Mechanized welding of light-gage materials is better established. Flash-arc and gas-shielded arc welding are types with new but excellent records in mass production. These methods, with improved thermit and oxyacetylene processes for heavy welding, enabled industry to swing rapidly into production and to deliver a huge volume of goods

George T. Horton, Chicago Bridge & Iron Co., Chicago: "As each year passes, it becomes more apparent that all steel juncture will eventually be welded and it is interesting and fascinating to think of the change in design which such juncture implies.

"Again, in thinking of the improvement of welding itself, one wonders what will be the processes, say, 50 years hence. When will we only use enough heat to bring the last layer of molecules to the proper temperature, and, finally, will we invoke the forces of cohesion without change of temperature, and if so, how?"

Albert S. Low, vice president and chief engineer, Austin Co., Washington, D. C.: "Cumulative war experience of construction industries points the way toward a much more economic use of steel in the postwar period. The all-out effort to conserve steel and other vital war metals has focused attention on many new and little used structural systems which have proven themselves satisfactory for many types of building.

"Designers of reinforced concrete structures have been increasingly careful in their computations on reinforcing steel. In some instances, this has led to substantial savings.

"There is little likelihood that steel will be replaced by any of the lighter metals in structural framing or long-span units, although corrosion-resistant alloys having a permanent finish are sure to make a strong bid for use in installations exposed to weathering or process vapors. The lighter metals may find extensive use in traveling cranes and other mobile equipment.

"Steel has played a strategic part in the successful adaption of timber to many large and heavy construction projects, for it was metal ring connectors which made it possible to design wide-span trusses and arch forms with board lumber and by the use of minimum quantities. There is little danger that timber construction will replace steel in heavy structures after the war, although improved laminating techniques and availability of split ring connectors should make it a stronger competitive factor in some areas.

"Relaxation of wartime restrictions on steel will find the whole construction industry more interested than ever in the use of welded sections. It is to be hoped that some leading producers of structural steel will start without delay to study opportunities for development of shapes especially designed for use in welded structures. Engineers might produce many new ideas with such shapes.

"With greatly improved insulating materials available, we can look forward to more extensive use of porcelain enamel and light-gage rolled sections in walls of industrial and commercial buildings. Anticipated increase in use of air conditioning and in the number of windowless, controlled-conditions plants should be directly influenced by the availability of combinations like the steel and fiberglas used in walls and roofs at two of the world's largest air-conditioned buildings. Record insulating value and ease of erection characterize this composite wall and make it a logical contender for postwar use. Noncombustible, shatter-resistant and extremely light in weight, it provides, in less than 7 inches, insulation equal to an 80-inch brick wall, plus a high degree of sound absorption and light reflection. By the same token, the 6-inch roof of the same materials provides the best acoustical properties and insulation ever obtained in a roof."

A. P. Young, Michigan College of Mining and Technology, Houghton, Mich.: "It is significant that through the art of welding, combined with subassembly at points outside the ways, industry has been able to produce ships faster than the Axis powers can sink them. It is also significant that the average mechanic in the industrial field has become welding-minded.

"It is absolutely essential that the public as a whole be educated to the fact each welding job is a special job and must be done according to the particular requirements of the metal used and the form of the assembly which is to be welded. That requires special training on the part of the welding operator. All training courses in training centers and in schools and colleges must be organized in such a way as to avoid giving the impression to the trainee that once he can weld steel, he can weld all metals."

G. V. Slottman, manager, applied engineering department, Air Reduction Sales Co., New York: "The welding and oxyacetylene cutting industry was immediately able to serve rapidly expanding war industry because our tools —industrial gases, welding and cutting apparatus and machines—are tools of both war and peace.

"Flame cut and welded fabrication, now not only used to supplement other methods but also finding even greater acceptance on its economy, utility, material availability, and flexibility of design, will provide more and more an-

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STEELMAKING

INCREASING viscosity of fuel oil by addition of pulverized low-ash coal to be tried at open-hearth shop. Experiments on all-basic open hearth underway. New method devised for operating drawbenches and hydraulic presses. Basic and super-duty silica brick and rammed bottoms for steelmaking furnaces gain favor. Coatings applied to sheets undergo improvements

L. F. Reinartz, manager Middletown Division, American Rolling Mill Co., Middletown, O.: "To meet the shortage of labor, women in increasing numbers are coming into the steel mills, first in clerical positions, and later as laborers, dispatchers, inspectors, shear helpers, grinders, track walkers and on numerous other jobs formerly considered only for men. Labor-saving devices have been installed in many instances to assist them to do their jobs.

"Because of labor shortage considerable attention has been paid to increasing the efficiency of open-hearth furnace repair work by the payment of some form of incentive to repair laborers. In addition, mechanical equipment, such as chain hoists, elevators, conveyors, tractors, towmotors, large rock drills for breaking slag, etc., has been installed to speed up furnace repair jobs.

"Fuel quality problems, particularly in those plants where fuel oil is used to melt and refine steels, have harassed the steel melter all year. The lighter oil available for melting purposes, although not affecting the tons per hour of the individual heats to any extent, has decreased open-hearth furnace roof life and thus decreased overall tonnage per furnace per month, and considerably increased furnace repair costs. In conjunction with representatives of the fuels section of WPB, a midwestern steel plant is building a coal pulverizing plant to try to increase the viscosity of fuel oil for open-hearth use by the addition of 5 to 10 per cent of finely pulverized low-ash coal to the oil.

"Lump iron ore for charge and feed purpose is becoming more scarce every year. Many large scale experiments in nodulizing, sintering and briquetting fine ores have indicated that this problem can be solved from a moisture elimination standpoint, and also to increase the size of ore particles. Fine ores, low in silica, still are necessary for this service. Of these practices, sintering is probably the cheapest, then briquetting, and finally nodulizing.

"After the war is over, a number of older open-hearth furnaces will have to be completely rebuilt.

"War production drive committees have helped in some steel plants to improve the co-operation of management and workers. It has been demonstrated that the organization and functioning of such committees must be carried on in a spirit of friendliness and understanding; otherwise, they may prove to be a millstone around management's neck."

C. E. Sims, supervising metallurgist, Battelle Memorial Institute, Columbus, O.: "Despite the instant and insistent demands of war production, there exists a healthy concern in regard to postwar problems and developments. Considerable thought is being given to the problem of how new manufacturing facilities, new techniques, and new materials will fit into postwar production. How can the new scientific developments created with great ingenuity for the destruction of mankind be revised for peacetime benefits? How can present products be improved and developed to offset the inroads of newly created or greatly improved competing products?

"There is a growing conviction that the answer to these questions lies in research. Because these new processes and new products are the products of research, then more research is needed to further improve them or to offset fatal competition. This has resulted in a present trend toward greatly increased and intensified research investigations as an important development of the year."

F. Mohler, engineer, steel mill section, General Electric Co., Schenectady, N. Y.: "The year 1943 was characterized by the building, installing, and placing in service of equipment for the vast expansion program laid down by WPB. Practically all of the new major rolling mill units now are in operation.

"New amplidyne reversing mill control was put to work on 18 reversing mills—including blooming, slabbing, and hot-strip mills. All of its previous production records were broken by an existing 44-inch blooming mill which had been modernized with this control.

"Considerable electric equipment was manufactured to meet the needs of plate, hot and cold strip, rail and structural, rod, and tube mills in this and allied countries.

"A novel close-coupled tube mill recently put into operation in the Chicago area has 16 stands on 12½-inch centers, each driven by a 75-horsepower motor designed especially for close speed regulation and low-impact speed drop.

"Large demand for tubes for aircraft led to unprecedented activity in the building of drawbenches; General Electric alone built 100 of these drives, the majority of them of the direct-current type.

"Need for extruded shapes for aircraft resulted in a large expansion of extrusion press facilities. Two large plants, one in Michigan and the other in California, have already gone into operation; four others are now being built. These extrusion presses are driven by either 300 or 500-horsepower synchronous motors.

"Electronic-amplidyne control of flying shears has proved so successful that a fourth unit is now being built. The entire speed control is electric rather than the conventional adjustable gear for ınnecting the flying shear to the last and of the hot-strip mill.

"Considerable emphasis is being laced on the use of electronics. Already broad use and general application of lectronics exists in the steel industry, ıcluding rectifiers, pyrometers, photo-lectric relays, battery chargers, exciters, lectronically controlled welders, pinhole etectors, and Thy-mo-trol drives for upplying power and controlling mo-ors."

'red A. Harvey, director of research, Iarbison-Walker Refractories Co., Pittsburgh: "There has been a definite trend toward the use of rammed open-hearth bottoms in place of the conventional burned-in bottom of magnesite. Material used in the rammed bottoms contains a component which

ives it a cold set and the operator is able ɔ ram the bottom in place and put the ırnace into operation more rapidly and t lower cost than with the older type urned-in bottom.

"Trend toward the use of basic brick ı the open-hearth furnace seems to be ccentuated. Several open hearths in ıe United States have been built with ıbstantial portions of their roofs of basic rick. This development is being watched ith great interest by both operator nd manufacturer.

"Super-duty silica brick for open-earth roofs are making considerable eadway. In general they appear to give ıcreased life and to justify the extra are and expense which goes into their ıanufacture.

"New construction work requiring re-ractories is largely finished. Refrac-ories manufacturers have been able to upply materials needed without hold-ng up construction or operation of fur-ıaces. No government control of distri-ɔution has been needed in the industry. t is evident that there will be no short-ıge of refractories except possibly in a ew specialized types.

"The new Manual of ASTM, 'Stand-ırd Testing Methods for Refractory Ma-erials', the sixth of the series of these ıanuals, seems to be filling an impor-ant place in the refractory industry."

C. D. King, chairman operating committees, United States Steel Corp., Pittsburgh: "Despite increasing raw material and manpower problems, open-hearth ingot production during the past year reached new record levels. Intensive efforts to reduce operating delays, application of mechanical or other

means of cleaning slag pockets, maintenance of efficient condition of checkers throughout the campaign, and more rapid rebuilds, have increased potential steelmaking capacity. Some plants have reduced time out for rebuilds to as little as 4 per cent of total time. Prepared ores, whether nodulized, sintered, or briquetted, have not only made it possible to utilize higher pig iron charges advantageously, but in many cases have provided increased production. Considerable ingenuity has been shown by operators in meeting the required usage of alloy turnings. The present high state of open-hearth practice has been clearly demonstrated by the ability of this process to meet successfully the sharply increased demand for alloy steels before electric furnace capacity was sufficient for these requirements.

"Wider applications of bessemer steels have taken place, several plants successfully producing bessemer alloy and killed steels, the latter utilizing improved deoxidation practices. The bessemer process, whether in the production of ingots, synthetic scrap, or as a source of blown metal for stationary and tilting furnaces, still constitutes an important part of the total ingot output, representing approximately 12 per cent.

"Many large sized electric furnace units have been installed or will soon be completed. Some of these units will employ blown or decarburized metal, thereby providing increased output from such units. In addition, generally faster melting practices now being developed assure increased productivity from electric furnaces."

Kenneth B. Lewis, consulting engineer, Worcester, Mass.: "Steady advance is being made in wire technology. At present, this progress is marked chiefly by a stepping up of quality and uniformity, both due largely to recent advances in the delicacy of control in the various heat treatments, both strand and batch.

"Pre-eminent among newer developments with long-range implications is 'reactive' drawing, or the drawing of wire which goes to the die heavily stressed in tension by a back pull. Active interest in this, the only basic change ever to threaten wire technique in a thousand years, will probably follow closely on the restoration of normal conditions. It will be found that an effective back pull must be of substantial character and closely controllable, and so applied that the energy can be fed back into the system.

"Substantial and attractive power savings will bulk large in the eyes of early explorers of this field, and will be realized, but other advantages will eventually outweigh power savings. New combinations of physical properties will be attainable, new finishes and, in all probability, new lubricants of a nature to affect profoundly all phases of the process.

"The chief problem will be the adaptation of the reactive principle to continuous drawing. It will be solved."

M. J. Bradley, Leeds & Northrup Co., Philadelphia: "Tons per hour is accepted generally as a criterion of combustion efficiency within an open-hearth furnace under present operating conditions. However, in view of approaching fuel limitations and substitution of different types of fuel, it would appear that other means of determining combustion conditions are desirable.

"Metered volumes of fuel and combustion air are the starting points for automatic combustion control equipments. These units have reached a stage in their development whereby they maintain the set ratio at various demands and require little maintenance attention. Equipments and methods are now being developed to measure flame conditions as well as the continuous analysis of the products of combustion, especially the percentage of oxygen carried along in the waste gases. These new tools make it possible to analyze and to set combustion conditions for the particular furnace application to obtain maximum production efficiency.

"The combustion engineer should not just drift into this position from some other operating engineering position in the plant. He should be well informed with respect to the chemical reactions between oxygen and what is called fuel, with particular reference to various factors, proper mixing of fuel and air and their temperatures which influence the speed of these reactions, and to those factors which limit the extent to which each reaction can proceed under specific conditions. He should have an adequate knowledge of physics and physical chemistry, and the ability to apply this knowledge to the solution of mill problems.

"In steel plants, as elsewhere, there are many places where the efficiency of utilization of fuel can be improved greatly with simultaneous improvement in quality, as well as reduction in cost per unit of product."

M. H. Mawhinney, consulting engineer, Salem, O.: "Outstanding developments of past year in the field of industrial heating furnaces have been in connection with the problem of fuels and the necessity for greater production.

"Extensive and difficult changes in fuel systems have been caused by temporary or permanent shortages in gas and fuel oil available. These changes have included the use of fuel oil for applications not previously thought possible and the rapid development of equipment for the accurate and scientific control of producer gas and pulverized coal.

"An unbelievable number of furnaces have been built in the United States since Pearl Harbor. Many of these replaced obsolete equipment, and in the design of new equipment one eye was focused on the future in many cases, so that present mills will be well equipped with heating furnaces for some years to come. However, many new developments await time when the demand for munitions has been ended, and because of the tailor-made character of industrial furnaces, there is every indication that the demand for new furnaces of new design will continue.

"World War II has produced less new development in furnace design than the last war, because the furnace industry, born in the last war, was in a full grown and vigorous condition at the beginning of this one. With no time to waste and a vast accumulation of knowledge available, the logical course was to make use of it without attempting new things. However, from the accelerated application of this knowledge, a flood of new ideas can be expected as soon as time is available to assemble the result of present experience."

C. L. McGranahan, assistant general superintendent, Pittsburgh Works, Jones & Laughlin Steel Corp., Pittsburgh: "Undoubtedly with the end of the war strip mills of the country, which account for an average of 50 per cent of all plates being produced, will return to their normal position in steel mill operations. This change can be effected by reinstalling finishing equipment which in most cases, is still intact and can be put to use within a reasonable period and without any technical problems. The changeover will not be simple, however, as about 40 per cent of the prewar personnel of the strip mills are either serving in the armed forces or are working in war industries. This means that even if many of them return to their old jobs after the war, the industry will still have a difficult problem of job rehabilitation and job training to solve before its forces can be brought up to peak efficiency.

"The type of material to be produced on strip mills after the war will show little change from the prewar product in carbon steel grades, except that progress made in the manufacture of steel during the war period will probably be applied after the war to flat steel products. Advancement has been made in the application of coatings to sheets to improve their appearance and protection. This is a trend which will continue and further enable steel sheets to maintain a favorable position in competition with postwar materials. Also it is possible that competition from aluminum and magnesium sheets may require the manufacture of high-tensile light-weight steel sheets, but for the most part it is expected that steel will continue to be the best, most versatile of all metals after the war just as it was before—and it should continue to be the lowest cost and most adaptable material for any application."

L. C. Hewitt, vice president, Laclede-Christy Clay Products Co., St. Louis: "The refractories industry met demands placed upon it by the war by enlarging its production facilities. Additional installations of tunnel kilns and rotary calcining kilns have, in particular, contributed not only to increased volume but to an efficient use of fuel and labor.

"The necessity of conserving stocks of India kyanite used in super-refractories has led to the use and application of domestic topaz in many instances.

"Refractory specialties, such as cements and plastics, have found new uses contributed greatly to furnace construction and repair. A new use for a heat-setting mortar widely used in the iron and steel industry has been as a jointing material for hot tops. The mortar, while preventing leakage between the hot top and the ingot mold, likewise does not bond so tightly that the hot top cannot be easily removed at the end of the heat. Further, in that it can be applied with a relatively low moisture content, boiling of the steel in conjunction with the joint is minimized. An additional new use for this type of product is as a jointing material for hot metal mixers and transfer ladles.

"Unlike many industries, the refractories industry does not have a postwar conversion problem, in that its normal production is of a type essential to both war and peace time needs."

A. F. Kenyon, steel mill engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.: "Greatest expansion in rolling mill capacity has been in slabbing and plate mills to produce plate for the enormous shipbuilding program. A 140-inch wide reversing mill, and a 120-inch wide universal mill, both now in production, each have the working rolls driven by a 7000-horsepower reversing motor equipment. This is the largest power yet applied to any plate mill stand. The upper and lower working rolls of a 160-inch wide 4-high mill are separately driven by two 5000-horsepower reversing motors, constituting a 10,000-horsepower twin-motor drive. This is the first application of a twin-motor drive to a plate mill.

"A 2250-horsepower reversing motor equipment is being furnished for a universal plate mill in Mexico, and a 5000-horsepower main motor and 500-horsepower edger motor are being furnished for a universal plate mill in Brazil.

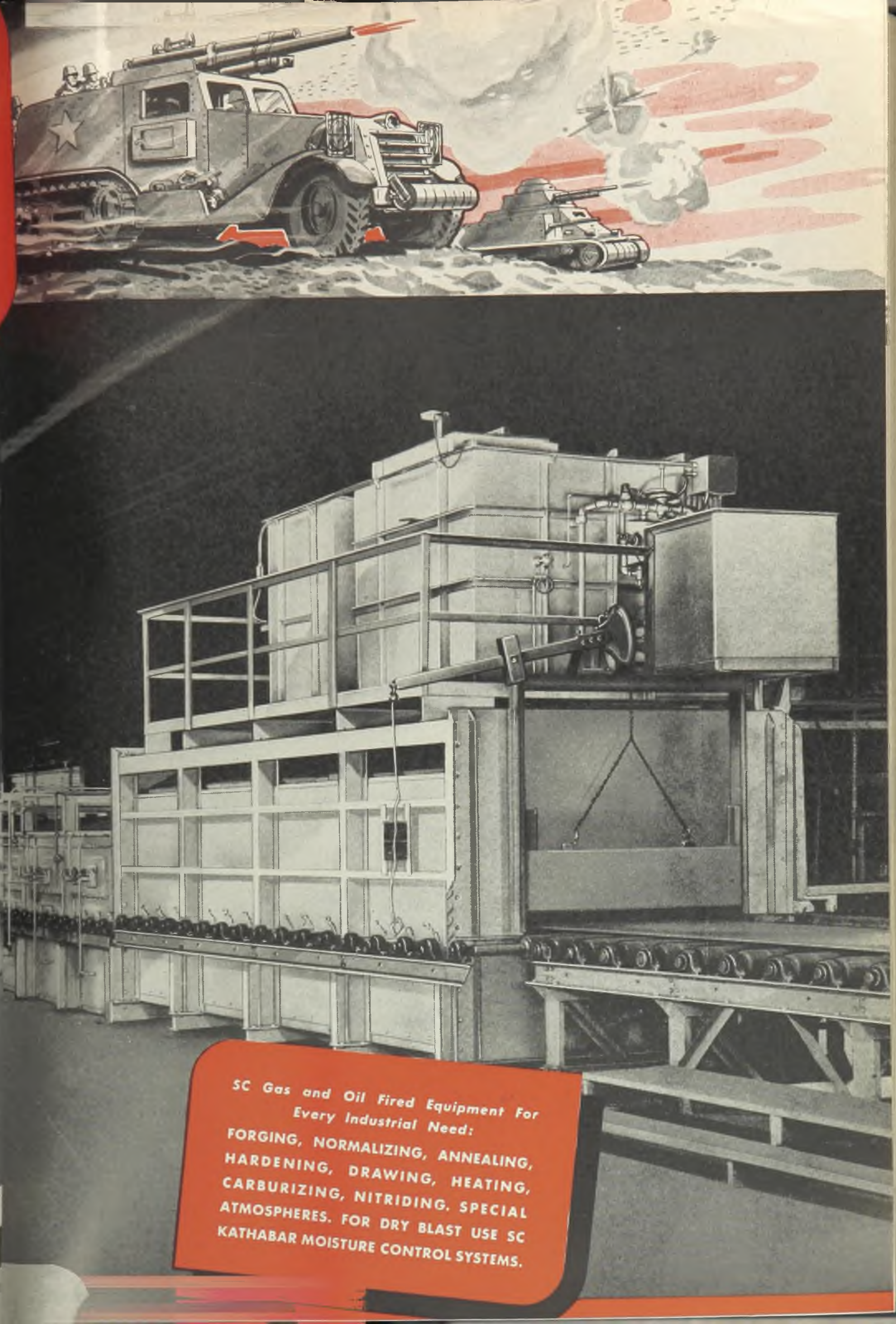
"An automatic limit switch control equipment has been provided for the screwdown on a 132-inch wide reversing roughing stand, to enable fast and accurate automatic movement of the screws to each succeeding pass position, thus simplifying the operation and assuring more uniform drafting of the steel.

"Demand for high-grade alloy steel has been met by the installation of large electric arc furnaces, many of 50 tons or greater capacity, and operated from transformers of 12,000 to 15,000 kilovolt-ampere rating. Furnace performance has been improved and maintenance reduced by the adaptation of Rototrol regulators for the control of the furnace electrode motors. The Rototrol regulator operates on the same basic principle of balancing the electrode current against the arc voltage which has proven successful by many years use with other regulators, with the further advantage of smooth variable voltage control of the electrode motors, and elimination of regulator and relay contacts. Rototrol regulator electrode motor control has been installed to replace older contact regulators on existing furnaces, as well as for several new furnaces."

A. J. Boynton, A. J. Boynton & Co., Chicago: "Progress in pig iron manufacture in 1943 would seem to be the increasing interest in means of control of the operation. These means are sometimes enforced by economy, as in the case of ore concentration but they all contribute to quality control. They include washing of coking coal, screening of iron ore and sintering of the fines, sizing of coke, bedding or stockpiling of materials for the sake of averaging the composition, air conditioning of the blast, regulation of furnace pressure, and increased instrumentation. Notable among these matters is the greater importance now ascribed to the quality of sinter with respect to size and hardness, distinctions too long and too generally overlooked.

"All of these practices have as primary or secondary objectives the increase of reducibility of ore and the avoidance of influences which interfere with the absorption of heat by the charge. The more nearly these objectives are fulfilled, the greater is the certainty of pig iron free from residual oxides, high in temperature and well suited to steelmaking requirements.

"The benefit which the steelmaking processes derive from good pig iron has


SC Gas and Oil Fired Equipment For Every Industrial Need:
FORGING, NORMALIZING, ANNEALING, HARDENING, DRAWING, HEATING, CARBURIZING, NITRIDING. SPECIAL ATMOSPHERES. FOR DRY BLAST USE SC KATHABAR MOISTURE CONTROL SYSTEMS.

always been apparent. It seems that the industry is increasingly recognizing that any reasonable expenditure which adds to blast furnace regularity and efficiency is more than repaid in the cost and quality of steel."

C. E. Bales, vice president, Ironton Fire Brick Co., Ironton, O.: "Production of refractory materials is on the decline, due to the completion of nearly all construction projects requiring large quantities of silica and fireclay brick. The large demand for fireclay brick, silica and basic refractories, for repair and maintenance purposes is expected to continue until the war is definitely won.

"Several companies have modernized and expanded their plants and some new units have been built. Sea water magnesium is now being made on the East Coast and with the expansion of the dolomite industry, steel manufacturers may no longer require foreign magnesite.

"More technical investigations are under way today, than ever before. The ceramic engineer and technologist have done an excellent job and the consumer can look forward to many improvements in all types of refractory materials.

"American Refractories Institute has continued its Industrial Fellowship at Mellon Institute; the American Ceramic Society has carried on its promotional and educational activities; the American Society for Testing Materials, through Committee C-8 has issued a new manual on refractories, containing an unusually interesting survey on electric furnace refractories. Many universities are engaged in research work on refractories as well as Battelle Memorial Institute and Armour Research Foundation.

"Some new refractory products have come into wide use during the year, such as basic ramming refractories, siliceous ramming refractories for electric furnace bottoms, steel foundry ladles and side-blow bessemer converters and a super-quality refractory bonding mortar for foundry melting furnaces."

S. M. Jenkins, building materials division, Armstrong Cork Co. Inc., New York: "The past two years have seen a greater use of insulating fire brick than any similar period. Their use has cut down fuel losses and contributed to speeding up furnace operations in meeting the tremendous demands under war conditions.

"About 14 years ago when insulating refractory material was placed on the market in commercial quantities, the material was divided into a series of insulating firebrick made for various exposed temperatures, from 2000 degrees upward. Already it has been proven that before designing a new type furnace, all types of thin insulating firebrick walls should be checked to take advantage of these benefits.

"The life expectancy of various types of furnaces built of them when subjected to different types of fuels, reducing atmospheres, and gas pressures, can be had by checking the number of installations built of different grade insulating refractories that have been directly exposed and in continuous operation in all types of furnace equipment using various fuels over the past decade. Some of the latest type furnaces could not have been built had not insulating refractory materials been used in their design.

"The future of all types of insulating firebrick will be governed by the reports from installations made during the past few years. A study of these developments should lead to the most efficient thin wall constructions, rapid heating and cooling, larger units where their parts are handled by cranes for lifting or lowering them into place, panel type construction, flat arch or hanging wall constructions of permanent or removable design, and the possibility of further use of larger and more complicated light-weight tile and prefabricated shapes that can be put into place by mechanics on the job."

H. N. Kraner, research engineer, Bethlehem Steel Co., Bethlehem, Pa.: "The refractories situation in the steel industry for 1943 continues in the 1942 trend. Most new installations requiring large volumes of refractories have been completed and the supply problem has eased considerably, although plants are all busy, particularly in super-duty refractories. The latter are continuing to prove their worth in many applications. The trend toward hard firing of other clay refractories is being extended as the manufacturer learns that spalling resistance is less important than volume stability and strength in many jobs.

"Sufficient time has elapsed at high production rates to realize that shorter open-hearth roof life has not been due solely to green help as had been suspected at the beginning of the upsurge of production. The time has come when joint endeavors of brick manufacturers and consumers of brick should be pointed towards an improved quality of brick with a consequent conservation of manpower and reduction in time lost on maintenance and repair work.

"Interest in the all-basic furnace has been revived and experiments are under way to study furnace operation with new combinations of basic endwalls and at least partial roofs. In some of these as in many other refractory installations, considerably higher costs are conceded to gain tonnage and to cope with operating delays and labor shortages, particularly in the repair gangs. A need still exists for a basic refractory for this service, which will not peen or spall due to liquid development and penetration."

John L. Young, vice president, United Engineering & Foundry Co., Pittsburgh: "Construction of one of the world's largest aluminum sheet rolling mills was completed at Trentwood, near Spokane, Wash., for the Defense Plant Corp., to produce high-strength alloy aluminum sheet for the aircraft industry's wartime program.

"Other mills for the heavy steel rolling program covering war needs have been finished, or are nearing completion.

"As this entire program of construction of rolling mill equipment for both ferrous and nonferrous metals is reaching its conclusion, considerable thought is being given to the development and modernization of existing equipment, and of better mills and processing equipment for the entire industry. A number of new developments are ready for marketing.

"Out of the war development has come an entirely new principle of operation of hydraulic presses. This development will be extended into postwar fields in a complete line of hydraulic presses based upon this new principle.

"Another development is a completely automatic and continuous cold draw bench. In the near future, a unit will be placed in service to demonstrate the practicability of the development in actual production."

J. L. Whitten, Lee Wilson Engineering Co. Inc., Cleveland: "During 1943 wide application was made of nitrogen atmosphere for all types of annealing and spheroidizing work—especially for products coming directly from the hot mill with scale still attached. Problems of proper analysis, dewpoints and establishment of gas equilibriums have formed a basis of methods which make the approach to this type of annealing fairly standard.

"During early and middle 1943 large installations were put into service, process problems worked out and spare parts adequately provided for long continuous runs to set this part of war machinery in complete and steady production.

"In this development phase radiant tube heating application was accepted for all types of furnaces. One important development in radiant tube applications is in the field of heating air or gas for conditioning for use in other furnace operations. The first large gas heating unit for use in direct metal reduction has 128

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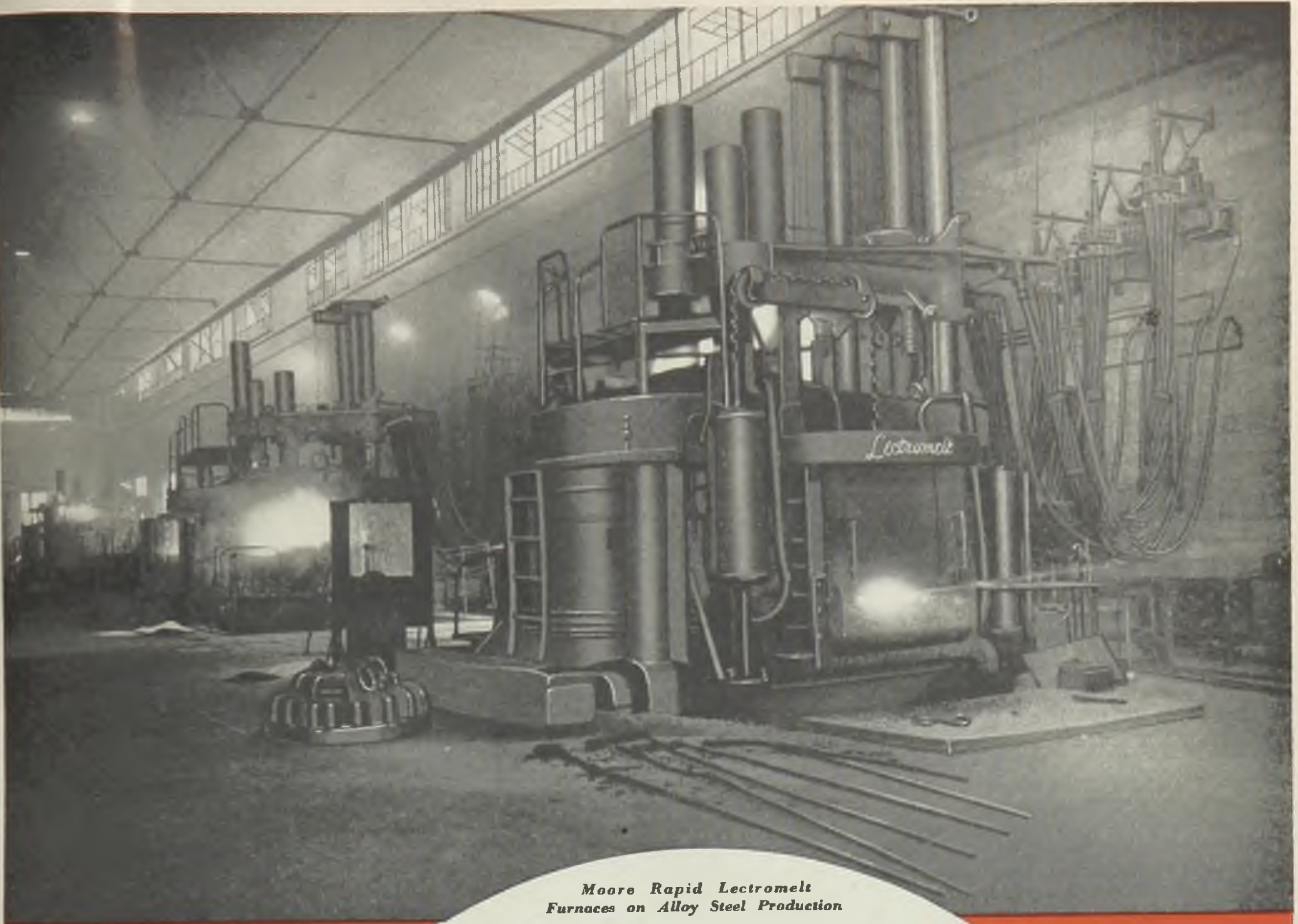

Moore Rapid Lectromelt Furnaces on Alloy Steel Production

HEAT TREATING

TODAY the heat treating industry is using many advanced methods and much improved equipment such as automatic continuous controlled-atmosphere furnaces and multiple salt-bath heating and quenching cycles. All these are having a striking effect on the war program. Selective heating, including electric induction heating and various types of flame treatment, is being used with excellent results to prevent distortion. These advances portend important postwar applications

P. E. Petersen, fuel engineer, Chase Brass & Copper Co., Waterbury, Conn.:

"The tremendous requirements of war have resulted in an unparalleled expansion in the brass industry. The demand for increased production has required the building of heat treating equipment in sizes and numbers far beyond peacetime requirements. The very special nature of many of the wartime heat treating operations has required completely new designs of furnaces and advances in heat treating.

"During the past year there has been a great advance in the application of mechanical handling to heat treating equipment, and the furnace is being regarded more and more as a production machine. An indication of this is the widely expanded use of rotary drum and of mesh-conveyor-belt type furnaces for small-arms cartridge cup annealing, and of the driven roller hearth or chain conveyor for almost all kinds of mill heat treating, whether bar, sheet, tube or coil. The trend in the brass industry to much heavier bars makes complete mechanical handling almost a necessity. Continuous strip and strand annealing is finding more application.

"There have been definite strides in certain methods of heat application that are helping our war requirements. The use of high-velocity forced convection for fast and uniform heating has found increased demand, particularly for low temperature anneals of shell or similar products difficult to heat by radiation and conduction. This method is also finding extended use at higher temperatures, being limited by alloy and fan design, since it makes possible exceptional uniformity of heating. For many special heat treating operations, high-temperature radiant cups have proven definitely advantageous. These can be built into a continuous machine to give local annealing such as on the taper anneal for cartridge cases, or can be built directly into a furnace to give overall high-speed heating. These two methods, high-speed convection and high temperature radiation, are almost directly opposite methods, but both are finding increased use in brass heat treating."

W. E. Benninghoff, manager, induction division, Ohio Crankshaft Co., Cleveland:

"High frequency electrical induction heating and hardening has been truly accepted during 1943 as a working tool. No longer is it regarded as an experimental project.

"New induction applications of the past 12 months have demonstrated its complete capacity for treating large size parts in addition to smaller parts. This is seen in the successful hardening of 26-inch final drive gears, once made of costly high-alloy steel, but now made of plain carbon steel hardened in 90 seconds by the induction process.

"From another angle that bears sharply on the current problem of vital materials, this adoption of carbon steel has effected a saving of 144,000 pounds of nickel per year. The efficacy of the induction process is borne out in this case alone, and it is but one among many. Use of induction in the field of forging likewise is growing daily.

"New is the induction application for the continuous heat treating of tubing and bar stock for physical properties. Requiring an unusual type of fixture, the results are complete uniformity of treatment bar to bar, tube to tube, and inch to inch on a given bar. The heat treating of long lengths has been greatly simplified by this development.

"Postwar planning calling for wider use of induction treatment is sharply in evidence. New, improved methods will have their place. Heating by high frequency will be one of the means achieving that end."

Frederic O. Hess, president, Selas Co., Philadelphia: "During 1943 many significant advances in heat treatment, performed with gas fuel, have been brought about by combustion developments permitting high-speed heating.

"It is now possible, with modern gas equipment, to heat steel from room temperature to forging temperatures at speeds as great as 1 inch per 3 minutes. Equally surprising heating rates have been demonstrated at different temperatures and for different metals. Already, these new heating methods and techniques have been widely applied to speed up war production as well as to obtain new and desirable process results.

"Armor-piercing shot caps have been selectively heat treated in less than 2 minutes to maximum hardness at the nose, without increase of the hardness of its skirt. Steel cartridge cases have been selectively hardened in continuous-line production equipment to the desired tensile strength, but without distortion. The seam of thick-wall welded steel tubing is being homogeneously annealed at a production rate of 50 feet per minute. Work-hardened stainless steel tubing is being fully annealed during continuous travel in a total time of 5 seconds. Three-inch steel billets are brought to forging temperature in 5 minutes.

"Obviously, such significant advances in heat treating technique, and the new possibilities they suggest, have materially influenced shop practice during the past year. New flexibilities and new metallurgical results assure an even broader adaptation of these techniques in the future. Indications are that high-speed heating will influence steel mill practice as well as general metal fabrication and manufacturing."

L. A. Lanning, assistant plant manager, New Departure Division, General Motors Corp., Bristol, Conn.: "One of the most significant trends during the past year has been an increase in the use of the Jominy test in determining the fitness and relative abilities of materials to respond to a given heat treatment.

"This test has received considerable impetus from the use of the new NE steels. It has also had a definite application in the examination into the properties of the so-called 'needled' steels. These steels promise to be of considerable importance after the war effort has been satisfied and will reflect heavily in our peacetime economy. Their utilization has been broadened and control of heat treatment has been greatly assisted by the Jominy test which has enabled investigators to obtain results in a relatively short period of time which could only have been established through tedious trial and error and by other methods.

"It is believed that this test will play an increasing part in the control of physical properties of materials as time goes on."

Arthur E. Focke, research metallurgist, Diamond Chain & Mfg. Co., Indianapolis, Ind.: "In the heat treating of large numbers of duplicate parts, the modern trend is toward the development of equipment or practices by which heat treating can be accomplished without interrupting the flow of the production line. This may be accomplished either by use of special heat treating machines, which include continuous controlled atmosphere heating furnaces, automatic and continuous quenching, and means for moving the parts continuously through the tempering furnace; or by use of a molten salt for heating, another molten salt for quenching, and still another salt for tempering; or by use of selective hardening.

"In the last case, the induction heating methods appear to be preferred to flame hardening because, if the amount of production is sufficient to justify the initial equipment cost, the cost per unit volume hardened will be less and the electrical controls make it possible to be more positive that the results will be duplicated day after day.

"The proper choice between each of these three general methods depends on the part to be treated and the results desired. The recent developments of tempering salts which will prevent the formation of the usual oxide colors or scale may make it desirable to combine these methods so that the advantages of bright hardening in controlled atmosphere furnaces can be retained and the cost of the preparation of the surface for subsequent finishing kept to a minimum.

"To the extent that this equipment has been developed for the special purpose of heat treating a single part, a change from present to postwar production will involve some changes in the equipment."

G. B. Berlien, chief metallurgist, Lindberg Steel Treating Co., Chicago: "The demands of the Victory Program during the past year have made an important impression on the heat treating industry. Cutting the time as short as possible between fabrication and ultimate service requires that the heat treater employ such methods as will require a minimum amount of corrective dimensional operations. Developing the maximum physical properties in the alloys being treated also allows for the maximum conservation of those alloys.

"Today, we find the heat treating industry thoroughly familiar with advanced and improved methods of heating. These methods employ the conventional furnace operation with controlled atmospheres, the use of salt baths at elevated temperatures, and a wider application of the use of selective heating to avoid distortion. This includes various types of flame hardening equipment and induction heating machines.

"All of these techniques are here to stay and will certainly play their part in lowering the cost of postwar products. We look to the future with the anticipation of enjoying many things that have been brought to us by a new application of the developments of 1943."

T. L. Counihan, chief metallurgist, Hyatt Bearings Division, General Motors Corp., Harrison, N. J.: "The use of induction hardening has continued to multiply during the past year. The available cycle frequencies have been increased, so that we now can consider frequencies in the order of several millions, instead of hundreds of thousands per second. This has broadened the use of induction heating.

"In carburizing equipment, the desire to circulate the carburizing gases increases. Forced mechanical circulation has advantages which cannot be overlooked.

"The use of prepared atmospheres for heat treating or hardening furnaces continues to be regarded with favor. The furnace equipment for batch type hardening is quite satisfactory. A critical surveyor of continuous hardening equipment for handling large quantities of small parts at low cost can see a place for needed equipment. If a person wishes a controlled atmosphere, constant recording of temperature, and desires that each piece of work progress through the furnace on a known cycle and then be quenched at the proper time, he will find that these refinements may not always be attained when hardening certain types of product.

"It is believed that the use of quenching media operating at higher temperatures and with faster circulation than those now in force will receive greater attention in the future.

"Inspection equipment for detecting differences in heat-treated structures by electrical means is coming into being and will likely play a very great part in controlling quality in tne near future. The deep acid etch test on heat-treated parts is an excellent means of detecting the degree of straining produced as a result of heat treating operations, but its use must always be somewhat limited and any electrical device which would supplant it would be a welcome substitute."

R. J. Cowan, consultant, Youngstown, O.: "The process of continuous gas carburizing has been greatly improved by the use of the so-called RX gas. For carburizing purposes this is mixed with a small percentage of hydrocarbon gas and used as a mixture. The RX gas is similar in some respects to the older CG gas which it largely replaces. It differs from CG in that it is free from carbon dioxide and contains only a very small amount of water vapor. This is made possible by the use of a special catalyst in the reaction chamber which accelerates the reactions and establishes practical equilibrium more rapidly.

"By controlling the moisture content of the carburizing gases in this manner, the amount of hydrocarbon that it is necessary to add for efficient carburization is held to a minimum. The carburized work comes from the furnace absolutely clean; the carbon content of the case is controllable at will to any desired value, and the life of the alloy used for supports and fixtures is greatly extended. These principles are finding application in the recarburization of parts which have been finished, and then found to have been decarburized in some step of the manufacture.

"There has been a great advance in the quenching of steels, particularly steel shell. For the quenching of airplane tubing, a gas quench is being used which gives physical properties beyond those obtained by the former quench and draw. Quenching is conducted in a controlled atmosphere.

"There has been a great extension in

the use of forced air heating for the heat treatment of aluminum parts.

"In all these improvements there is one thing noticeable—their object is the handling of large quantities of work without a letdown in quality. In most cases the quality has been improved—a testimonial to the fundamental character of the heat treating procedures used and to the skillful interpretation of these requirements."

F. Lloyd Woodside, president, Park Chemical Co., Detroit: "Significant in 1943 was the trend toward increased use of salt baths in heat treating. Much of this increase resulted from installation of additional facilities for such well-known operations as high-speed steel hardening, neutral salt-bath hardening of carbon and alloy steels, liquid carburizing, solution heat-treatment of aluminum, etc.

"In addition, some relatively new uses of the salt bath were further developed, chief among them being salt-bath brazing and quenching and selective carburizing in liquid carburizers. Salt baths for copper brazing and for silver soldering have given excellent results.

"Heat treating operations which involve the use of molten salts for quenching over a wide temperature range have produced physicals exceeding those produced by conventional quench and draw.

"Introduction of No-Kase, a stop-off paint used for selective carburizing in liquid carburizer, has generated an increased interest in this method of carburizing.

"A continuation of this trend toward liquid heating mediums in the postwar period may be expected. Equipment is simple, inexpensive, and easy to operate. Results are uniform, and readily duplicated. Economies effected will be a determining factor in postwar competition."

C. L. Ipsen, manager, industrial heating division, General Electric Co., Schenectady, N. Y.: "Continuous furnaces for operation at temperatures up to 2100 degrees Fahr. were developed in the decade preceding the war. In many of these furnaces the complete cycle is automatic, thus eliminating the human element. In many cases protective atmospheres prevent all oxidation and decarburization. These furnaces have now conclusively demonstrated their effectiveness in heat treating the vast quantities of precision parts required for the war.

"A more recent development is a rotary-hearth electric furnace for operation at temperatures up to 2500 degrees Fahr. The atmosphere that protects the parts being heat treated also protects the high-melting-point heating units and insures their long life at these high temperatures. Experience has proved the effectiveness of this atmosphere; with it, high-speed steels of any analysis have been protected completely against surface changes; knife-edged parts maintain their sharp contours and are file hard. Thus, industry now has available a continuous furnace for heat treatment in a high-temperature field where heretofore scaled and decarburized parts have been accepted as inevitable.

"High-frequency induction heaters have provided industry with another new tool. Precise control, speed of heating, and accurately localized application make these heaters a most effective means of carrying on production-line manufacture."

Robert C. Gibbons, production metallurgist, Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.: "Two factors have combined to cause changes in heat-treating practices during the last year. One has been the change to the National Emergency steels which, with lower alloy content and generally lower hardenability, has demanded improvement in both equipment and technique. The other has been the increased production schedule which has permitted installation of mass production furnaces to a greater extent than ever before.

"The pusher and conveyer types of continuous furnaces with controlled atmosphere have come to be the main development for increased production. Some of these have chambers for controlled cooling in the same atmosphere for annealing purposes, while others have automatic quench.

"Batch-type furnaces are still preferred for most of the small parts and for small runs, but they have added atmosphere control in most cases. Various types of controlled atmosphere are used, but manufactured types predominate and produce relatively inert gases known by proprietary names. Such gases, enriched by controlled quantities of propane or other sweeteners, have come to the front in gas carburizing. Batch-type gas carburizers often use liquids which decompose at high temperatures to give a carburizing atmosphere.

"Local hardening treatments have become more significant. A recent development is the hardening of a part all over to an intermediate hardness, then rehardening certain sections by flame or induction equipment to higher hardness. Lower alloy steels can be used with such treatments. Recent development of higher frequency induction equipment for thinner cases has made possible treatments never before used and has replaced some cyanide hardening. Many new designs for both flame hardening and induction hardening equipment have been put on the market recently."

C. E. Peck, direct-current generator engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.: "Separately prepared and closely controlled protective atmospheres for metals during heat treatment are being applied to new and broader applications in the alloy steel annealing field, in gas carburizing, and in the sintering of powdered metals.

"Long-cycle annealing of alloy carbon and high carbon steels can be accomplished without decarburization or oxidation by using a high nitrogen content gas prepared from combustion of a fuel gas and from which carbon dioxide and water vapor have been thoroughly and separately removed before the atmosphere is introduced to the furnace. Gas atmospheres produced by the complete reaction of an air-fuel gas mixture into a gas containing high percentages of carbon monoxide, hydrogen and nitrogen without undesirable carbon dioxide and water vapor are quite useful not only for hardening carbon and alloy steels without decarburization but as an efficient 'carrier' gas for gas carburizing.

"Gas atmospheres produced from the complete reaction of air-fuel gas mixtures are also very efficient for use in sintering of powdered metals. The total available reducing properties in the gas are as high as 60-65 per cent of the volume and exist in the form of hydrogen and carbon monoxide. These high reducing properties which are available directly from fuel-gas air mixtures are usually much more cheaply produced than those from other sources such as dissociated ammonia."

Robert N. Blakeslee, vice president, Ajax Electrothermic Corp., Trenton, N. J.: "Induction heating is continuing to expand in industry at a rapid pace. Installations in the past year, as in the past several years, have been almost exclusively for war production, although the equipment is long lived and will be converted to peacetime operation as soon as war requirements begin to slacken.

"Probably over 95 per cent of all applications use the motor generator as a source of high-frequency power, with spark gap and vacuum tube converters supplying the power used for

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FINISHING

IMPROVED metal finishing materials and processes make remarkable war record. Changes mainly involve new production techniques. Electrolytic tinplate steadily gains ground. Plating for greater wear resistance, electroforming of surfaces, flame priming and descaling of steel also expand. Research in anti-corrosion finishes focuses attention on copper and zinc coatings for steel and aluminum. New organic paints afford faster finishing

Lt. Commander W. H. Spowers Jr., Bureau of Ships, Navy Department, Washington, D. C.: "Galvanizers have for many years been unable to determine the presence or absence of secondary metal when requisitioning spelter. Elimination of certain types of secondary metals is highly desirable in order to obtain high quality galvanizing.

"Galvanizers have also lacked any adequate procedures which will provide a predetermination of varying degrees of fluidity in the many types and brands of zinc. Fluid or nonfluid zincs are each desirable for specific purposes in the galvanizing process.

"Development tests for the purpose of specification development along these lines are being conducted by the Bureau of Ships. It is hoped, upon completion of this program, that some very interesting and useful data may be made available to the galvanizing industry."

R. O. Loengard, vice president, United Chromium Inc., New York: "The past year has shown a continuation of the trend of the previous year. The use of chromium plating in connection with internal combustion engines and particularly for increasing the life of cylinders, cylinder liners and piston rings has become well established and experience has, in many cases, indicated the proper surface of a chromium finish which gives the best results in specific applications.

"Much work has also been done on the development of improved corrosion resistant coatings for steel, particularly with regard to zinc-plated steel in the many cases where zinc has been used as an adequate replacement for cadmium.

"In addition, much thought has been given to the use of some of the lighter metals, such as aluminum, and the finishing problems raised in connection therewith, all of which developments have focused attention on new processes of copper plating and zinc plating which lend themselves to the problems of today."

George Diehlman, research laboratories, National Lead Co., Brooklyn, N. Y.: "Anticipation of a greater production of iron and steel and a further speedup in fabrication schedules has led to development of red lead paint primer formulations which will conform with current requirements. The effectiveness of any paint coating in preventing corrosion of the underlying metal is primarily dependent upon the inhibitive pigments contained. Red lead, with its long, successful record, has established itself as the outstanding corrosion-inhibitive pigment.

"The present trend is toward quicker air-drying or faster baking coatings. These objectives are usually accomplished by an adjustment of the pigment (solid portion) and to an even greater extent by a change in the vehicle (liquid portion).

"Various degrees of dry film gloss, ranging from glossy to flat, are obtained by varying the proportion of total pigment to total vehicle solids by volume. Drying times ranging in intervals of a few minutes or longer are obtained by the use of vehicles made with the newer resins and newer drying oils.

"Postwar possibilities on corrosion-preventing paints are being investigated. Among them are new modifications of alkyd, phenolic and other resins, synthetic rubber products, vinyl, styryl and acrylic compounds, and many others. This work will undoubtedly be productive, and improved red lead paints can be expected."

F. P. Spruance, vice president, American Chemical Paint Co., Ambler, Pa.: "Cuprodine, used generally in the production of steel cartridge cases, introduced a problem of removing copper to facilitate pickling after annealing. A new copper stripping solution for this purpose has proved of unusual interest, since it contains no chromates or cyanates. Stripping time, in most cases, is even shorter than with the use of more objectionable materials.

"A rust-resistant product known as Cuprotek has been developed for protection of copper-coated parts so that they may be stored for longer periods without corroding. The processed work is merely immersed in the protective solution, then rinsed in a weaker kindred solution, and dried. While the thin copper coatings so produced are not comparable with galvanizing, their resistance to corrosion was much improved.

"There has been extensive research conducted recently with an improved liquid chemical intended to simplify pickling of ferrous metal surfaces, especially, difficult alloys. Parts are immersed in the chemical bath and then introduced wet into an annealing or heat treating furnace. Results indicate pickling is both speeded and improved.

"Collaboration with the pickling industry has made possible the introduction of new grades of older solutions and a new material designated as 'ACP Pickle Bath Toner' for use in sulphuric acid pickling baths in instances where a good inhibitor is deemed unnecessary. The pickle bath toner leads to cleaner,

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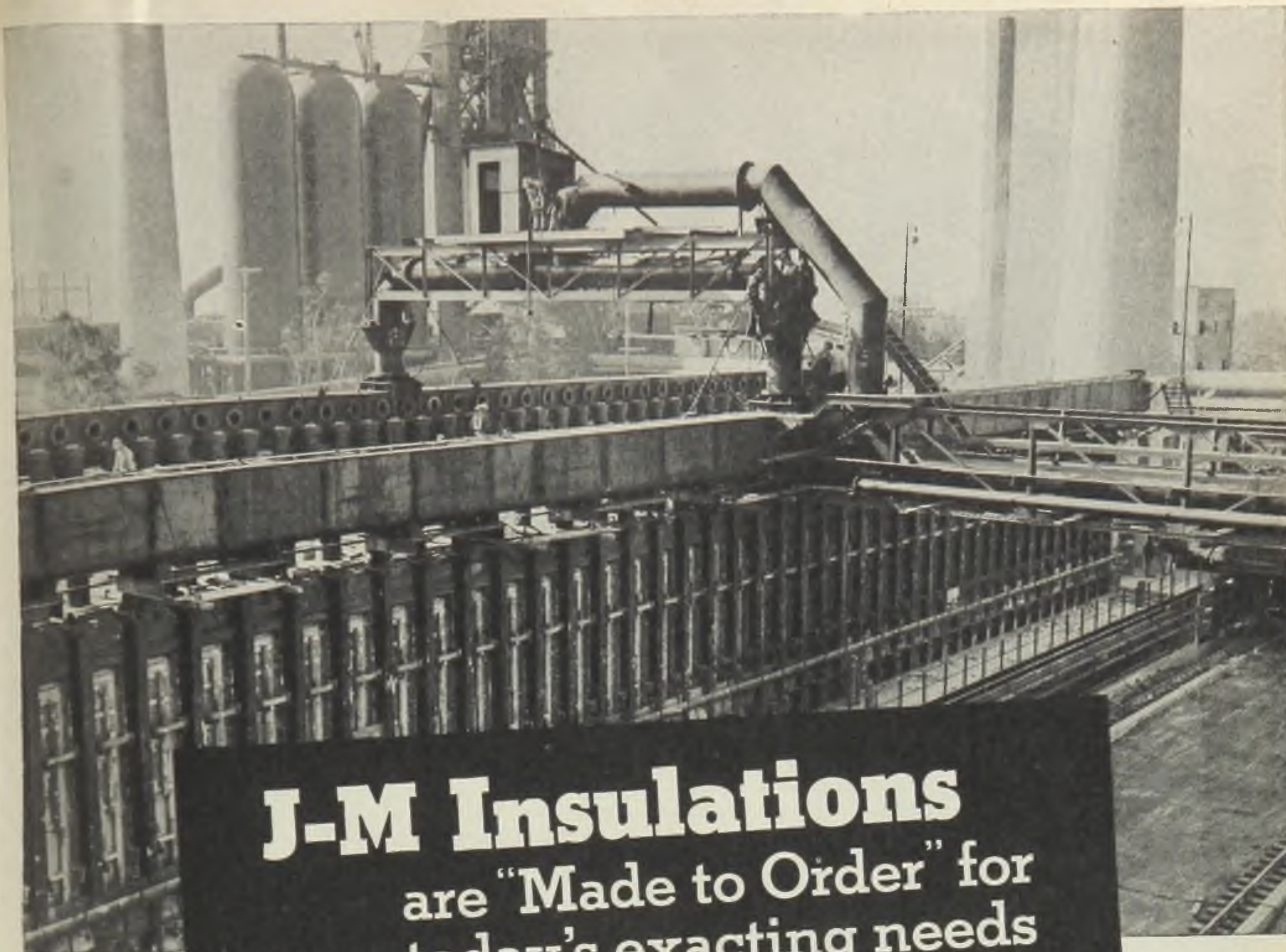

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FOR STEAM LINES UP TO 700° F. J-M Asbesto-Sponge Felted Pipe Insulation is recommended where maximum efficiency, high salvage and resistance to abuse are essential. For temperatures over 700°, used in combination with Superex. It is available in 3-ft. lengths, from 1″ to 3″ thick, for standard pipe sizes.

SIL-O-CEL C-3 CONCRETE—Cast on the job from Sil-O-Cel C-3 aggregate and cement. Sets up into a strong, durable semi-refractory insulating concrete for temperatures up to 1800° F. Crushing strength: 1000 lbs. per sq. in.

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CASTING

TIMELY recognition by foundrymen of benefits of research reflected in higher quality and general integrity of all castings. Mechanization and equipment program, now well advanced, confirmed by labor crisis. Side-blow converter steel bids for quality market. See trend toward more die castings to absorb surplus magnesium. Duplexing system makes headway in the malleable field. War need stimulates advancement in precision casting

W. L. Seelbach, secretary and treasurer, Forest City Foundries Co., Cleveland, and president, Gray Iron Founders' Society Inc.: "The transformation of the highly adaptable gray iron industry from a great commercial producing enterprise to all-out, vital war service was accomplished without conversion of plants or important additions to facilities. The industry faces, then, no problem or question of reconversion or overexpansion as it looks to victory and to peace.

"Since the gray iron industry is basic, however, and so very intimately related to the overall industrial situation, its production pace in the immediate postwar future will be governed by the ease or difficulty with which the nation as a whole makes the transition to peace. If nothing is permitted to stand in the way of production to meet a tremendous demand for civilian goods at home and the essential needs of the world in the period required to get European industry back on its feet, if all industry is enabled to reconvert quickly and employ fully, gray iron foundries will suffer no serious readjustment.

"Modern war has demonstrated thousands of old and new uses for gray iron castings, redemonstrated that nothing has replaced gray iron in its wide range of important engineering applications. The strains of war have, in fact, but served to emphasize that the gray iron industry has developed remarkably in recent decades, that it has kept pace with technological advances and production techniques.

"In after-victory days the industry expects sharply competitive markets, but it is prepared to meet competition aggressively and to move into an advanced world with multiplied skills and the advantage of a wider recognition of the experience, the ingenuity and technique which goes into gray iron castings. Where the stakes have been the lives of men, victory and freedom, gray iron has been retested. And it will continue to make good in the great engineering developments which are the promise of peace."

Charles W. Briggs, technical and research director, Steel Founders' Society of America: "After the war, consumer specifications for steel castings will be more exacting and mechanical property requirements will be increased for many grades. Also, buyers will select higher property grades for their future requirements. This will necessitate a greater use of liquid quenching by the industry. Many steel foundries have become completely set up for performing time quenching on a mechanized basis. The industry is also pushing use of normalized, and quenched and tempered heat treatments.

"There will be greater use of destruction or service testing of casting units and comparing them with similar tests on forged and welded units. Such tests will bring out true values of castings and will do much, along with economical considerations, to decide the type of construction. Wide use of nondestructive testing, carried on in the steel foundries today, will continue and be extended. Nearly all new castings will be preceded by a pilot casting which will be investigated by radiography and magnetic inspection along with surface inspection and dimensional accuracy checking.

"There will be more commercial use made of centrifugal steel castings. Their use has been so accelerated during the war period that equipment builders will continue to specify them.

"Cast weld and composite fabrication, wherein steel castings are welded to steel castings or to wrought steel to form complete units, were well under way before the war; they will be attacked with intensified interest.

"There will be a broad use of the low alloy steels of the National Emergency series. Foundrymen are learning that it is not necessary to use alloy content of a total of from 2 to 6 per cent, in order to obtain additional properties.

"It may be expected that the surface of castings will be improved when there is time for the study of molding sands and materials at elevated temperatures."

H. A. Schwartz, manager of research, National Malleable & Steel Castings Co., Cleveland: "The most interesting development in the malleable industry is the introduction of very small amounts of boron, approximating 0.001 per cent, for improving annealability of malleable iron. The use of this small addition goes far in overcoming difficulties arising out of the introduction of stray alloy elements through the scrap, which bade fair to become quite troublesome."

James H. Lansing, shop practice and development engineer, Malleable Founders' Society: "In 1943, much was done to improve efficiency and eliminate bottlenecks in plants of the malleable iron castings industry. Where pulverized fuel was not already in use in melting and annealing equipment, it has been applied. Where type of production has made it practicable, there has been increased mechanization. Certain plants have increased or are increasing their facilities for the production of large rear-axle housings, for which the requirement is considerable.

"The above steps have been progressive ones, but they have not and cannot solve the main problem of the industry in 1943. The demand for malleable iron castings is great, but it is not beyond the capacity of the industry; it is, however, beyond its present manpower capacity. The industry could increase its production by 30 per cent and be abreast of the demand were the men available. The industry has been active for many months in trying to augment its personnel and is bringing the matter to the attention of governmental agencies. Early results of an effort to obtain Mexican nationals to complete manning of the plants were encouraging, but the attempt failed due to international complications. Release of excess labor from the South or southern Texas, or release of a few thousand Italian prisoners of war for service in its plants is now hoped for to place war production of malleable abreast of requirements."

W. H. Worrilow, president, Lebanon Steel Foundry, Lebanon, Pa.: "The marvelous progress that has been made in improved foundry engineering, thereby insuring more certainly the interior integrity of steel castings, has been the greater contribution of our industry this year.

"The users of steel castings are further protected by the additional use and increased knowledge of X-ray, Gamma-ray, Magnaflux, Ziglo, and other magnetic tests. Following a known chemical composition, a carefully and accurately controlled heat-treatment, the proper heading and gating, gives to the consumer an assurance of quality and dependable steel castings that he has never possessed in the past and which should lead to a marked increase in use of the product."

F. W. McIntyre, vice president and general manager, Reed-Prentice Corp., Worcester, Mass.: "Die casting of aluminum alloys and magnesium will have a tremendous expansion in the postwar period. There is a possibility that it will regain some of the requirements lost to the plastics industry, especially with magnesium material. This change in prospects has brought about the redesign of a complete line of die casting machines and the addition of a larger size machine with die plate area of 30 inches by 30 inches, locking pressure up to 600 tons and pressure on material up to 35,000 pounds. Machine and furnace can be equipped with mechanism for successfully drawing off the gases when casting magnesium.

"The writer has recently returned from Australia where they have installed between 40 and 50 machines, many of them of large capacity, for producing zinc aluminum alloys and magnesium die casting. They have produced successfully shell fuses from zinc casting and many other components of machine guns and munitions. One interesting development on small bullets was the loading of tips with plastic injection molding material rather than lead only. Australia has built and is now operating a plant for producing magnesium and will be in a position to furnish all of the material for Australian requirements."

Oliver Smalley, president, Meehanite Metal Corp., New Rochelle, N. Y.: "The foundry industry in 1943 has striven mightily in the face of increasing handicaps to achieve maximum production. Deficiencies of common and skilled labor and experienced executive personnel have forced producers to turn to labor-saving devices and equipment that will have profound and far-reaching influences on methods of casting after the war.

"There has been a great growth in the understanding of the engineering properties of Meehanite castings, particularly those types which have been used so successfully in place of critical materials such as steel castings, forgings, bronze and alloyed materials. Research activities of the Meehanite groups have been stimulated by new demands and new opportunities for helpful applications. For example, much useful and substantial information on the creep properties and heat resistance of Meehanite castings used in the manufacture of synthetic rubber has been gathered and correlated. There has also been made a number of metallurgical studies concerning the transformation of austenite in Meehanite aimed toward the development of a maximum tensile strength.

"One momentous development during the year has been the extensive adaptation of Meehanite for tool shanks and milling cutter bodies.

"Expanded applications might be seen in the overcoming of many traditional oppositions to cast metal by the services."

Harold H. Roast, vice president, Canadian Bronze Co. Ltd., Montreal, Canada: "The next year bids fair to require the same amount of high-pressure manufacture and delivery of bronze castings for the war effort that obtained in 1943. When the present conflict ceases, there will, in many cases, be a tendency for designing engineers to go back to prewar standards for the physical constants of metal. As an example, the emergency alternate provisions of the American Society for Testing Materials will, to a fairly large extent, probably be eliminated.

"The making of castings 'honestly good all the way through' will still be the only desirable standard. This should mean a definite increase in the number of castings fractured, as the fracture of the casting is the easiest way for the foundryman to satisfy himself that this slogan has been lived up to.

"Sand control is gradually assuming an orderly development as between seller and user so that even the smaller foundries in 1944 will place sand control on the same basis as metal control.

"Centrifugal casting in both chill and sand molds will continue to increase.

"In the postwar period, one would expect a tendency for foundries presently engaged only in casting to extend into the machining field."

F. A. Melmoth, vice president, Detroit Steel Casting Co., Detroit: "Most prominent development in 1943 is the use of low alloy compositions designed to economize on stringent alloys, while meeting the high standards of physical qualities demanded by war purposes. The use of intensifiers, principally boron, has grown out of this necessity, and the conditions surrounding its effective use have been thoroughly investigated.

"Of greater moment, however, is the probability that the year will go into the record as the one in which the founding industries became research-minded.

"The major technical organization of the founders, and the trade organization of the steel founding section, have each embarked upon ambitious schemes of co-operative research, destined to have marked effects on the postwar situation by enlarging the field of castings application.

"From the purely operating viewpoint, the year will live in memory as the one in which the muddled equation of vital demand versus available manpower arrived at its most illogical acme, when the only men available were those physically or mentally, or both, unfit for military needs, having to be taught the often tedious and always slowly-absorbed details of industrial production, and being expected both quantitatively and in quality of work to pick up at the point where their experienced counterparts finished.

"While postwar considerations must be at best secondary, war experience is building in the steel founding industry a technical foundation of great value, and nothing but good can come from a proper evaluation and docketing of such long-time factors against the day when they will be needed in normal competitive production."

N. K. B. Patch, secretary, Lumen Bearing Co., Buffalo: "The manpower shortage at this time is one of the critical things that faces industry in its attempt to satisfy war demands. Every effort should be made to spread manpower in the most effective way so as to insure maximum production. The government would do well to take immediate and forceful steps to correct the labor hoarding evil by whatever means seems most effective.

"In the nonferrous foundry industry there is a definite shortage of labor which is seriously handicapping production, to say nothing of reducing the efficiency with which any given plant can operate by reason of the inability to pick the most effective man for a given job.

"We believe that the conversion from war to peace is going to occur with considerably less upheaval after this war than was the case following the previous war in spite of the fact that this is an all out effort this time as compared with a considerably more local effort in the previous war. If movement is not interfered with by either government or organized labor, it will result in a surprisingly simple conversion.

"Industrial executives have given this problem a considerable amount of thought. In consequence, they have carried on advertising campaigns dealing with their peacetime products in spite of the fact that they could not deliver any of these articles to the public under present conditions and have also been planning their co-ordinated effort in meetings of national industrial associations."

J. W. Bolton, director, metallurgical research and testing, Lunkenheimer Co., Cincinnati: "The castings industry has been markedly influenced by general manufacturing progress. It has, to an appreciable degree, taken advantage of developments in scientific metallurgy and in the newer methods of measurement, instrumentation and control. There have been many advances in mechanical handling and working in the foundry, in transportation of materials, in cleaning, in machine molding, and the like. The greater number of foundry managements have paid more attention to advanced mechanization than to possibilities within the extension and application of metallurgical science.

"Gray iron has had and will have a considerable place in our industrial economy. Its merits are not fully exploited. This does not say that the same foundries will make the same product the same old way—far from it. It indicates that, in the long run, a material of construction finds the field of acceptance for which it is best adapted. The time lag or lapse can be greatly shortened by seeing to it that the story is properly and promptly told to the consuming public.

"No branch of the castings industry has exceeded the steel group in its consistent and co-operative backing of foundry metallurgy. The sound, tough, reliable steel casting of today is a result of faith in and financial backing of metallurgical advance.

"The light aluminum and magnesium base alloys have attracted the attention of the public and have increased the interest of capital and management. The lightness of these metals, their machinability, the greatly expanded production capacity now available, and the lowering in cost per pound to the founder or other user are a combination which suggests expansion in domestic usage after the war."

Gordon C. Curry, manager, war products division, The Hoover Co., North Canton, O.: "There is undoubtedly a trend by government agencies toward the use of more die castings, especially in magnesium and zinc. Magnesium die castings have been held up due to the lack of equipment on which to manufacture them. Cold chamber machines on which these are made had not been in general use previous to the war and in the early days of the war many aluminum jobs were scheduled on these machines that could have been made on the goose-neck type.

"The War Production Board is rectifying this by backing certain installations of cold chamber machines for magnesium only. The aviation industry is anxious to see this done and any one entering the field should have no trouble in filling equipment to capacity. The government will follow this closely as magnesium is not being adapted to new uses fast enough to absorb the quantities manufactured.

"There has been some reticence on our government's part to use zinc die castings as widely as have the British. This is gradually being corrected, and it is well, as there is a large manufacturing capacity here which heretofore has not been used.

"The die casting industry is in an enviable position to resume postwar business, as it has not been overexpanded. Tools and dies on items that will go back into civilian production continuing in the same design as prewar models, can be put into immediate use and production had within 30 days.

"Type of machines and metal to be used will depend on the base price of the metals. Aluminum in virgin form will sell at 10 cents or under and the secondary market will be considerably below this. Much secondary can be used and it depends on what the price structure of magnesium and zinc is as to which alloy will dominate the engineer's design."

M. F. Becker, vice president, Whiting Corp., Harvey, Ill.: "The bottleneck for steel castings has been partly alleviated by the installation of approximately 50 side-blow converters installed within the past year or so. This change, brought about after exhaustive tests conducted by the Battelle Memorial Institute, proved that side-blow converter steel was just as good as steels made by the electric furnace and open hearth methods. On Aug. 24, 1943, Specification QQS-681-B was revised to include the converter as an approved process for making steel castings.

"Quite a number of gray iron foundries are considering installing side blow converters for blending cupola iron with blown steel for producing semisteel and high-test gray iron castings. This process will grow in popularity and enable gray iron foundries to produce higher quality castings at a reduced cost.

"Looking toward economy of labor and materials, many foundries are installing mechanical cupola charging equipment which enables them to keep up production with a reduced force. Dry blast and hot blast equipment have both played vital parts in improving the quality of gray iron and at the same time saving between 20 and 25 per cent of coke.

"In order to increase the production of malleable iron castings, many malleable foundries are converting to the duplexing system which utilizes cupolas and air furnaces. The charges are melted in the cupola, which is the most efficient of all melting furnaces, and then tapped into air furnaces for refining and superheating."

John Howe Hall, metallurgist, General Steel Castings Corp., Eddystone, Pa.: "During 1943, there was great activity in development of the centrifugal method of making steel castings.

"Methods that have been practiced for some years in the casting of tubing in rapidly revolving horizontal molds are being extended to the production of hollow shafting and similar articles, where no central core, or only minor coring, is used. Until quite recently, this method has been used chiefly for the

(*Please turn to Page* 383)


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MACHINING

MACHINE tool builders regard the tapering in their regular business only as a challenge to their ingenuity in making eleventh-hour conversion to war work other than machine tools. That the postwar period will bring new types of machines is presaged by current developments in superspeed milling. The need for adequate financial reserves is stressed

Tell Berna, general manager, National Machine Tool Builders' Association, Cleveland, Ohio:

'Machine tool production in 1944 will probably be about one-fourth of the maximum output that the industry reached in 1942, and about one-third of what the industry will have shipped by the end of 1943. As far as possible, machine tool builders will use their excess capacity for the manufacture of other types of war material.

"Regardless of the length of the war, there are three things which machine tool builders are thinking about:

"1. Getting other kinds of war work into the plant has the advantage not only of supporting the war effort, but also proving to a variety of possible postwar customers that the machine tool builder's facilities, the special skill of his engineers and shop men, fit him to handle a wide variety of precision work and handle it well. This proof may stand him in good stead in the postwar period.

"2. Machine tool builders are thinking about a complete redesign of the machine tools they have been building so that the minute the war is over, they will be ready to offer their customers new and better machine tools for cutting production costs.

"3. Machine tool builders are becoming increasingly concerned regarding the financial outlook for their companies. When all-out machine tool production for the war was the one vital consideration, financial problems were given scant attention, and the machine tool builder took chances when it was necessary to do so in order to drastically and rapidly increase his output. The time has now come to turn the search-light in this direction. Inventories of parts and machines in process must be reduced to a degree commensurate with current orders. The cancellation of contracts must be carefully studied, and from now on new orders must not be accepted without careful consideration of the cancellation risks involved.

"In every past cycle of a similar nature, the machine tool industry has always been able to regain its markets by providing new and better machine tools, which enabled more manufacturers to produce better things for more people at less cost. I have no doubt that the machine tool industry will again supply this principle to revive the market at home and abroad when the war is over."

Wendell E. Whipp, president, Monarch Machine Tool Co., Sidney, Ohio:

"If employment throughout the country is to be maintained at proper levels when the war is over, it is of the utmost importance that machine tool builders start to redesign their machines right now.

"When the boys come back from war, we will have in this country far more people expecting to have jobs than we had in the prewar period. How are those jobs going to be created?

"There is a formula for creating jobs. It is a basic principle. It has created more jobs than any other factor in the history of the world. It is the formula of mass production: Lower prices plus larger volume equals more jobs.

"Now this cycle starts with lower prices, and lower prices start with better machine tools. Therefore it is up to the machine tool industry to help manufacturers of this country tool up for prices *low* enough, and volume *large* enough, to absorb—in manufacturing, distribution and servicing—millions more people than were ever thus employed before.

"Can we do it? I think we can, if we are left with enough earnings after taxes and renegotiation, to implement our program. It is going to take a lot of money for research, for new design, for tooling up, and to hold our organizations together until our new machines are in production. That's why we need those reserves!"

Brig. Gen. H. F. Safford, Ord. Dept., U.S.A., Chief, Production Service Branch, I. D., Washington, D. C.:

"Among recent Ordnance manufacturing developments of grinding versus hand finishing methods can be cited the successful application of grinding of breech ring slot in 75 mm and 76 mm weapons.

"This operation is difficult due to very close clearance, interfering projections and toughness of breech ring material. The finished surfaces of the breech ring must be flat and smooth in order to insure freedom from wear of mating components, in the field.

"The grinding method has now been in use for approximately 20 months and in that time has saved one and one-half man hours per unit. Advantages of the grinding process are as follows:

(a) Broaching of the slot can be allowed wider limits since the grinding machine removes stock more quickly than hand work.

(b) The resulting ground surfaces are smoother and entirely free of torn areas generally encountered in a filed or scraped steel surface.

(c) Radii can be accurately controlled by truing the grinding wheel to drawing specifications.

(d) Grinding machine operators can be trained to turn out volume production in a short time as compared with the period of training to produce breech rings by hand finishing methods.

"A standard surface grinder was equipped with a special double wheel vertical spindle arranged with two grinding disks to finish both the top and bottom surfaces of the breech ring in one setup. No difficulty was encountered in producing acceptable breech rings which could be checked by test plugs before removal from the machine fixture. Experience in the field has apparently been very satisfactory as other producers of this same part have converted from hand finishing to finish grinding."

Charles J. Stilwell, president, Warner & Swasey Co., Cleveland: "So far as the immediate future of the machine tool industry is concerned, the course, it seems to me, is set.

"The industry has tooled the country for war. If we are perfectly honest, we must admit that the country is probably over-tooled at the moment. This is said without the slightest criticism of anyone, for we have nothing but praise for those men in Washington who foresaw and carried out this tremendous job of tooling for war.

"The machine tool future is definitely divided into two periods: first—win the war; second—postwar.

"We have in this industry certain skills and knowledge which not only can be applied to the manufacture of machine tools but can be quickly converted to production of a wide variety of direct war equipment, work which requires the same extreme accuracy necessary in building machine tools.

"Our first task is to build and ship as rapidly as possible every type of war work up to the capacity of our plants. Plans for the postwar future may be set aside for the moment—our only interest should be in doing our share for war production, and that share is nothing less than capacity.

"To be sure we must retain a reasonable flexibility to meet such machine tool demand as may still develop for replacement, and for such occasional expansion as will still be authorized for war purposes. But I would go so far as to say that machine tool builders should stop building new machines except to meet such reduced demands as may still develop for war purposes only.

"With the tremendous over-production of standard machine tools that has taken place during the war period, there is little question in my mind that in the postwar period the surplus for redistribution will seriously interfere with the normal prosecution of the business.

"Until such time as machine tool builders can accomplish a thorough and complete redesign of their own products—and by and large that will cover a period of years—machine tool skilled personnel and the accumulation of experience and knowledge in precision manufacture make it possible to turn to other fields in order to occupy the industry's expanded plants and enable it to do its full share in the re-employment of men returning from the armed forces.

"Our base can readily be broadened to include products having other markets, which can be developed for manufacture and sale, in order to fill in the gap.

"One of our greatest problems will be the accumulation of a sufficient reserve out of profits to enable the companies of our industry to carry on the necessary development and experimental work which the transition period will force upon us. If such reserves are allowed after taxes and after the renegotiators have finished with us, I believe the outlook for a successful solution of the problems of this important industry is favorable."

Philip M. McKenna, president, Kennametal Inc., Latrobe, Pa.: "The greatest advance in the application of cemented carbide in 1943 was in the field of the milling of steel parts at high speeds and with precision and smooth finish by the use of milling cutters of designs embodying negative angles and cemented carbide tips of tungsten-titanium carbide (WT_1C_2) compositions capable of functioning at these negative angles because of the hard, non-adhering and crater-resistant surfaces of these strong steel-cutting grades of cemented carbide.

"Way back in 1939, fly cutters—single-point tools revolved about a center and functioning similarly to the blades of a multi-point milling cutter—were successfully employed in the milling of steel surfaces. These fly cutters were tipped with steel cutting cemented carbide and operated at speeds two to four times that customary for cemented carbide tools in other machining operations such as turning, facing, and boring.

"It is still a debatable question whether the high speed found necessary for optimum tool life was entirely due to the better machining properties of steel cut at these greater speeds, or whether the chief advantage may not be more reasonably attributed to the greater steadiness to the cutting edge at these higher speeds. The utility of these fly cutters, and their economy of initial cost and upkeep, resulted in their wide use in cutting steel aircraft parts up to 43 rockwell C in hardness and 180,000 pounds per square inch in tensile strength.

"Despite the fact that only one blade was used, instead of 8 or 10 blades as in a high speed steel milling cutter, the table feed was at least equal to that of the multi-bladed high speed steel cutter because greater chip loads were found preferable with cemented carbide and the cutting speed was 10 to 20 times that customary with tungsten steel.

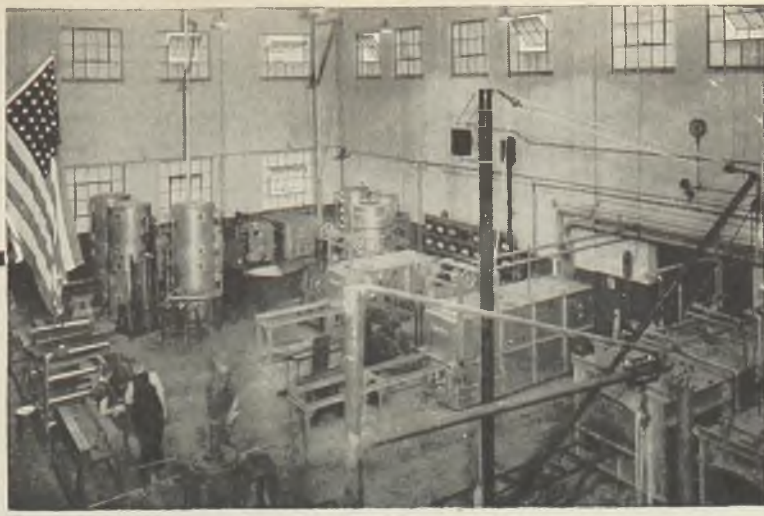
"During 1943, designs of steel-cutting carbide tipped cutters, having about one-third as many teeth as customary with high speed steel cutters, were made available. The tips were economically mounted on high strength cast iron bodies or on boiler plate bodies, by brazing, or by slotting for holding carbide tipped tools. These designs afforded space for the rapid escape of the large volume of chips made by these fast moving cutters, and had vibration-damping properties. Steel parts are now being machined at speeds 2 to 10 times those previously considered maximum, and with greater precision and lower tool cost.

"Milling machines may become as universally used as lathes, now that it has been found possible to attain the potential advantages of steel-cutting cemented carbide in this method of metal cutting. As engineers and designers become aware of this accomplishment, they may employ designs for steel articles and parts which they have hitherto avoided because of the cost of milling operations as previously practiced."

Albert M. Stedfast, president, American Machine Tool Distributors' Association, Boston, Mass.: "In the year 1944 the Machine Tool Distributor organizations will continue the services that they have been performing in the past several years wherein they assisted in tooling up the war industries. Many plants will convert and in doing so will call on the distributors' field service men to assist them in the retooling of their plants. They will suggest improved methods in machining and fixture design.

"A number of the smaller manufacturers will be in position to obtain government surplus machines, or where they are not available, can purchase new ones that still remain unassigned on DPC pool orders. In many cases these smaller companies have not had contacts with the governmental agencies and the distributors' men will be in position to give them the necessary information and guidance in preparing the required papers to get machines they desire.

"Field service men will be called on to assist in the installation and starting up of machines that are obtained by manufacturer from the governmental agencies, the same as if a new tool of the make which they represent had been purchased. This class of work will take up much of the distributors' time but they will be found willing then as they have been in the past to assist the war effort in every way possible within their power to do so."



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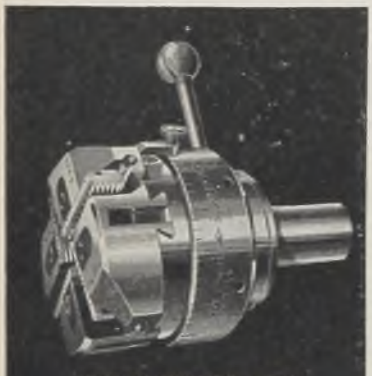
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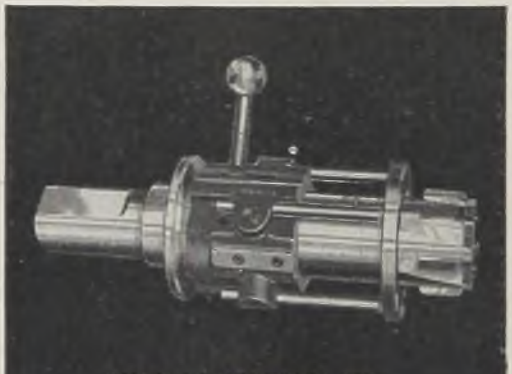
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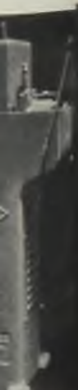

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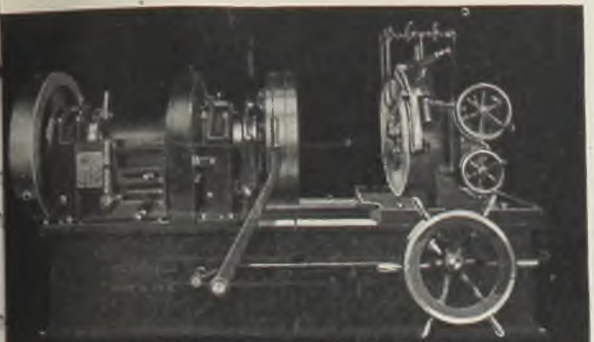
See *Announcement* on Page 81



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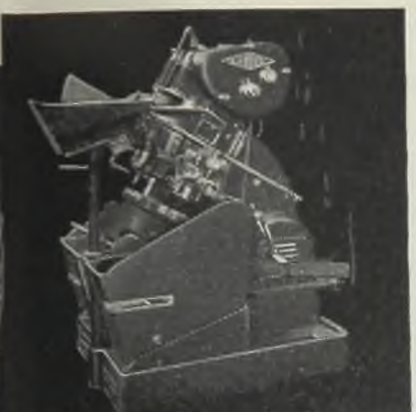

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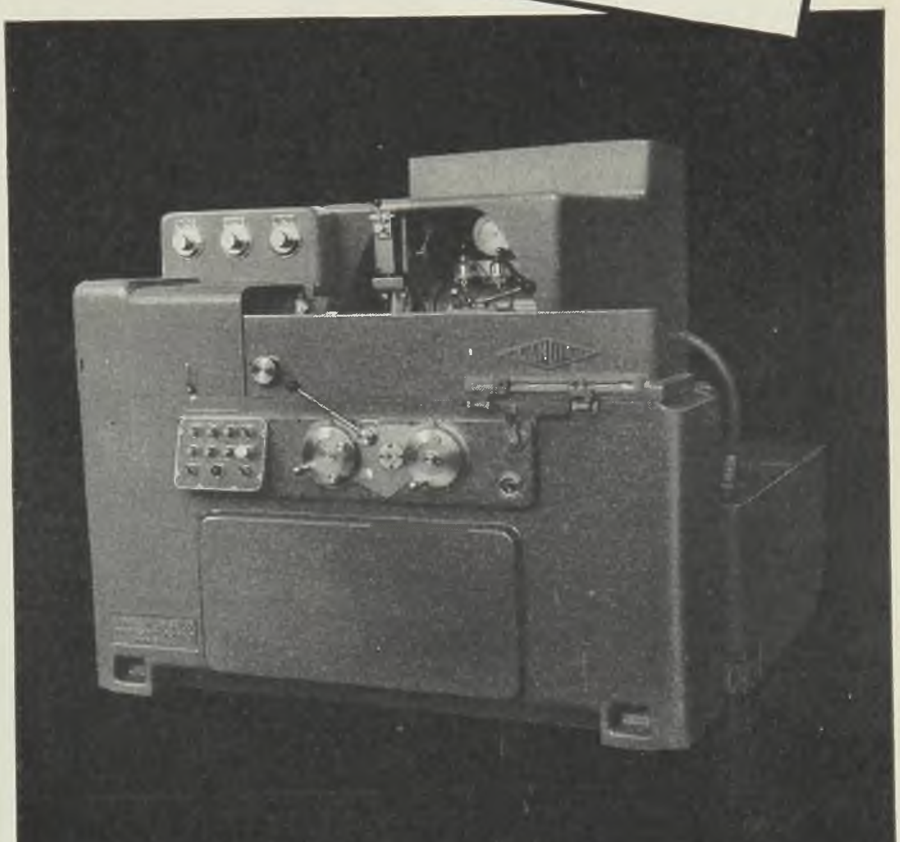

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R. S. Babcock, development engineer, Linde Air Products Co.: "Outstanding in oxyacetylene cutting is the increased range of thicknesses that can be successfully cut. Blowpipes and nozzles capable of cutting through sections exceeding 40 inches in thickness have been developed. Fabrication of heavy forged sections for large marine engines and shafting by oxyacetylene cutting has aided in speeding up delivery of war material. Improved operation of heavy cutting equipment has enabled shops to cut to closer tolerances and relieve the overtaxed facilities of foundries and manufacturers of large forgings. Metallurgical inspection of steel structure in large ingots has been speeded up through sectioning test ingots by this method, as well as inspection of highly important samples of war steels."

A. G. Bryant, president, Bryant Machinery & Engineering Co., Chicago: "The war job of American industry has been to produce, and that part of the war effort has paced the victory march. American genius to engineer, organize, build, manufacture and distribute has confounded the enemy.

"In facing the future, however, both in the first task of finishing the war and the second one of building the peace, American industry must learn to add another function to its organization. It must take more of an interest in governmental affairs.

"Industry now finds that to produce and to sell will not be enough. For having extended its plant investment in the war effort, it has tied up its capital in buildings, machinery and inventory. In addition, wartime taxes have absorbed profits and in many cases, renegotiation of contracts has consumed reserves set up to support postwar product development and employment.

"Without such reserves, the durable goods industries are weakened. New engineering research cannot be undertaken, plans for new markets are empty dreams. This is calamitous to the national welfare as well as to the private interest involved. Furthermore, it is an unnecessary handicap to the future prosperity of America.

"Hasty legislation, short sighted administration and lack of effective industry leadership are the causes. Extremes of government policy could have been avoided to a considerable extent in the past, if industry had at an early stage recognized the dangers and evolved a constructive policy to avoid them.

"Labor is mobilized constantly to further its cause. Farmers are on the alert and are organized to fight for their interests. But business is divided and fumbles. A few voices cry in the wilderness of confusion; but cohesion is lacking, purpose is not crystalized.

"Leadership in industry must rise above selfish interest, of course. It must be based on a statesmanlike grasp of true, broad, national economic interest. Without this leadership, business will be further buffeted by every storm. With it, business can take new hope and the country can be more assured as to its future economic health."

Elmer S. Sawtelle, vice president and manager, Tool Steel Gear & Pinion Co., Cincinnati: "Drastic war changes in steel products have brought to a sharp focus the need for various improved types of rolls. Machines designed for leveling or straightening light sections have suddenly had thrust upon them the necessity for handling armor plate or similar heavy jobs. Unusual study and activity in the roll industry has been necessary to produce types of rolls suitable for these applications.

"Similar problems probably will continue in the postwar period. Many of the metal-rolling applications developed for the war will be found to have a new significance in future productivity.

"American industry fortunately has shown itself able to meet situations like this. We believe that its future history will be no less replete with success stories based on ingenuity and technical ability."

L. C .Kemp Jr., director of research, The Texas Co., New York: "It has been rather generally recognized that the petroleum industry was faced with tremendous problems in stepping up its production of high octane aviation gasoline, aircraft engine oils, heavy duty diesel lubricating oils and other products required in much larger quantities than those demanded in peacetime. It is also rather generally recognized, as a result of the necessities of wartime demands, that there is now within the industry a great deal of flexibility, so that operations can be shifted rapidly from one type of product to another. It seems reasonable, therefore, to assume that even should the war end suddenly, it would be possible for the petroleum industry to shift over within the space of a few weeks to the manufacture of peacetime products.

"This does not mean, however, that the last shot fired in the war will be the starting signal for a nation-wide automobile marathon on the part of the general public. There are many problems in the disposition of stocks on hand and the readjustment of transportation and distribution system which will require time for solution. It is not anticipated, however, that this interval will be very prolonged. As far as the availability of petroleum products for industrial purposes is concerned, it is not expected that the petroleum industry will have any difficulty in keeping plants fully supplied as they change over from war to peacetime production.

"It would be impossible to cover adequately in so short a discussion the numerous developments in the petroleum industry which, although arising out of the war effort, will be of immeasurable value to peacetime users of petroleum products as is the case with developments in other industries. Many, in fact most, of these developments must remain undisclosed during the war. It may be said, however, that far reaching improvements in many fields have been made which will, undoubtedly, be available to you in the postwar period."

George H. Johnson, president, Gisholt Machine Co., Madison, Wis.: "Our company is very seriously analyzing problems involved in postwar production. Of course, we machine tool builders have largely been building our regular peacetime product in huge quantities to be used for the production of war materiel; consequently, the machine tool builder either must look to improved designs to make obsolete existing machines, or to products outside of the machine tool field.

"Our company is actively engaged in extensive research on our machine tool designs. It is our hope that very shortly after the termination of the emergency we can bring out new designs of production machinery which will greatly increase the usefulness of our product. We will not need new plant equipment for this, as our present factory equipment should be more than adequate to enable us to manufacture these new machines. It is our expectation that we might like to purchase part of the modest amount of government facilities that we are now operating.

"We are extensively investigating the possibilities of magnesium and aluminum, not only from the standpoint of utilizing these materials in our own product, but also from the point of view of better adapting our machine tools to the machining of these new alloys. Already we are using a considerable amount of plastics in our machine tools, and would expect to increase their use where feasible.

"The one most important postwar problem for a machine tool builder is to develop products that will not compete with the large surplus of machine tools

built for war purposes. In the ingenuity and resourcefulness of the individual company will be found the successful solution to this problem."

Paul H. Miller, chief engineer, Carboloy Co., Inc., Detroit: "Industry's acceptance of cemented carbide-tipped milling cutters for milling of steel constitutes one of the major metalworking developments of the past year. Its success bids fair to revolutionize milling practice even to the extent of eventually obsoleting a major portion of our present day milling machines.

"Contributing to the success of carbides in milling of steel has been the establishment of controlling factors governing design and use of the cutters themselves. Most important of these, perhaps, is the more general combination of negative shear angle, positive or negative rake angle, and bevel angle for the cutter blades. This combination has resulted in giving both increased cutter life and greater protection for the nose or chamfer—normally the "weakest" portion of the carbide cutter blade or tooth.

"Since carbide-tipped milling cutters are capable of removing metal at a vastly higher rate than ordinary cutters (due to the higher cutting speed), they do require considerably more machine horsepower when the same number of cutting teeth are employed and feed per tooth is the same.

"For this reason and since the wide scale use of carbides for milling steel is relatively recent, carbide cutters may have to be modified as to number of teeth when employed on milling machines originally designed for other types of cutters. This situation has made necessary the widespread use of cutters with fewer teeth than normally employed to reduce power requirements and still maintain adequate tooth loading. Even single tooth fly milling cutters making use of a single point tool which can be ground free hand—are being used successfully.

"Even those steels which are difficult to mill at all with ordinary cutters are today being successfully rough and finish milled with carbide cutters at speeds as high as 500 to 1000 surface feet per minute, and at nominal feeds-per-tooth of .005 to .008 inch.

"Present indications are that, as carbide-tipped milling cutters come into even wider usage, there will be a complete revision in the conception of what constitutes optimum milling machine performance. Machine manufacturers already recognize this. Carbide-tipped milling cutters make it possible to operate machines at speeds and metal removal rates never before attained. In so doing, however, there is created a need for greater power than is available in most milling machines today. This factor may well render obsolete a major portion of present day milling equipment, with a consequent side-spread impending demand for new designs of milling machines to replace them.

"However, even with present day milling machines, a material lowering of costs and stepping up of production has been obtained through the use of 'modified' carbide cutters. When the transitional stage is completed and milling machines especially designed for using carbides are available, there should be a further general and substantial lowering of costs in many lines of products through the savings made possible in both time and tool costs."

C. N. Kirkpatrick, president, Landis Machine Co., Waynesboro, Pa.: "There is no doubt but what intelligent and sane postwar planning is a necessity on the part of each branch of industry.

"There is a question, however, whether all of the publicity that is being given to postwar planning is required and whether too much of such publicity may be more or less harmful to the individual manufacturer. After all, any company interested in its prosperity and, in fact, in its continued existence, will strive for its own benefit to make plans to create business and employment after the war is over.

"I agree with Mr. Charles F. Kettering, vice-president, General Motors Corp., that to many people 'postwar planning' is really nothing more than 'postwar wishing.'

"The danger in over-playing postwar planning is that the trade in general and the public also will look for such radical changes in the designs of machinery and commodities that there will be considerable disappointment which may be harmful to the commercial life of our country. Too much stress on postwar planning may lead the metalworking industry to look for tools and equipment that may not attain their much advertised expectations.

"Some progress has been made in the designing of tools and equipment even during the war. Such progress was forced by the demand for greater accuracy and higher production. Costs apparently have not been considered of prime importance during the war—in many cases, rightfully so. The time is coming, however, when production costs will again assume their proper importance.

"Inasmuch as costs have not been the prime consideration, there has been a tendency to exaggerate certain processes in the metalworking field. For instance, the increased demand for thread accuracy and thread finish brought forth thread grinding. We recently placed the Landis thread grinder on the market with very satisfactory results. Due to the excellence of advertising and salesmanship on the part of thread grinder manufacturers, the grinding of threads developed into more or less of a fad. In many cases, when a fairly close tolerance and finish was required on threads, the manufacturer considered only the thread grinder, regardless of the cost of installation or the cost of grinding the threads.

"In many cases, such action was not necessary. With improved die heads and chasers, we found that threads could be cut with the required accuracy at a much higher rate of speed and at lower cost than by grinding the threads. As a matter of fact, many threads produced early in the war on thread grinders are now being cut with Landis die heads, and chasers, with the desired results and greatly lowered costs.

"When industry generally is again in a position where the cost of a product is going to merit real consideration, then we feel that not only in the production of threads but in many other operations, new designs will be offered featuring low cost of operation just as much as the accuracy and the production.

"Landis Machine Co. plans to have ready to offer for the postwar period, not only improved designs of present products, but also new products. In offering these products, the cost of producing threads will have equal consideration with accuracy and high production. It is hoped that with cheaper threads, the ultimate products in which the threads will be employed will also be cheaper, thus affording wider distribution and greater employment."

George T. Trundle, Jr., president, Trundle Engineering Co., Cleveland, Ohio: "We hear a lot these days about how we are going to return to peacetime products after the war is over. I question that word 'return.'

"I don't think we can return to anything. When this war is over, we can't go back to the prewar world. It will no longer exist. We will have to go on and forward to a new world—a world far more different from prewar days than many of us now realize.

"Industry's postwar job is often described rather loosely as that of 'reconversion' to peacetime products. I think 'reconversion' also is the wrong word. To a large extent it will be conversion just as truly as was the case when we converted from prewar peacetime products to wartime manufacture, for many of us will be making things far different from what we made before the war and some will be making things that

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FORGING

***W**ARTIME experience gives full expression to forging skills and ingenuities. More efficient drop forging machines and forging presses compensate for inexperienced labor and heavy schedules; improved parts design makes maximum use of grain flow in wrought metals; importance of correct heating cycles in hot working alloy steels receives greater recognition. Larger equipment is appearing. Present facilities deemed insufficient for probable postwar requirements*

R. E. Dillon, president, Lake Erie Engineering Corp., Buffalo: "Such development as benefits press design for war production will also benefit press design for production of civilian goods after the war. The research and development work which has been done is largely of a basic character and can be applied as is, or will open up new avenues for improved designs for postwar machines.

"In this war, methods of production had to be changed and substitution made for scarce materials. But such changes will, in many instances, prove to be of permanent value, and the hydraulic press which carries a heavy load in the production of war goods will play an ever greater part in the postwar industry."

Howard F. MacMillin, president and general manager, Hydraulic Press Mfg. Co., Mt. Gilead, O.: "There has been a very noticeable trend to the use of presses in the production of many vital forgings, especially aluminum and magnesium forgings.

"Probably the most important consideration affecting the turn to press forgings is that, generally speaking, closer tolerances may be obtained in press forgings than in hammer forgings. That these closer tolerances are obtainable is due, primarily, to the basic difference in a press and a hammer—the press exerts a steady, powerful squeeze action with resultant flow of material, while the hammer relies on impact.

"It has been found that this same basic difference results in longer die life when forgings are made on a press. Particularly is this true in the forging of aluminum and magnesium, wherein comparatively low forging temperatures are required. Die breakage from hammer impact is much greater in hammer forgings than in press forgings.

"In the case of some extrusion forgings, particularly such as steel cartridge case cups, the steady squeeze action of the hydraulic press results in an advantageous grain structure. These forgings have a grain completely parallel with the punch shape. When made under an impact blow, the grain is often driven out to the edge of the cup, perpendicular to the surface. In subsequent draws, the cases have a tendency to pull apart at the point of intersection of the grain and surface.

"The most significant recent advance in the field of press forgings has been the development of the forged aluminum cylinder head for radial aircraft engines. This heavy, intricate forging usually requires three separate pressing operations, and tremendous savings in time have been effected through the use of presses."

M. A. Monaghan Jr., vice president, Mondie Forge Co. Inc., Cleveland: "The most outstanding developments in the drop forging industry in the past year have been the pooling of ideas and the exchange of practical production methods and practices among the members of the drop forging industry. This letting down of the barrier has stimulated production, which has been of tremendous value to the armed forces.

"The industry has shown by its willingness to serve its customers from a consulting standpoint that its engineers can be of valuable assistance by being consulted on the matter of design of forgings, which not only simplifies the parts but permits faster forging and conservation of material.

"The industry, in the face of the manpower shortage, has not only increased production, but has made great strides in conserving its manpower by sponsoring safety through its safety committees, which has cut down the accident frequency, thereby utilizing manpower that had been suffering from accidents.

Eugene C. Clarke, president Chambersburg Engineering Co.,Chambersburg, Pa.: "Many very real and significant contributions have been made to the advancement of forging practice since the war began. While the advances are common to the entire range of forging processes, they tend to give special emphasis to drop or impact die forging.

"Developments in the design of prime movers and transportation vehicles highlight stepped-up operating speeds. Assuming that such increasing speeds will carry over into the postwar world, the only reasonable conclusion is that component parts entering into our peacetime mechanical designs must continue to increase their ratio of strength to weight. Such components must be able to carry constantly mounting stress loads without appreciable increase of mass. The answer to such demands appears to be ever-improved forgings.

"Advances in heating have made possible forged surfaces practically free of decarburization. Improved die-making techniques have provided a basis for extremely close-tolerance forgings, in many cases to exact finished sizes. Such refinements have effected a tremendous saving in materials, machinery and man-hours—at the same time developing wider horizons for the designers. These improved techniques, when combined with the greater power, higher speeds and more delicate precision of the modern drop hammer, have enabled the industry to produce with difficult metals

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