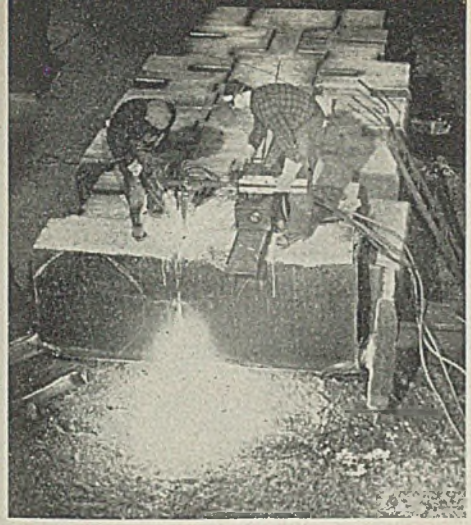

Operators flame cut 42-inch crankshaft, racking all transverse motions by hand. Page 110

STEEL

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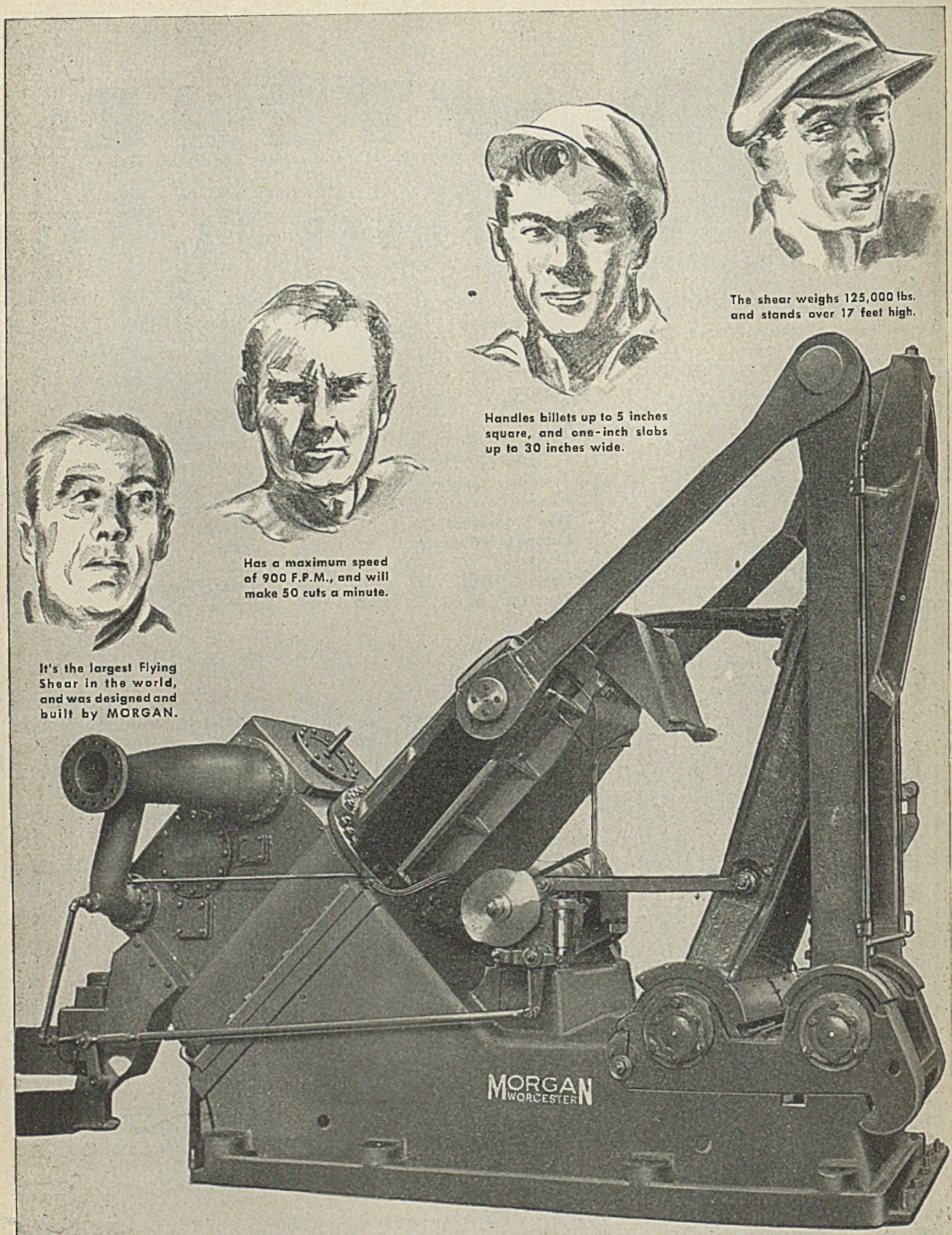
NEWS

TECHNICAL

FEATURES

MARKETS



R-116

MORGAN FLYING SHEARS

MORGAN CONSTRUCTION COMPANY • WORCESTER, MASS.

STEEL
December 13, 1943

Need Relief from Erratic Rule

We believe the American people today are more cynical than at any previous time in history. Housewives, farmers, industrialists, professional men, industrial employes and domestic servants—all are inclined to discount much of the official information which comes to their attention.

Why is this? Why, at a critical time in the greatest emergency ever confronted by this nation, should the average citizen be so skeptical?

The answer, we contend, lies in the devious path traced by government policy during the past decade. When the present administration took control in 1933 it went to great lengths to pooh pooh many existing principles and institutions. It derided thrift and ambition, discounted the law of supply and demand, encouraged fictional class antagonisms and—above all—promoted the idea of a planned economy.

The sponsors of this movement undertook to remake the nation. They introduced alphabetical agencies by the score to cure the alleged ills of agriculture, commerce, labor relations, public utilities, finance and what not. As failure after failure rewarded their zeal, they complained that their planning did not reach far enough into the vitals of the country to be truly effective.

Just as they were on the point of being discredited, war engulfed the nation. It provided them with an opportunity to plan on a truly comprehensive scale. Today the government is thoroughly engaged in a "Mother knows best" program which presumes to tell the citizen what he or she shall do or not do in great detail.

Today the inequities, contradictions, bungling and generally confusing aspects of this attempt at large-scale planning confront individuals and business on all sides. The nation is fed up with the idea that the bureaus know best what is good for the people. The reaction of the man in the street is reflected in Congress, where administration recommendations are received with increasing opposition.

But the trial of a planned economy is further complicated by the administration's policy of social discrimination. Even the heroic efforts of sincere men in high government positions fall flat because of this background of favoritism.

As a result, the government administration of domestic affairs is in a mess. The certainty of government by law has given way to the confusion of rule by personal whim. This state of affairs, at a time when industries and individuals are planning for the difficult periods ahead, is deplorable.

The nation needs relief from erratic government.

SPOILS A GOOD RECORD: In the testimony of John A. Barr, attorney for Montgomery Ward & Co., before the House Committee on Expenditures in the Executive Departments, appears this paragraph:

"The Post Office Department, on instructions from Washington, drastically curtailed delivery of our mail-order mail and dumped a large part of this mail in a warehouse which it rented for this purpose —obviously an act in support of the union and the WLB. We had to close the store."

That the United States Post Office Department, which through the years has created a wholesome respect for the sanctity of the mails, has been prostituted to the service of minority groups will come as a shock to many Americans. Yet the Montgomery Ward incident is not an isolated case. During the "Little Steel" strikes it was not uncommon for pickets to be permitted to go through the U. S. mail and to dictate which letters or parcels could go through and which could not. These facts were recorded in newspapers at the time and are reported on pages

(OVER)

269, 327 and 331 of Tom M. Girdler's autobiography "Boot Straps."

It is a shame that new deal fanaticism for alleged social reform has marred the fine record of the postal service. It will take the Post Office a long time to live this down. —p. 88

° ° °

GLORIOUS ACHIEVEMENT: There seems to be an epidemic of record breaking. During the past week numerous individual companies have announced new peaks in production in November. Reports to the American Iron and Steel Institute indicate that by the end of this year a new record in the tonnage of steel shipped to consumers will have been established. New records also will be achieved in the shipments of plates, hot-rolled and cold-finished alloy and carbon steel bars, and seamless steel tubing and pipe.

Another record which has received much notice recently is the feat of American shipyards in delivering 25,284,287 deadweight tons of merchant ships since Jan. 1, 1942. This tonnage, taken in conjunction with the heavy tonnage of naval ships delivered in the same period, represents a pace in shipbuilding never even remotely approached before.

This achievement reflects great credit not only upon shipbuilders, but also upon steelmakers, other material suppliers, fabricators, engine builders, and scores of other industries. As Admiral Vickery put it so aptly, "The modern shipyard is merely a final assembly line of a nation-wide plant."

—pp. 80, 81

° ° °

HARMONIOUS QUARTET: One of the noteworthy features of the "Second War Congress" of the National Association of Manufacturers, held in New York last week, was a panel discussion on postwar employment. The panel consisted of William Green, Philip Murray, Paul G. Hoffman and Frederick C. Crawford.

Doubtless this quartet would find it hard to agree upon some issues, but all four concurred without qualification in the premise that the American system of free private enterprise must be preserved. Also there was agreement in the desire of employers and employed to be freed of wartime government controls as rapidly as possible after the emergency has passed.

Maybe the new deal fiction that capital and labor must be at loggerheads can be destroyed.

—p. 82

HOUR'S WORK DOUBLED: Enders M. Voorhees, chairman, finance committee, United States Steel Corp., made a strong case against oppressive tax policies in his testimony before the Senate Finance Committee. Using figures from the corporation's books, he showed that in 1902, by the use of tools provided by the owners, a man's work for an hour resulted in the production of 29.7 pounds of steel. By 1942, the tools had so improved that the hour of work resulted in 60.6 pounds of steel. With the tools of 1902, the hours worked in 1942 would have produced 10,100,000 tons. Actual shipments in 1942 were 20,600,000 tons.

The importance of tools should be recognized in tax policy. Corporations must be given an opportunity to keep the tools in order. This means taxes should not drain off the money needed for plant and equipment.

Gems from Mr. Voorhees' testimony were, "A full order book must bear the costs of a lean order book" and, "Depression losses are boom costs." —p. 84

° ° °

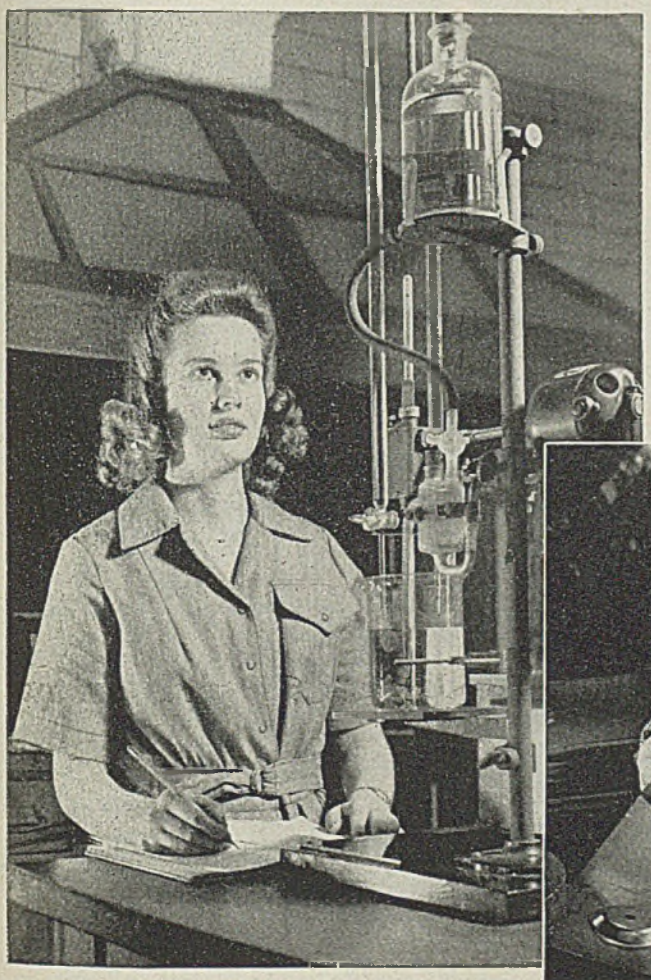
HEAVY FLAME CUTTING: Wartime conditions have made it necessary in some shops to organize the flame cutting of steel sections on a production basis. In one large flame cutting installation, where heavy scarfing, general maintenance cutting and a wide range of machine cutting are performed, experience has shown that requirements are much more exacting than in plants where only one of these operations is performed or where the volume does not call for rigid production schedules.

A primary requisite, especially where sections up to 4 feet or more in thickness are to be flame cut, is an adequate supply of oxygen and fuel gas. This calls for generators and a piping system large enough to handle maximum momentary loads. Torch tips must have sufficiently large orifices to do the work. On heavy cutting, experience has indicated that the preheat flame is highly important.

Flame cutting has proved to be indispensable in the war effort. It will emerge with new adaptations for the postwar period. —p. 110

E. L. Shaner

EDITOR-IN-CHIEF



There are many types of employment open to women — machine operation, welding, stenography, laboratory work, etc. The need is so great that a woman should be able to find exactly the type of work for which she is best suited.

Perhaps Joan Could Help, Too!

Have you stopped to consider there is a place for your sister, your daughter—yes, even your wife—in the great effort the metal working industry is making to help win this war?

Through your everyday conversation the women in your family realize the need for more production. They know about the shortage of workers. They know that it is patriotic to work, but because their place has been in the home, many of them are timid about going to work in an office or factory.

You, as a worker in America's great metal industry, can dispel that timidity by telling them about the many kinds of jobs open to women. Let them know that they are as safe in the factory as in the home; that modern American factories are clean; and that factory associations are interesting.

Talk to Joan, Helen, Barbara this evening. In years to come they will be proud of the work they did to help keep America's homes safe and free.

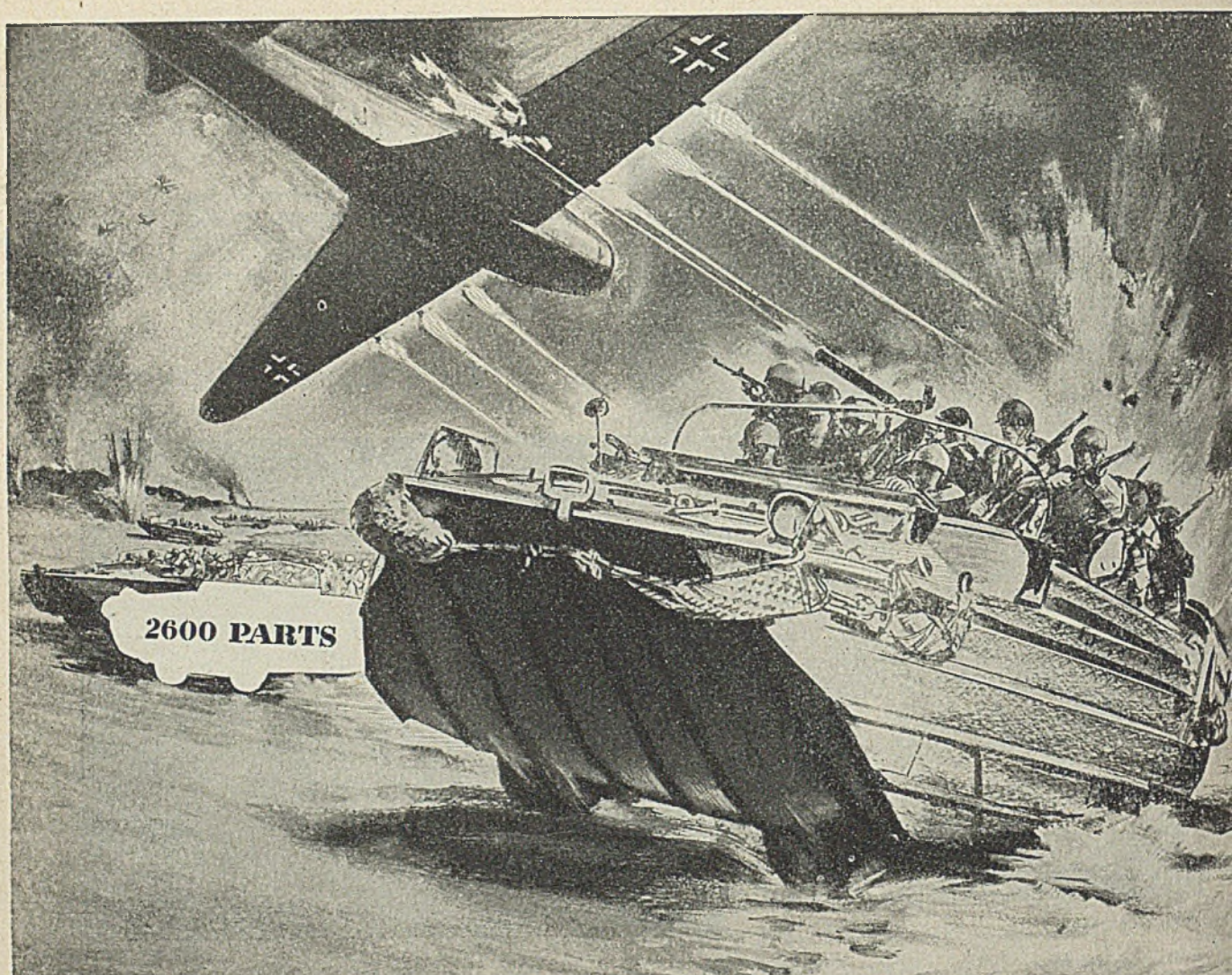
ARMY E NAVY

Check your local help wanted ads for specific needs in your area, or ask the local U. S. Employment Service.

INLAND STEEL COMPANY

38 S. Dearborn St. 50th ANNIVERSARY Chicago 3, Illinois

Milwaukee Detroit St. Paul St. Louis Kansas City Cincinnati New York



SAVED BY THE THOUSANDTH PART OF A DUCK

Down comes a Focke-Wulf in a screaming dive, while the Duck's "land legs" churn sand and water for seconds that seem to last forever!

Thousands of parts make the big Duck "walk". Piston, connecting rods, agile on oil-rinsed bearings, pour power to straining gears and drive shaft. Vibration tests each metal fastener.

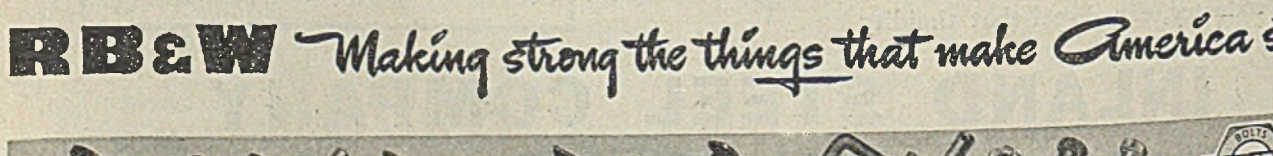
The wheels still sink, dig deeper—then, seconds later, get firm hold . . . Bullets lash the surf scant yards behind.

Perhaps you helped to save the boys who rode the Duck that day . . . Perhaps a few minutes' extra care some months ago, the time you took to check and double check some tiny part, an extra thought you gave to better, faster machines and methods—helped keep that amphibian roaring on to victory . . . *For—every part, down to the smallest, counts.*

At R B & W's three great plants where millions of big and little fasteners are made each day, we workers realize how much *each* bolt, nut, screw or rivet may count for life or death o a distant shore or sea . . . how much i gained from R B & W's special manu facturing processes, its vast productio facilities coordinated in a hard-drivin campaign to help get this war ove quick!

If you would like the workers i your plant to feel with us this keene sense of battle-urgency, we will gladl send a poster version of this ad fo your use. Write us. No advertisin matter—and the poster's free. Russell Burdsall & Ward Bolt and Nut Com pany, Port Chester, New York.

RB&W *Making strong the things that make America strong*



RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

STEEL

Union's Demands, If Met, Must Bring Compensating Price Rise

U. S. Steel president says labor rates have kept pace with living costs since start of emergency while prices have held unchanged

FURTHER increase in employment costs as a result of wage increases, will leave the United States Steel Corp. with no recourse other than to seek a compensating increase in steel prices, Benjamin F. Fairless, president of the corporation, said last week commenting on the demands of the United Steelworkers of America to reopen existing labor contracts in the steel industry with a view to obtaining an increase of 17 cents per hour in wages and other advantages.

The United Steelworkers' policy committee last week at Pittsburgh drew up demands to be served on the various steel producing companies. (See STEEL, page 74, Dec. 6).

Mr. Fairless last week announced that Carnegie-Illinois Steel Corp., American Steel & Wire Co., Columbia Steel Co., National Tube Co., and Tennessee Coal, Iron & Railroad Co., all U. S. Steel subsidiaries, have replied to the notices served by the United Steelworkers of America on Dec. 4, reopening the labor contracts now in effect, and will meet with representatives of the union in Pittsburgh on Dec. 14.

The meeting will be held in the William Penn hotel and will be attended by representatives of these steel producing subsidiaries who will negotiate jointly the terms of a new agreement.

It is expected the union's formal demands will be presented and discussed at the Dec. 14 meeting, but it generally is conceded the issue finally will be laid before the War Labor Board.

Wage increase of 22 cents an hour was asked last week by the Weirton Independent Union for 10,000 production employes of the Weirton Steel Co., Weirton, W. Va. This is 5 cents an hour more than was asked by the CIO United Steelworkers of America. The Weirton union also asked for "equitable" increases for all salaried employes of the company, and that any increase granted be made retroactive to Dec. 1, 1943. The union, however, did not ask for a guaranteed minimum weekly wage, one of the outstanding demands of the CIO steelworkers' union.

"We believe in holding the line against inflation and have practiced that sound governmental policy to date," said Mr. Fairless. "We shall continue to do so as long as this is possible but if the line is to be breached by the union the steel corporation is certainly entitled to adequate protection against the financial consequences to it of that breach.

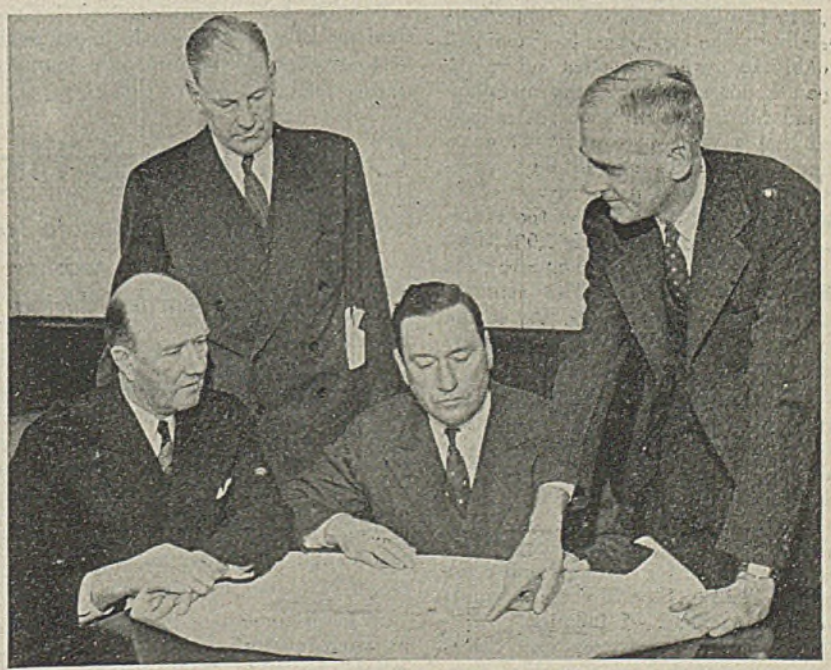
"If our employment costs are to be further increased as a result of wage and other demands by the United Steelworkers of America and by the United Mine Workers we have no recourse other than to seek a compensating increase in steel prices.

"One of the many demands of the steelworkers' union is reported to be an increase in wages of 17 cents an hour for most employes. This would increase our basic common labor rate in the Pittsburgh district from 78 cents an hour to 95 cents an hour, an advance of approximately 22 per cent. The justification is alleged to be increases in the cost of living.

"Since the commencement of the present national emergency the increase in labor rates within the steel corporation has kept full pace with the advance in the cost of living index. On Jan. 1, 1941, our basic common labor rate in the Pittsburgh district was 62½ cents an hour; this was increased to 72½ cents an hour on April 1, 1941, (when there had been little or no recent increase in the cost of living) and was further increased to 78 cents an hour on Feb. 16, 1942. Such hourly common labor rate is today nearly 25 per cent in excess of what it was on Jan. 1, 1941. The U. S. Department of Labor reports an advance in its cost of living index of approximately 25 per cent between Jan. 1, 1941, and the present time.

"Increases which have been made in our hourly common labor rate, although in full accord with the reported advance in the cost of living index, tell only a small part of the real wage story. The important consideration is what does the average steel worker actually receive per hour, and how much does he take home at the end of each week. Most of our employes receive wages on the basis of rates far in excess of the common labor rate.

"The average hourly earnings of all wage earners in our steel producing and fabricating subsidiaries, both North and South, has risen from $.853 an hour in



INSPECT WAUKEGAN WORKS: Shown after an inspection trip to the Cyclone Fence division at Waukegan, Ill., of American Steel & Wire Co. are, left to right, seated: C. F. Hood, president, American Steel & Wire; B. F. Fairless, president, United States Steel Corp.; standing, H. B. Jordan, vice president in charge of operations, American Steel & Wire; J. R. Gaut, general superintendent of the Waukegan Works

January, 1941, to $1.159 an hour in October, 1943, an increase of 35.9 per cent. During October, 1943, the average weekly earnings of all such wage earners, embracing about 185,000 employes, was $50.42 per week, as compared with $33.01 per week during January, 1941. This is an increase in wages of 52.7 per cent per week, or more than double the recorded advance in the cost of living index during this same period. Part of this increase is occasioned by time-and-one-half pay for overtime.

"What has happened to our steel prices between Jan. 1, 1941, and the present time? Practically nothing. Prices for major steel products today are the same as the published prices of 1939. A ceiling on steel prices at such level was established by Office of Price Administration in April, 1941. While our prices for steel products in general have not advanced, our costs have gone up most substantially since Jan. 1, 1941. Increased labor rates alone have added about $135,000,000 a year to our total employment costs throughout the Steel corporation. Building up our manufacturing operations to full capacity, with resulting economies from such greater production, has been a major factor in enabling us to date to absorb these additional costs and leave a small balance for our stockholders. The end of that road has been reached, however. We cannot repeat this operation, as we are now operating at full capacity. Furthermore, as the end of the war grows nearer there may be some recession in our operating rate.

"If wage earners are granted pay increases, adjustments upward on a similar scale must be made to our salaried employes in the lower salaried group. Corresponding wage and salary increases will inevitably follow in our other subsidiary companies not engaged in the manufacture and fabrication of steel. It is estimated that a wage increase of 17 cents an hour, after including all the adjustments and increased social security and pension costs which must ensue therefrom, will add approximately $141,000,000 a year to the total employment costs of the Steel corporation. This estimate takes into consideration only one of the many reported demands of the United Steelworkers Union."

Weekly pay envelopes of the steel industry's wage earners in September, 1943, contained an average of $52.55 per employee—$18.60 more than average weekly take-home pay of $33.95 in January, 1941, according to the American Iron and Steel Institute. January, 1941 is the base month for earnings under the so-called "Little Steel" wage formula formulated to head off inflation.

Thus over the past two and three-quarters years of the war period, average take-home pay has risen 55 per cent. Meanwhile the cost of living as indicated by the indexes of the U. S. Department of Labor has advanced approximately 25 per cent, or relatively, less than half as much as the increase in weekly earnings.

Generally throughout the industry, the wage increases which have been granted to hourly wage earners have also been granted to salaried employes below the rank of top management.

Average base prices received by the steel industry from the sale of its products, as reported in the trade journals, have remained virtually unchanged during that entire period.

Average hourly earnings of steel employes have increased about 35 per cent since January, 1941, from 86.6 cents per hour to $1.16 per hour. The rise in weekly wages has outstripped the increase in hourly earnings because of the longer work week which employes are currently working and for part of which they get time and a half rate of pay.

Between January, 1941, and September, 1943, there have been two general advances in steel wages. The first of these came April 1, 1941, when the basic wage rate was advanced 10 cents per hour. Then in July, 1942, under the "Little Steel" formula, there was a further advance of about 5½ cents per hour in the basic wage rate in the steel industry.

On both occasions, payments of time-and-a-half wages for overtime work beyond eight hours a day or 40 hours a week resulted in increasing the average hourly earnings even more than did the increase in the basic wage. The overall effect of the April, 1941, 10-cent wage rise was to increase average hourly earnings by about 13 cents, from 87 cents per hour to the neighborhood of $1 per hour. The raise which became effective in July, 1942, lifted average hourly earnings to about $1.10 by the end of the year.

Imposition upon the steel industry in May, 1943, of the mandatory 48-hour work-week likewise acted to increase average hourly earnings still further by increasing the amount of overtime pay. The current figure of $1.16 per hour earned on the average by steel wage earners shows the effects of that action. That average is nearly 80 per cent above hourly earnings in peacetime year 1929.

RECORD PAYROLLS

Steel industry payrolls in October established a new record, amounting to a total of $144,937,000, according to the American Iron and Steel Institute. Previous peak was $143,769,000 during September which had one less working day. In October a year ago, payrolls totaled $126,627,000.

Number of steel plant employes in October was 615,000 compared with 620,000 in September and 635,000 in October 1942.

Wage-earning employes averaged $1.158 per hour in October, against $1.16 in September and $1.086 in October of last year. Since January, 1941, the base month for wages under the "Little Steel" formula, average hourly earnings have increased nearly 35 per cent, while average weekly earnings have risen more than 50 per cent.

An average of 44.6 hours per week was worked by wage earners in October, which compares with 45.3 hours per week in September and 39.9 hours per week in October 1942.

Green Urges High Postwar Rates

Union chief tells Senate Truman Committee adjustments should be made so that workers' take-home pay for 40 hours will equal that earned during war on longer work-week

WASHINGTON

WAGES in the immediate postwar period should be adjusted so that workers will receive the same amount of take-home pay for 40 hours that they now are receiving for a longer work-week in producing for war, declared William Green, president, American Federation of Labor, before the Senate Truman Committee.

"This is something that is needed just as much by employers as it is needed by labor," he said. "When the war ends employment will drop off by at least one-third. That means, when you include the 40-hour week in the calculation, that the total payroll will be cut in half. If you have that sort of a situation there will not be enough purchasing power to get the peacetime economy rolling. We earnestly recommend passage of the Murray-Wagner-Dingell bill to take care of unemployed workers over the immediate postwar period." This is the bill to amend the Social Security act.

Mr. Green declared reconversion must be handled promptly, under a top council to include representatives of management, labor, agriculture and Congress. This council should decide on policy in disposing of government-owned plants, inventories and surpluses.

"We recommend that prompt settlements be made upon contract terminations," said Mr. Green. "The comptroller general should be allowed to check these settlements only in order to obtain evidence of fraud. Settlements should be made final and binding and not subject to review. Labor just can't stand by idle over a long period while auditors are going over every last item."

Only Few Shortages Remain

Iron and Steel Industry Advisory Committee told war production in some lines to be curtailed to avoid tremendous surpluses when hostilities end

WITH the exception of such items as bearings, forgings and castings, where the manpower situation prevents full utilization of existing capacity, everything in the way of raw materials, components and end products that the armed services require is available to them, H. G. Batcheller, formerly WPB operations vice chairman, told the Iron and Steel Advisory Committee at a recent meeting in Washington.

With surpluses appearing in some fields where there is no civilian requirement, WPB is developing a policy for the curtailment of production to fit current demand and to avoid tremendous surpluses at the end of the war, Mr. Batcheller said.

Such a policy already has been developed with respect to the strategic metals needed to make steel. Mining will be curtailed when safe reserves against emergencies have been stockpiled.

Mr. Batcheller said the point is being approached where many limitations on the production of civilian goods could be relaxed aud materials released for the manufacture of needed items.

No difficulties are foreseen in supply of any steel products with the exception of flat-rolled and possibly tubing, according to J. H. Whiting, director of the Steel Division. A surplus of ingots has developed, he said, and production cannot be maintained at the present level. In December, the ingot surplus is expected to be 70,000 tons.

Committee members expressed the view that the time has come to consider what can be done with all the steel that can be produced. From now on, the emphasis should be on products rather than ingots. Using up of inventories should be encouraged, one member observed, pointing out that anything that can be done in this respect will reduce the difficulty when war orders cease.

Although the iron ore movement on the Great Lakes fell far below original goal, committee members were told reduction in consumption during the year indicates stocks on April , 1944, may total 17,870,000 tons.

Steel Division representatives emphasized that a serious problem confronts the industry in a surplus of alloy scrap, which is being generated at a rate of 100,000 tons a month in excess of consumption. Carbon steel scrap is in much shorter supply and a shortage before the winter is over is possible.

The crisis in coal supply demands two steps, according to William Kerber of the Steel Division. These are: Allocation of coking coal; restrictions on inventory to bring about the reduction of large stocks and to facilitate the building up of low stocks.

Present, Past and Pending

■ LABOR FORCE MUST RISE TO 66.3 MILLION BY JULY

WASHINGTON—Total labor force of 66,300,000 in July, 1944, an expected increase of 1,500,000 over the like 1943 month, is envisaged by the War Manpower Commission.

■ NEW FORD MOTOR PLANT PRODUCING SULPHUR

DETROIT—Ford Motor Co. is operating a new sulphur plant, extracting approximately six tons of 99 per cent pure sulphur daily. It is extracted in the purification of coke oven gas which, in turn, is produced at an average daily rate of 54 million cubic feet.

■ CONSTRUCTION OF GENEVA SHAPE MILL HALTED

WASHINGTON—Defense Plant Corp. has been notified by the War Production Board to stop construction of its structural shape mill at Geneva, Utah. The entire project is being financed by the government at a price of about $180 million. Work on the shape mill was about 40 per cent completed.

■ OUTPUT OF AIRCRAFT JEWEL BEARINGS SOARS 370%

WASHINGTON—Production of jewel bearings for aircraft instruments has been increased by 370 per cent since January, 1943. A reserve stock equivalent up to nine months' needs will be accumulated.

■ PORTABLE CONVEYOR ORDER BACKLOG INCREASES

WASHINGTON—Order backlog of the portable conveyor industry is equivalent to about four and one-half months' output, compared with two and one-half months in May.

■ BRITAIN MAY PLACE NEW ORDERS FOR TOOLS HERE

WASHINGTON—Curtailment of machine tool production in the United Kingdom in 1944, in order to divert labor and facilities to other war work, may result in some additional requirements for machine tools from the United States.

■ RESTRICTIONS EASED ON BAKING PAN, HANGER PRODUCTION

WASHINGTON—Manufacturers may use warehouse and mill stocks of tin mill black plate rejects to make baking pans, while they may make wire hangers out of wire shorts or rejects and material obtained from distressed stocks or included in a manufacturers' inventory on July 17, 1943. This was provided in WPB order L-30-d, as amended.

■ WESTINGHOUSE DELIVERIES AT NEW HIGH

EAST PITTSBURGH, PA.—Westinghouse Electric & Mfg. Co. made record deliveries of equipment for the fighting fronts and war industries in October, says A. W. Robertson, chairman of the board of directors. Net sales billed for the month totaled $63,113,578. The company's backlog of unfilled orders at the end of October amounted to $976,101,040.

■ MILLIONTH COMMUTATOR MADE IN MANSFIELD PLANT

MANSFIELD, O.—Millionth commutator for radio equipment recently rolled off the production line of Westinghouse Electric & Mfg. Co.'s plant here.

■ ELECTRIC TRUCK SALES TOTAL 712 IN SEPTEMBER

CHICAGO—Domestic bookings of electric industrial trucks and tractors during September totaled 712 units, according to the Industrial Truck Statistical Association, this city. Net value of chassis only totaled $8,943,962, compared with $2,930,768 in August.

Work Started on Large Malleable Foundry

Work is started on a $3,360,000 malleable foundry at Ashtabula, O., for the Lake City Malleable Co., Cleveland. It will be financed by the Defense Plant Corp., and construction is scheduled for completion by next May.

Rust Engineering Co., Pittsburgh, is the engineer and contractor. The plant will more than match Lake City Malleable Co.'s Cleveland plant capacity.

The country's malleable casting facilities were ample for war needs until about six months ago, but changes in specifications requiring malleable castings in place of other metal parts have put the industry behind on orders, states John H. Redhead, president, Lake City Malleable Co.

Steel Shipments Setting Records In Six Products

Plates, hot-rolled and cold-finished alloy and carbon bars, and seamless tubing output to reach new peaks in 1943

RECORDS for shipments of at least six major classes of steel products as well as a new peak for the total tonnage of steel shipped to consumers, will be set during 1943, reports from the American Iron and Steel Institute covering shipments in the first ten months of the year indicate.

Total shipments of all classes of steel products over that period were 55,684,000 tons—more than 1,200,000 tons greater than shipments in the corresponding months of 1943.

Products for which new records are in the making include steel plates, hot-rolled and cold-finished bars, both carbon and alloy steel, and seamless steel pipe and tubing.

In the first ten months of this year, steel plate shipments totaled 10,678,000 tons. At that rate this year's output will exceed the 1942 total by about 10 per cent. Hot-rolled carbon steel bar shipments are about 8 per cent above 1942.

Similarly, total shipments of 2,931,000 tons of alloy steel bars through October of this year are at a rate which could bring the year's total about 40 per cent above 1942.

Cold-finished carbon bar shipments in the first ten months of 1943 totaled 1,473,000 tons which would indicate that the year's total might exceed the previous peak by about 40 per cent. Shipments of seamless pipe and tubes in the same period amounted to 1,825,000 tons, a rate which would bring this year's total several thousand tons above the previous record.

Two products for which new records for total shipments were established in 1942 are falling short of record levels this year. Current shipments of structural shapes and concrete reinforcing bars, both used principally for construction, are well below a year ago largely because of the virtual completion of the construction phase of the war program.

Shipments of 3,176,000 tons of structural shapes and 418,000 tons of concrete reinforcing bars in the first ten months of 1943 are, respectively, 24 and 75 per cent below a year ago.

Other products for which 1942 shipments exceeded the current rate are rails, butt weld pipe, barbed wire, tin plate, and cold-reduced sheets and strip.

Among the products for which 1943 shipments are ahead of 1942 are electrically welded pipe, lap weld pipe, drawn wire, woven wire fence, hot-rolled sheets and strip and cold-rolled strip.

UNCLE JOE'S TOAST:

Possibly the greatest tribute ever paid to American industrial production came from Russia's Premier Josef Stalin during the recent conference of the Soviet leader with President Roosevelt and Great Britain's Prime Minister Churchill at Teheran, Iran.

In a toast at a dinner party, the Soviet premier said:

"Without American production the United Nations could never have won the war."

Premier Stalin should know.

During the course of the conversations, it was reported that the Soviet marshal revealed Russia's monthly aircraft production is about 3000 planes, compared with 3500 by Great Britain and nearly 9000 by the United States.

Shipyards Exceed Goal; Deliveries Since Pearl Harbor, 25,284,287 Tons

AMERICAN shipyards have delivered 25,284,287 deadweight tons of merchant ships since Jan. 1, 1942, exceeding the goal of 24,000,000 tons for the two-year period ending Dec. 31. This was revealed last week by Rear Adm. Howard L. Vickery, vice chairman of the Maritime Commission.

November deliveries totaled 1,692,700 tons.

Reviewing the achievements of the two years, the admiral said:

"In the spring of 1942, the President established as the merchant shipbuilding goal the construction of 24,000,000 tons deadweight during 1942 and 1943. Of this total, 8,000,000 tons were scheduled to be built during 1942 and 16,000,000 this year.

"By September, 1942, shipyard output had topped a million tons a month, almost equaling the deliveries for the entire year 1941. American merchant shipyards not only met their 1942 goal, but even exceeded it.

"The number of vessels delivered into service last month was 164; their aggregate deadweight, 1,692,763 tons. Included in these totals were 16 high speed vessels of the commission's unexcelled C-types and 19 fast tankers. Also, there were completed 23 vessels of various types for military and special uses, 89 Liberty ships and 17 tankers adapted from the Liberty design.

2000 Production Records Broken by U. S. Steel

More than 2000 production records have been broken by United States Steel Corp. subsidiaries in producing 60,000,000 tons of steel since Pearl Harbor, according to Irving S. Olds, chairman of the board of directors. The new records included high marks in production of raw materials, manufacture of pig iron, steel ingots and finished products, and outstanding accomplishments in the construction of naval craft.

"United States Steel alone shipped

more than 82,000,000 tons of ore from the Lake Superior district since Dec. 7, 1941," Mr. Olds said. "For five consecutive months these shipments shattered all previous monthly ore shipping records for comparable months."

Mr. Olds said nearly 100,000 employes have entered the armed forces and that to replace these workers and man new facilities U. S. Steel has trained approximately 200,000 new employes. Women have played an increasingly important part in steel production since the beginning of the emergency.

Mr. Olds disclosed that to meet wartime demands, U. S. Steel embarked upon an $811,000,000 expansion program. U. S. Steel funds for this program amounted to $330,000,000, with the government financing the remainder. The new facilities, plus conversion of peacetime equipment to war production, enabled U. S. Steel, among other accomplishments, to more than double its platemaking capacity and to increase armor plate output six-fold.

November Ingot Output Below October Peak

Steel ingot and castings production in November declined from the October peak in total tonnage and rate of operations, the American Iron and Steel Institute announces. Total in November was 7,356,828 net tons, equivalent to 98.4 per cent of capacity. In October, the record month to date, 7,819,061 tons were produced at 101.3 per cent of capacity.

In announcing November figures the Institute revised figures reported for previous months of 1943, to include production of new facilities not previously reported.

November production averaged 1,714,878 tons per week, compared with 1,765,025 tons per week in October and 1,673,616 tons per week in November, 1942.

Invasion Craft Program Given Precedence Over All Others

Shift in munitions program indicates preparations for intensified drive in Pacific. . . Dislocations of workers due to cutbacks continue, but WMC believes all will be absorbed in new programs

INVASION craft last week were given top ranking priority in the munitions program, giving their production right-of-way over aircraft, high-octane gasoline and all other urgency programs.

Four thousand prime contractors, it was said, will be engaged in manufacturing the landing vessels. Four times this many subcontractors will be required to help in the vast program to produce invasion craft.

Total Navy program for landing craft includes 80,000 units, about 25,000 of which already have been completed. Those under the newest program are destined to be used in Pacific warfare. Cost of the program will be between $5 and $6 billion, according to Rear Adm. Edward L. Cochrane, chief of the bureau of ships.

Many observers believed the increased emphasis on landing craft and other shifts in war production indicate intensified preparations for the war against Japan. They reason that a time lag of about six months occurs between delivery of munitions in the United States and their arrival at the fighting fronts, and some believe the European war will be terminated by the time all equipment destined for that theater arrives.

Another indication that military and production officials are beginning to look toward intensified war in the Pacific is seen in the double tracking of some western rail lines, the installation of new siding and the construction of additional warehouses.

Cutbacks necessitated by the changing emphasis in military tactics are continuing to cause some temporary unemployment in a few centers. War Manpower Commission officials, however, estimated that while 150,000 will be laid off due to cutbacks during the next 90 days, 500,000 new workers will be needed in several industries.

Ore Season Closes with 84 Million Tons Shipped

The 1943 season iron ore vessel movement of 84,400,000 gross tons exceeded the final quota for the year and represented a "very successful" season in spite of the late opening of navigation and adverse weather during most of the period, Office of Defense Transportation officials state. They added that the total would have been considerably larger had not WPB authorized ODT to shift some of the ore boats to the grain trade.

The shipment of ore this season will assure all steel plants at least a 50-day stockpile as of April 1, 1944, ODT officials estimate. Normally the shipping season opens April 20.

New England Shops Report Operating Gaps Filling

BOSTON

Openings in schedules caused by cancellations and deferments are filling, considerable tonnage having been moved forward, supplemented by mild improvement in buying, with substantial bulges in some war programs, notably for various types of landing craft and pontoons.

Steel requirements are being given serious consideration for an increase in production of domestic refrigerators at an eastern plant which would raise output of such units from zero to possibly 30 per cent of normal capacity. There are other signs to indicate more steel products for a broader line of fabricated consumer goods early next year. Probably this will not be sufficient to bring steel consumption near normal requirements but sufficient to offset possible cutbacks and contribute to orderly but indefinite return to somewhat near normal schedules.

Contracts for 75,000 more pontoons

(*Please turn to Page* 180)

U. S. STEEL INGOT STATISTICS

	Estimated Production—All Companies								Calculated weekly production, all companies	Number of weeks in mo.
	—Open Hearth—		—Bessemer—		—Electric—		—Total—			
	Net tons	Per cent of capac.	Net tons	Per cent of capac.	Net tons	Per cent of capac.	Net tons	Per cent of capac.	Net tons	
Based on reports by companies which in 1942 made 98.3% of the open hearth, 100% of the bessemer and 87.6% of the electric ingot and steel for castings production										
Jan.	6,576,524	97.8	478,058	85.9	369,395	95.4	7,423,977	96.8	1,675,841	4.43
Feb.	6,031,363	99.3	447,843	89.1	344,532	98.6	6,823,738	98.5	1,705,934	4.00
March	6,787,630	100.9	503,673	90.5	381,219	98.5	7,672,522	100.0	1,731,946	4.43
1st qtr.	19,395,517	99.3	1,429,574	88.4	1,095,146	97.5	21,920,237	98.4	1,704,529	12.86
April	6,510,563	99.9	481,810	89.4	382,532	102.1	7,374,905	99.3	1,719,092	4.29
May	6,669,436	99.1	483,024	86.8	398,057	102.9	7,550,517	98.4	1,704,406	4.43
June	6,202,640	95.2	453,599	84.1	384,645	102.6	7,040,884	94.8	1,641,232	4.29
2nd qtr.	19,382,639	98.1	1,418,433	86.7	1,165,234	102.5	21,966,306	97.5	1,688,417	13.01
1st hlf.	38,778,156	98.7	2,848,007	87.6	2,260,380	100.0	43,886,543	98.0	1,696,426	25.87
July	6,556,531	96.8	466,288	90.6	393,342	94.0	7,416,161	96.3	1,677,864	4.42
Aug.	6,699,850	98.7	484,957	94.0	407,224	97.1	7,592,031	98.3	1,713,777	4.43
Sept.	6,646,702	101.4	480,635	96.4	391,241	96.6	7,518,578	100.8	1,756,677	4.28
3rd qtr.	19,903,083	99.0	1,431,880	93.6	1,191,807	95.9	22,526,770	98.4	1,715,672	13.13
9 mos.	58,681,239	98.8	4,279,887	89.5	3,452,187	98.5	66,413,313	98.1	1,702,905	39.00
Oct.	6,891,753	101.6	513,521	99.5	413,787	98.7	7,819,061	101.3	1,765,025	4.43
Nov.	6,525,323	99.3	440,941	88.2	390,564	96.2	7,356,828	98.4	1,714,878	4.29

The percentages of capacity operated in the first 6 months are calculated on weekly capacities of 1,518,621 net tons open hearth, 125,631 net tons Bessemer and 87,360 net tons electric ingots and steel for castings, total 1,731,662 net tons; based on annual capacities as of January 1, 1942 as follows: Open hearth 79,180,880 net tons, Bessemer 6,553,000 net tons, electric 4,554,980 net tons. Beginning July 1, 1943, the percentages of capacity operated are calculated on weekly capacities of 1,531,789 net tons open hearth, 116,494 net tons Bessemer and 94,667 net tons electric ingots and steel for castings, total 1,742,950 net tons; based on annual capacities as follows: Open hearth 79,867,450 net tons, Bessemer 6,074,000 net tons, Electric 4,935,960 net tons.

1944 War Demands Will Be Heavier, Industry Warned at N.A.M. Meeting

Industrialists and labor lauded for performance to date. Girdler says uncertainty is deterrent to planning. Labor panel is feature of convention

Prominent at the War Congress of American Industry were these officials of the National Association of Manufacturers. Left to right: William B. Warner, president, McCall Corp.; Frederick C. Crawford, president, Thompson Products Inc., Cleveland; Charles R. Hook, president, American Rolling Mill Co.

NATION'S industrialists and labor were acclaimed by military and War Production leaders in New York last week for their performance in producing munitions, but they were warned that overall demands would be still heavier next year and to look for a prolonged war.

Charles E. Wilson, executive vice chairman, WPB, said these demands were scheduled to be 20 per cent greater, and added that the war in Europe looked to him "as if it were going to be a long, hard, bitter fight."

Occasion for these comments was the second War Congress of American Industry held in connection with the forty-eighth annual conference of the National Association of Manufacturers at the Waldorf-Astoria, Dec. 8-10, attended by more than 3500 members from all sections of the country and with the program given over to a searching discussion of various phases of war production and postwar planning.

Uncertainty as to the overall attitude of government toward business is one of the great deterrents at this time to such planning, Tom M. Girdler, chairman, Republic Steel Corp., Cleveland, and Consolidated-Vultee Aircraft Corp., San Diego, Calif., told members. There is an urgent need, he said, for the development of sound policy on labor and taxes and for an early determination of policies governing the termination of war contracts, disposal of government-owned plants and the ending of wartime controls and restrictions.

Asserting that the war in Europe seems likely to tax the country's capacity for industrial production beyond anything experienced thus far, Mr. Wilson said that the 1944 overall production schedules call for performance not only higher than the present rate but for a performance actually 80 per cent above the country's 1942 level. Munitions output alone for 1943 will be 85 per cent greater than last year, with current quarter output 120 per cent higher than in 1942 and with schedules for next year calling for production 136 per cent higher than 1942 output.

Aircraft tonnage in 1943 will be approximately 40 per cent greater than in 1942, with the current quarter rate actually 235 per cent higher. For 1944 WPB expects a rise to 325 per cent above the 1942 level. As far as number of planes produced are concerned, the country is now approaching top levels. The ascending curve in tonnage, he explained is accounted for by the steady shift toward heavier and more complicated models.

Ship Production 75% Higher

This year's naval ship production, figured in terms of "value-in-place," will be more than 75 per cent higher than in 1942. The fourth quarter rate is something like 215 per cent higher. He said there is reason to believe that subsequent developments may cause current levels to be maintained. The maritime construction record for 1943 will be a full 100 per cent higher than last year, with the current quarter rate 135 per cent higher. Next year's schedules call for production slightly in excess of the present rate.

Going further into detail, Mr. Wilson said that 1943 ordnance and signal equipment production will be about 60 per cent larger than last year, with the current rate 80 per cent up. He thought that 1944 production would fall off to a rate something more than 60 per cent above 1942 output. He pointed out that capital equipment for the Army is approaching completion and that the job soon will be production largely for maintenance purposes.

As for construction, "The great bulk of this work is behind us," he said The 1943 program will be less than half of 1942. The current rate is less than 50 per cent and the average for next year will be little more than 30 per cent of 1942.

This year's tank production is only 13 per cent higher than last year, with current production actually 17 per cent lower than 1942. Schedules for next year call for reduction of 25 per cent under the 1942 average. On the other hand, schedules for big trucks are steadily mounting. This year's output will be 20 per cent heavier than last, with the going rate more than 40 per cent and next year's requirements scheduled to be stepped up 100 per cent over 1942.

This year the country will have turned out 140 per cent more small arms ammunition than last. The fourth quarter rate is at about the same level, but a modification for next year indicates a drop to only 50 per cent of what is now being done. A reverse trend, however, is indicated in demand for artillery ammunition. According to present plans, production this year will be 70 per cent heavier than last with the current rate 120 per cent higher and with 1944 requirements calling for an average production about one-quarter higher than the current rate.

All of this, of course, may be revised, depending upon developments abroad, particularly in Europe, but that is the

setup, as it now appears, he said.

Mr. Girdler, commenting on the need of close co-operation between industry and labor, said there were four cornerstones on which industrial peace may be built: 1—Recognition of the principle of collective bargaining; 2—recognition of the right of employes to join or not to join any labor organization; 3—scrapping of the "class conflict" idea in labor-management relations and recognition that co-operation between men and management naturally follows mutual understanding of each other's problems; 4—incentive for investment in work—a fair return for venture capital and fair wages for employes.

Outlining industry's accomplishments, Mr. Girdler pointed out that peak steel production in the first World War was 50,500,000 tons, that this year's output will be close to 90,000,000 tons and that capacity will soon reach 96,000,000 tons. This latter figure almost matches the output of all the rest of the world combined. "The war," he said, "has seen no overall shortage of steel in this country and it will see none."

Aluminum production has increased about 500 per cent from 1939 to 1943 with present supply more than adequate to meet all military needs. Perhaps the most amazing story, he said, is in aviation. In 1939 the United States produced 7000 military and commercial planes. Output this year is expected to reach 80,000 with the 1944 program calling for 120,000 planes. In 1939, he remarked, the aircraft industry ranked only 75th in size among American industries. But in 1942 it was second and now it is first, with an annual production five times that of the biggest year the automobile industry ever had and heading toward an output of $20 billion annually.

Expresses Concern Over Wartime Control

Expressing concern over the possibility that wartime control of industry will be carried into peacetime, Wilfred Sykes, president, Inland Steel Co., Chicago, and vice president of the association and chairman of its postwar committee, asserted than unless industry is assured of postwar return to full responsibility, "it is putting the cart before the horse to talk of industry assuring jobs to men who come out of the armed forces or out of the war plants.

"Before industry can talk soundly of hiring postwar hands," he said, "it must be known whether it is going to be a hired hand itself with government doing the hiring. And until industry knows this, no postwar planning can be better than speculation concerning the jobs, freedom and opportunity that we thought the war would lead us back to."

Mr. Sykes also discussed such other transition problems as the cancellation of $50 billion of wartime contracts when the war is ended, the disposal of some $15 billion of government-owned war plants and the disposal of $50 billion of wartime supplies which the government will have in strategic stockpiles.

Discussing postwar foreign trade, William P. Witherow, president, Blaw-Knox Co., Pittsburgh, and a former president of the association, said: "The sooner we can put debtor nations back on a production trading basis the sooner the wheels of world trade will start turning to the advantage of all."

He suggested three things that should be done promptly after the war: 1—Provide funds for emergency relief of distressed nations; 2—put an early stop to lend-lease for postwar purposes; 3—agree on a settlement of past lend-lease on a basis that is possible of liquidation, "thereby taking the uncertainty of these obligations out of the trade picture."

He remarked that a problem to test political and industrial statesmanship in postwar years will be to get a proper balance of trade through encouraging more trade and still protecting the social gains, wage structures and living standards of this nation.

Maj. Gen. Levin H. Campbell, Army chief of ordnance, said that "never before in the annals of any country in the history of the world has there been mobilized a power such as American industry is now devoting to war."

He termed the American plane "the most formidable battle weapon of the war today," and predicted that allied air supremacy would continue to grow.

Joseph B. Eastman, director, Office of Defense Transportation, predicted an increasing stringency in transportation over the next several months, with limited production of trucks and of the proper type of rubber a factor, as well as restricted building of railroad equipment.

H. W. Prentis Jr., president, Armstrong Cork Co., Lancaster, Pa., and past president of the association, declared that Congress constitutes "the only dependable defense line" that stands between the American people and national socialism.

A special panel of management and labor devoted to postwar employment is agreed that high production necessary in providing for employment calls for the utmost in co-operation between labor and management. Panel members were William Green, president, AFL, Philip Murray, CIO, Paul G. Hoffman, president, Studebaker Corp., and Frederick C. Crawford, president, Thompson Products Inc., and retiring president of the association. All agreed that the free enterprise system, handicapped as little as possible by governmental restrictions, will be necessary to do the job.

Mr. Green said that "jobs for all is America's No. 1 postwar objective," but his sweeping statement was challenged by Mr. Hoffman who said that "we must be realistic and set realizable goals." Mr. Hoffman believes two or three million persons may have to be laid off when normal times return, and that we must strive for the highest possible industrial activity and the highest possible employment.

One important feature of the closing day was a panel discussion on the termination of contracts and disposition of surplus plants, with Malcolm Muir, president, *Newsweek*, and chairman, N.A.M. war committee, serving as moderator.

Featured speakers at the annual dinner Friday evening were Alfred P. Sloan Jr., chairman, General Motors, whose address was entitled "The Challenge", and Dr. William M. Wristron, president, Brown University, who spoke on "Free Enterprise."

GAYLORD HEADS N.A.M.

Robert Gaylord, president, Ingersoll Milling Machine Co., Rockford, Ill., was elected president of the National Association of Manufacturers succeeding Frederick C. Crawford, president, Thompson Products Inc., Cleveland, at the forty-eighth annual convention of the association in New York last week.

Newly elected directors at large for 1944-45 are: Donaldson Brown, vice chairman, General Motors Corp., New York; S. Bayard Colgate, chairman, Colgate-Palmolive-Peet Co., Jersey City, N. J.; Harvey S. Firestone Jr., president, Firestone Tire & Rubber Co., Akron, O.; T. J. Hargrave, president, Eastman Kodak Co., Rochester, N. Y.; Sydney G. McAllister, chairman of the executive committee, International Harvester Co., Chicago; and A. W. Robertson, chairman, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Electric Metal Makers Hold Sectional Meeting

Virtual tripling of electric furnace steel capacity since advent of the war program has generated increased interest in this process of metal production.

Evidence of the foregoing has been observed in national and sectional meetings of the Electric Metal Makers Guild Inc. Most recent of these was the Chicago sectional meeting at the Morrison hotel, Dec. 4. Program included a joint session of the ingot and casting groups in the morning, separate panel discussions in the afternoon, a luncheon and a dinner.

Chemical Exposition in New York Well Attended

Heavy attendance marked the nineteenth exposition of chemical industries in Madison Square Garden, New York, Dec. 6-11, the first since the beginning of the war. Interest was strong in ascertaining new developments.

Various companies associated with the steel, nonferrous and metalworking and affiliated industries, were included among the 200 exhibitors.

Financial Policies Must Permit All To Help Rebuild U. S. After War

U. S. Steel finance chairman tells Senate committee business cannot pay taxes, wages and other costs without limit. . . Says full order book must bear costs of lean order book. . . "Depression losses are boom costs"

SHAPING of national tax and financial policies "so that all of us will be able to do our part in rebuilding the nation after the war", was suggested to the Senate Finance Committee holding hearings on the 1943 revenue bill by Enders M. Voorhees, chairman, finance committee, the United States Steel Corp.

Mr. Voorhees told the committee that "the plain truth is that neither U. S. Steel nor any other business corporation has any mystical power to operate and hire men if it has no customers, nor any mystical power to turn out first class, well-priced goods with worn out tools or against costs beyond the control of management.

"This truth ought to be obvious but apparently it is not so to at least part of our people, who hold the notion that a corporation has within itself the independent economic power to dictate price, quality and quantity terms to the customer and therefore the power to pay taxes, wages and other costs without limit."

Mr. Voorhees explained that the corporation does not know what orders may be issued in the future by various governmental agencies with respect to products, prices and wages, nor does it know when the war will end, and continued: "But it can be noted that wage rate increases for coal miners are under discussion and that demands are being formulated for increases in steel wages.

"Even a small increase in wages would not only reduce the payments to owners or the amounts carried forward for future needs, or both, but also would make operative the carry-back provision of Section 710-C of the Revenue act of 1942. A substantial increase in wages would in effect put the tax mechanism in reverse and the federal government would pay back to U. S. Steel more than is collected from it. Thus the wisely enacted provision of Congress to offset in part postwar losses would become the means of paying wartime wage increases, and in the process U. S. Steel, although operating at capacity, would be squeezed dry and picked clean.

"We in management cannot base our future plans on the thesis that some sprite or bevy of sprites is about to invent a mechanism certain to regulate customers and prevent fluctuations. Planning on the basis of theory is not a substitute for preparing on the basis of experience. We in management know only too well that a full order book must bear the costs of a lean order book. Depression losses are boom costs.

"The nature and efficiency of tools and the manner of their use by men determine the scale of our national living. I will now show what the tools of U. S. Steel have meant to the progress of this nation. I will reveal to you in bare figures what to many is an amazing story of human gains. The figures are in men, in tons and in hours; the gains are in living, in freedom and in power to defend them.

"By the use of tools, a man's work for an hour in 1902 resulted in 29.7 pounds of steel. By 1942, the tools had so improved that the hour of work resulted in 60.6 pounds of steel. Hours worked in 1942, with the tools of 1902, would have resulted in 10,100,000 tons. Actual shipments in 1942 were 20,600,000 tons.

"That, gentlemen, is the record of U. S. Steel under the system we now have. I, for one, would not want to scrap this system before it was certain that we had a better one. Our system depends upon the voluntary supplying of the tools of production and exchange, their voluntary co-operative use and the voluntary purchase by customers of products and services."

Mr. Voorhees presented tables to the committee comparing the corporation's sales and costs for the first nine months of 1942 and 1943 and the corporation's record of tools and progress in 1902 and 1942, which appear elsewhere on this page.

30,000 All-Steel Freight Cars Scheduled for 1944

Total construction of freight cars for domestic use will be approximately 50,000 for 1944, or considerably more than any one year's output in the last decade prior to Pearl Harbor, according to L. L. White, director, Transportation Equipment Division, War Production Board.

This estimate of next year's output includes about 30,000 new, all-steel freight cars, made possible by an available supply of steel.

TOOLS AND PROGRESS—U. S. STEEL'S RECORD

Items	Amount 1902 (First Year)	Amount 1942 (Latest Year)	Per Cent Increase
Tons of Steel Bought By Customers	8,912,805	20,615,137	131
Tools Provided By Owners	$689,259,777	$1,740,709,564	153
Number of Workers	168,127	335,866	100
Total Hours Worked	599,774,451	680,115,109	13
Pounds of Steel Per Hour of Work	29.72	60.62	104

U. S. STEEL'S SALES AND COSTS

	Nine Months 1943	Nine Months 1942	1943 Change From 1942
Customers' Purchases	$1,446,647,355	$1,379,168,145	$67,479,210
Costs:			
Wages, salaries, s.s. taxes and pensions	671,332,660	571,668,720	99,663,940
Purchased products and services	496,390,916	467,514,548	28,876,368
Wear and usage	94,762,728	85,760,004	9,002,724
Estimated additional war costs	18,000,000	18,000,000	—
Interest	5,083,118	4,388,601	694,517
State, local and miscellaneous taxes	31,325,284	36,132,695	4,807,411 Dec.
Estimated Federal taxes on income	79,500,000	132,300,000	52,800,000 Dec.
Total	$1,396,394,706	$1,315,764,568	$80,630,138
Income	$ 50,252,649	$ 63,403,577	$13,150,928 Dec.
Dividends			
On cumulative preferred stock	$ 18,914,757	$ 18,914,757	None
On common stock	$ 26,109,756	$ 26,109,756	None
Carried Forward for Future Needs	$ 5,228,136	$ 18,379,064	$13,150,928 Dec.

Plan New National Association

Representatives of middle western companies attend organizational meeting at Detroit. To seek equitable disposition of government-owned tool surpluses

WITH one of the first steps on its agenda perfection of plans for equitable disposition of surplus government-owned cutting tools, the National Association of Cutting Tool Manufacturers held its organizational meeting in Detroit recently, approximately 150 representatives of middle western cutting tool interests attending.

Behind the decision to organize the association was the recent "tool scandal" in Detroit following sale of an estimated $2,000,000 worth of surplus government-owned tools as scrap. A committee of cutting tool manufacturers was called to Washington after that incident and among other things was asked to formulate plans to prevent future "fire sales" of this type.

Organizing committee for the proposed new association comprises Ernest C. Putnam, president of the Putnam Tool Co.; W. G. Robbins, president, Carboloy Co. Inc.; Emis Gairing, president, Gairing Tool Co.; George Sheldrick, president, Midwest Tool Co.; and Howard Simon of the law firm of Dahlberg & Simon, all of Detroit. Mr. Simon was named chairman.

This committee proceeded to arrange the organizational meeting in Detroit. Rather than attempting to gather representatives from cutting tool manufacturers throughout the country, it was decided to invite a group representing companies in the Michigan industrial area, and to obtain the recommendations of this group for expanding the activity nationally. It was suggested that a temporary board of directors be chosen to serve until by-laws for a national association could be drawn up and the mechanics of electing an official board of directors established. A corollary proposal was that there be vacancies left on the temporary board for later filling by representatives of tool manufacturers in other sections of the country.

To Study Surplus Problems

The proposed association is regarded as more than a wartime exigency.

With respect to the equitable disposal of surpluses, the new association is expected to give close study to a plan developed at the request of the War Production Board by a three-man committee headed by Mr. Robbins of Carboloy. This plan was approved by the services and the WPB and transmitted to the White House for consideration. Little has been heard of it in the intervening weeks. However, sources close to the industry are of the opinion that it involves two principal features: First, the recommended resale to original vendors of surplus tools at a discount of around 40 per cent from the list price, and, second, the alternative of returning of surpluses to original vendors on a consignment basis, with a definite period of time specified as to resale.

It is understood the latter alternative may require passage of enabling legislation since reportedly it is now illegal for any of the services to return material to vendors on a consignment basis.

POSTWAR PREVIEWS

TAXES—Financial policies must permit industry to help rebuild United States after the war. See page 84.

RADIO—Frequency modulation expected to be major postwar development, with television following. See page 86.

REHABILITATION—Carefully supervised program helps fit discharged veterans into productive employment. See page 93.

JEEPS—Opinions differ on acceptance of Army's light general purpose car for civilian use. Many believe popularity will be limited where highways permit use of more comfortable vehicles, but that tough midget will be used widely in undeveloped lands. See page 93.

DIESELS—Smaller size, less weight and lower cost will feature postwar marine diesels. See page 94.

AIR TRANSPORT—Analysis indicates maximum of airborne import and export freight may be 150,000 tons in postwar era. See page 98.

CANADA—Dominion expects period of postwar prosperity, with country benefiting by new industries developed during war. Controls over business already are being relaxed. See page 102.

ROADBUILDING—Important outlet for steel, and employment for many, may be found in rehabilitating and modernizing highways system. See page 104.

IRON ORE—New research facilities at head of the lakes may lead to use of greater amounts of low-grade ores. See page 107.

SPOT WELDED NICKEL—Native strength and corrosion resistance of nickel and alloys, Monel and Inconel, are valuable attributes when these materials are fabricated into chemical vessels and machine parts. Adaptability to spot welding augurs well for extended use in postwar products. See page 112.

INGENIOUS TOOLING—Important progress in tool design continues to prove that future and present are one. Fine surfaces previously attained only by grinding are now achieved with many-purpose carbide tool for turret lathe. See page 132.

CHROMATING—Zinc alloy die castings and zinc coated steel will be further safeguarded against corrosion and deterioration of metal from entrapped moisture by chromating process which inhibits formation of zinc oxide film. See page 134.

Jones & Laughlin Sets November Output Records

Continued drive for more war steel resulted in several new production records during November in the plants of the Jones & Laughlin Steel Corp.

At the Pittsburgh Works the No. 6 blast furnace and the open hearth shop broke their best previous record of October, 1942, while the No. 13 bar mill broke a record established in 1920, more than two decades ago.

The No. 3 seamless hot mill at the Aliquippa Works broke its April, 1943, record and the sintering plant at the Otis Works, Cleveland, broke its record of September, 1943.

The blast furnaces at Pittsburgh Works made a new production record for a 30-day month and a similar record was also established by the Pittsburgh Works rolling mills.

Also, all previous records for a 30-day month at Pittsburgh Works were broken in November when that plant made a new record for shipments of steel products.

WINDOWS of WASHINGTON

Headed for Going-over

THE CIVIL Service Commission appears headed for a congressional going-over because of its recent order to employes whereby they are to cease "loyalty investigations" of prospective federal employes. They are not to ask questions "concerning union activity, racial tolerance, sympathy for the Spanish Loyalists, membership in The Bookshop, and religious matters." Also, they are not to ask questions of married persons about activities of husbands or wives, or about personal friends or social acquaintances. The commission took this action on the demand of the leftish CIO United Federal Workers Union.

Vitamins Act Up

Of significance to all manufacturers operating under OPA price ceilings is a request by 13 vitamin manufacturers to enjoin Price Administrator Chester Bowles from issuing a vitamin price reduction order. They point out that the industry consistently reduced its prices both before and since price controls were established. They contend that the price reduction order would in effect constitute an unauthorized regulation of profits, thus circumventing the will of Congress. The request for an injunction was filed Nov. 30 in the United States District Court for the District of Columbia.

Statistics Galore

Business men soon will be getting, through the business publications, a large mass of statistics covering production, distribution, population trends and much other information that will enable them to plan their postwar manufacturing and distributing organizations more effectively. This will include a lot of statistics compiled by the Department of Commerce and the War Production Board in formulating various production directives and limitation orders. Heretofore considered restricted information, it now can be released since it no longer is in the category of information to be withheld from the enemy.

How To Be a Politician

The Congress of Industrial Organizations has prepared a booklet on how to become a political leader. The product of its director of research and education, J. Raymond Walsh, former Harvard economics educator, it says:

"Let's quit blaming the politicians and face the responsibility of full citizenship. Let's go to work where it counts—in the political party of our choice. Let's be sure our organizations do not waste their votes by splitting them. We are strong, if we vote, and vote together."

Here is how, the booklet says, to become a local political leader:

"1—Know the number of your ward and precinct.

"2—Do anything which needs doing.

"3—Become acquainted with the 'bosses' and your neighbors.

"4—Listen to your neighbor's beef, but don't argue with him.

"5—Make out a list of your friends and acquaintances. Call them on the phone, invite them to meetings, introduce them to candidates, make a list of those who attend.

"6—Do whatever favors you can for people.

"7—Make yourself heard at meetings, especially on subjects of policy.

"8—Start discussions of local politics at social gatherings—bridge parties, afternoon teas, stag affairs.

"9—Distribute literature of sympathetic organizations—labor unions, PTA's, religious and liberal groups.

"10—Get control of more votes than anyone else in the precinct—and the job's yours."

STEEL FOR FARMERS

Representative H. Carl Andersen, Minnesota, has introduced a joint resolution in the House (H. J. Res. 201) dealing with steel for farm implements.

The resolution which has been referred to the House Committee on Agriculture provides:

"That the War Production Board shall allocate, for the domestic manufacture of farm machinery and farm implements for domestic use, an amount of steel equal to not less than 125 per centum of the steel used for the domestic manufacture of farm machinery and farm implements for domestic use in the calendar year 1940, and such steel shall be allocated and made available soon enough to permit its use in the manufacture of farm machinery and farm implements for use by the farmers of the United States in the planting, cultivation, and harvesting of agricultural commodities during the calendar year 1944."

Postwar Outlook

Discussing the postwar outlook, George A. Sloan, commissioner of New York city's department of commerce, proposed recently: (1) Complete elimination of the war emergency controls over the nation's economy; (2) assurance by the executive and legislative branches of the government of a "proper environment of the risk taken required in the development of new products and processes which science and research are now making available;" and (3) early definition of the government's attitude in the reconversion period toward cancellation of war contracts and disposition of government-owned war plants.

Brown To Specialize

Prentiss Brown, former OPA administrator, has organized the law firm of Brown, Fenlon & Lund, to maintain offices in Detroit and Washington. Associated with him in Detroit will be his old partner Edward J. Fenlon. The Washington office will be conducted by Wendell Lund, who recently resigned as director of the War Production Board's Labor Division and as a member of the War Manpower Commission. With Mr. Lund in Washington will be Manning Shaw, who served as assistant deputy administrator of OPA under Mr. Brown and who also served Mr. Brown when he was a senator from Michigan. The firm is expected to specialize in rendering services to corporations.

Carbide Cutting Tools Group

Formation of a Carbide Cutting Tools Technical committee has been announced by the Department of Munitions and Supply, Toronto, Canada. Members of the committee, which will deal with the dissemination of information on the use of tungsten carbide cutting tools, are: C. Neil, Canadian General Electric Co. Ltd., Toronto, chairman; C. Clark, Carbide Tool & Die Co. Ltd., Hamilton; H. Champ, Hi-Speed Tools Ltd., Galt; G. Morrison, Kennamel Tools & Mfg. Co. Ltd., Hamilton; H. J. Cable, A. C. Wickman (Canada) Ltd., Etobicoke, Ont.

Postwar Radio Plans

Expected trends in radio manufacturing after the war were discussed at a recent hearing of the Senate Interstate Commerce Committee by Dr. Edwin Howard Armstrong, inventor of the regenerative circuit, the super-heterodyne, the super-regenerative circuit and the frequency modulation system.

Frequency modulation will be the major development after the war. Television will come at some later date—after development of frequency modulation. With widespread utilization of FM will come a heavy demand for FM receiving sets. Less than 50 per cent of existing sets, Dr. Armstrong estimated, are engineered to permit installation of devices by which amplitude modulation loudspeakers can be used to receive FM programs. Dr. Armstrong claimed prejudices held up FM development before the war.

Termination Troubles

The extent to which contract terminations have increased in number and volume was reflected by a War Department statement last week that it is considering manpower problems involved in shutdowns and retrenchments at plants producing materials no longer needed by the Army. "The Army will offer every aid," it said, "to facilitate re-employment of discharged workers in other industries."

The laziest bird on earth!

ONE UNSPEAKABLE MEMBER of the bird family is too lazy to dig for his own food! He rides on the backs of cows, and waits for them to move through the grass. As they do, they stir up insects for him.

But that's not why cowbirds are hated so. They're too lazy to raise their own young! Mother cowbird just drops her eggs in another bird's nest. Since the young cowbird usually pushes out all the other young, every cowbird is reared at the expense of the lives of at least two other birds!

Only one bird has ever outsmarted the cowbird. That bird is the Yellow Warbler. She just builds a new bottom for her nest—right above the egg of the cowbird!

Americans should have a feeling of kinship for the Yellow Warbler, because this ability to get things done by outsmarting the enemy, by bold, sweeping measures, has made American industry famous. It's the same reason so many of our war plants today are using Cone Multiple Spindle Automatic Lathes to get things done. For example, on one job, an 1¼" Six Spindle Conomatic in 10 seconds per piece completes 11 operations, one of which comprises simultaneous threading and tapping in the same spindle position.

A host of new industrial uses is being developed for Cone Multiple Spindle Automatic Lathes as a result of wartime demands. And after victory is won, these new uses for Cone Automatics will contribute in building the kind of world we've all been dreaming about.

CONE Automatic Machine Company, Inc., Windsor, Vermont

Committee Told of Administration's Methods of Enforcing WLB Rulings

Witnesses charged conspiracies among government departments to force business firms to abide by rulings. . . Mail order house says mail deliveries curtailed by Post Office Department. . . Plants seized by War Department

WASHINGTON

FANTASTIC stories of alleged administration conspiracies to persecute business firms, even to the point of driving them out of business, to enforce orders of the War Labor Board, have been related at recent hearings of the House Committee on Expenditures in the Executive Departments.

John A. Barr, attorney for Montgomery Ward & Co., Chicago, told how the War Labor Board, in November, ruled that the company must enter into a contract at its Oakland, Calif., store containing the maintenance of membership clause, also the checkoff system of collecting union dues. It ruled that at Portland, Oreg., the maintenance of membership clause should be included and that wage rates should be changed, some being increased and others substantially lowered.

"The reductions apply to jobs that have carried certain wage differentials over many years," said Mr. Barr. "The WLB rates are so unfair that if followed will result in closing our store. The peculiar thing is that when this case was discussed before the WLB panel the matter of wage rates was not even mentioned. We have appealed for a review but our appeal has been denied.

"The Post Office Department, on instructions from Washington, drastically curtailed delivery of our mail-order mail and dumped a large part of this mail in a warehouse which it rented for this purpose—obviously an act in support of the union and the WLB. We had to close the store."

The WLB, said Mr. Barr, is arbitrary and does not hold fair hearings. It is prejudiced on the side of labor and the employer does not have a chance.

"At a panel procedure in New York," he said, "the panel chairman said that although the rules provided for the examination and cross examination of witnesses he would not permit us to examine the union's witnesses in any way that might cause embarrassment and I think, as any lawyer would know, that eliminates all cross examination. This ruling was made after a union spokesman, in a lengthy speech, had made many statements a large number of which were untrue."

Mr. Barr charged that the WLB, as a result of its policies, is in violation of the fundamental liberty of working and earning a living without regard to membership in any religious, social or industrial organization.

An even stranger story was told by H. C. Dodge, president, and Matt B. Jones Jr., counsel, S. A. Woods Machine Co., South Boston, Mass. This company for more than ninety years has been manufacturing woodworking machinery and, in recent years, induction motors. In 1939 it took an educational contract involving shells. The outcome was that, largely with government funds, it built a specially equipped plant for making shells.

In April of 1941, representatives of the United Electrical and Machine Workers of America, CIO, asked for recognition and a contract. The National Labor Relations Board ordered an election and a contract was entered into covering the workers at the shell plant. Everything went along smoothly until the spring of 1942 when the company began retooling for a new type of shell. The men had been paid bonuses under an incentive system and during the retooling period the company restored the former guaranteed wage system to prevent hardship. Later, it revived the incentive idea, whereupon the union claimed the rates were not high enough. The company, on the other hand, contended the men had slowed down.

Mediation Before One-Man Panel

"The union complained to the United States Conciliation Service and the Secretary of Labor referred the case to the War Labor Board. We went through six days of intensive mediation before a one-man panel," said Mr. Jones, "and we ironed out all points with the exception of the matter of a maintenance of membership clause, compulsory arbitration of debated points, and the matter of determining how future bonus standards should be fixed.

"The board on Aug. 1 ruled that we would have to accept maintenance of membership, compulsory arbitration, also, compulsory arbitration of future bonus standards. We refused on the basis of the biased record of the United States Conciliation Service.

"On Aug. 19, 1942, the President signed an executive order directing the secretary of war to take possession of the 'plant' of the S. A. Woods Machine Co. The next day a platoon of 250 soldiers armed with machine guns and tommy guns, and accompanied by a hospital unit, arrived at the plant and it was taken over by Col. Ralph E. Gow."

Not only was the shell plant taken over, but also the plant making woodworking machinery and electric motors. Colonel Gow ejected the executives from their offices and got together an organization of Army men and civilians. The Army operated both plants up to Oct. 12 when it leased it to the Murray Co., Dallas, Tex., for operation.

"Production of woodworking machinery and electric motors recently has been declining," said Mr. Jones, "and now the company has discharged all of its sales personnel and is getting ready to discontinue these lines altogether; it is going to manufacture radar parts under a subcontract. The War Production Board, in view of the great need for woodworking machinery, has been trying to keep this production maintained, but so far without success. It looks as though this business has been destroyed.

"Not only are we unable to sell to our customers all over the United States, but we are unable to furnish repair parts to them to keep their present equipment going."

In operating the two Woods plants, said Mr. Jones, the War Department did some singular things. The first thing it did was to reinstate three workers who had been discharged for soldiering. It granted wage increases and extended wide seniority which the union shop committee repudiated as unsound. It removed the ban on smoking despite a dangerous fire hazard—and this also worried the union representatives.

Not only did the Secretary of War exceed his authority in taking over the woodworking and electric motor plant, as well as the shell plant, declared Mr. Dodge, but he again exceeded his authority when he took over the new shell plant that the company had built at Natick, Mass., in 1942. The President's order, he explained, could have applied only to the South Boston shell plant, for the reason that a collective bargaining operation was then under way at the woodworking machinery and motor plant and this plant was not involved in the WLB order.

"It is strange how this matter of enforcing a War Labor Board works out," said Mr. Dodge. "I remarked to Robert P. Patterson, Under Secretary of War: 'You and the War Labor Board are asking us to break the law.' Judge Patterson replied 'you just obey the President's orders—the way I do.'"

Judge Patterson and General Somervell tried to cajole him into obeying the WLB order and finally Patterson said that if Dodge and the other executives did not go back and behave like "good boys" he would take over the Natick plant as he had the two at South Boston. Patterson did that soon after the conversation, without any further authorization from President Roosevelt.

Colonel Gow, questioned as to why he took over the two South Boston plants, instead of just the shell plant, tried hard to justify this action on the ground the two plants had a railroad switch in common, that they were run with one set

HOUSE GROUP STARTS INVESTIGATION OF WAR SPENDING BY ADMINISTRATION

HOUSE Committee on Expenditures in the Executive Departments, long the abode for bills which the administration wanted pigeonholed, now promises to become one of the most spectacular committees in Congress. The committee has vast powers, delegated to it when it was created in 1927 to take the place of 11 separate committees on bureaucratic expenditures, some going as far back as 1816. Congress authorized it to examine:

"The accounts and expenditures of all government agencies, departments and commissions; the economy, justness and correctness of such expenditures; their conformity with the appropriation laws; the proper application of public moneys; the security of the government against unjust and extravagant demands; retrenchment; enforcement of payment of moneys due the United States, and the abolition of useless offices."

Republican members of the committee, irked over the refusal of the majority to live up to this responsibility, discovered a provision in the law under which the committee must go to work when called upon to do so by seven of its members and that on such action "every executive department and independent establishment of the government shall . . . furnish any information requested of it relating to any matter within the jurisdiction of said committee."

The eight Republican members signed a letter to Chairman James A. O'Leary (Dem., N. Y.) invoking the statute. That they propose to explode a lot of political dynamite was indicated at the initial hearing by a tiff between Acting Chairman John J. Cochran (Dem. Mo.,) and Clare E. Hoffman (Rep., Mich.) in which the latter exclaimed:

"When it comes to a question of investigating fraud and criminal negligence, you have stood between an investigation by this committee and what the administration desires. You are a loyal party man and you don't intend to let anyone get anywhere with an investigation, but we of the minority are determined to get to the bottom of these crimes."

It is expected the committee's investigations will be largely concerned with the administration's war spending.

of books, that they had some personnel in common, that they got electric power from one outlet and so on. Questions asked by committee members indicated they were not much impressed with the explanations and that they were inclined to believe that the administration and the Army had lined up to enforce the War Labor Board's order.

The hearings tended to indicate that the WLB is just as arbitrary and unfair in its proceedings as the Price Adjustment Boards are alleged to have been in functioning under the Contracts Renegotiation act. Witnesses said they were denied the right to cross examine union representatives who were not telling the truth, also that the WLB panels did not permit any record of the proceedings to be made. They also said the WLB orders covered features of employment relations not mentioned in the hearings. Furthermore, employers were given no information beforehand as to what subjects would be discussed.

Pressed for an explanation as to the source from which the War Labor Board derives its power to order maintenance of union membership, Chairman William H. Davis said that it originally stemmed from Executive Order 9250 and that it now stems from the National Labor Disputes Act of 1943. The board, he said, takes the attitude that it has the power to order unions and employes to enter into any agreement which they legally might enter under the National Labor Disputes Act of 1943 or the Wagner act. Questions by committee members indicated they were somewhat skeptical about this interpretation.

Court Action Denied

Asked why the board had not conformed to the request of the S. A. Woods Machine Co. that a court decision be obtained in order to test the authority of its order, Mr. Davis snorted that would have been "ridiculous."

"The act of Congress," he declared, "imposes upon the board the duty to establish by order the terms and conditions of employment which shall govern the relations of the parties in order to end a dispute. The War Labor Board has been given by Congress the duty to tell them what to do, whether they agree or not. Now, believe me, you cannot settle a labor dispute by tears or prayers or urging. When you get a tough one where the parties have made up their minds they will not agree, the only thing you can do is let them fight it out on the picket line or tell them what to do.

"We don't want any court reviews of our orders," declared Mr. Davis.

Wayne Morse, public member, said that in his opinion no court has jurisdiction to review a WLB order. He did not know how an aggrieved party could test the legality of a WLB order. He expressed the opinion that even Congress could not stop the President from seizing plants in time of war as the constitution grants him that power.

Asked why he refused to join in approving the Ickes-Lewis settlement of the issues in the coal strike, Mr. Morse said the sole reason was his refusal to violate the board's policy of refusing to review cases while men were out on strike. The settlement in itself, he said, is satisfactory.

Asked whether a 15-minute lunch period would not force the miner to wolf his meal and cause indigestion, Mr. Davis said:

Explains "Lunch" Period

"The funny thing about that is that a miner does not eat any lunch in his lunch period. It is a rest period. They have periods of interruption of work made necessary by blast, setting timbers or what not and they have the habit of going to their lunch boxes and taking what they call a 'piece' and they eat their lunch that way, but the half-hour period in the middle of the day is a rest period. The miners now will get a 15-minute period instead of half an hour. I am talking about the miner at the face of the coal."

Mr. Davis, in response to questioning, said he would welcome a court review of the board's power to order maintenance of membership. The board believes it has power to order the closed shop—but it has decided not to go any further than the maintenance of membership clause with the provision under which a member may withdraw from a union within 15 days after the order has been issued.

"After all," said Mr. Davis, "the men cannot use the strike to fight for their rights during time of war, and the unions cannot call strikes. It is only fair to give the unions some feeling of security. The maintenance of membership clause with its 15-day escape period does not always work to the advantage of the unions. We know of many cases in which the escape clause has ruined the union."

The board is handling 600 dispute cases a month. It is reviewing voluntary requests for wage increases at the rate of 3000 a week.

Copper Recovery Corp. To Be Dissolved This Month

Plans are being completed to dissolve the Copper Recovery Corp. before the end of this year, John P. Sullivan announced recently. The corporation was formed in the spring of 1942 by prominent members of the copper and brass industry at the request of Metals Reserve Co. to act as its agent in purchasing idle and excessive inventories of copper and copper-base alloys.

PRIORITIES–ALLOCATIONS–PRICES

Weekly summaries of orders and regulations, together with official interpretations and directives, issued by War Production Board and Office of Price Administration

INSTRUCTIONS

CAST-IRON FURNACES: Recent 9 per cent increase authorized in manufacturers' sales of steel warm-air and cast-iron furnaces applies only to the furnace proper and does not apply to any auxiliary equipment.

ALUMINUM: Aluminum for the manufacture of bottom boards and additional types of flasks may be obtained now by pattern makers under procedures and within the limits outlined in direction No. 1 to CMP regulation No. 5. A pattern maker may obtain up to 600 pounds more of aluminum per quarter for use in making patterns than is turned in to him in the form of obsolete or defective patterns without applying to the WPB by placing the MRO symbol and certification provided in CMP regulation No. 7 on his orders.

INTRA-COMPANY DELIVERIES: With-in company deliveries are not subject to the order-placed requirements established in direction No. 1 to priorities regulation No. 18. A producer must not accept an order for one of the products covered by the direction, if he has purchase orders on hand which bear equal or higher priority ratings or which are part of a frozen schedule and because of such orders he does not believe he will be able to fill the new order. The direction does not apply to: Orders for listed products required for MRO; orders placed with or by persons who take physical delivery of listed products for resale; orders for used or second-hand products; orders for specified products (group B) in any case where all orders placed with the producer for delivery of the same item on the list to the customer in the same calendar quarter do not exceed $10,000.

RADIATOR VALVES: Directives that prohibit the use of brass in manufacture of radiator valve bodies will not be withdrawn prior to Dec. 31 but they may not be renewed when they expire on that date. Manufacture of radiator supply valves may be resumed then within the limits of material available. Manufacturers are cautioned by WPB to avoid excessive production of valves made of substitute material. Proposed changes in schedule VIII of order L-42 would lift some of the restrictions on manufacture of vapor and vacuum heating specialties. Manufacturers wishing to make radiator supply valves should file a CMP-4B application for the controlled materials that he desires to have allotted to him for this purpose for the first quarter of 1944.

WHOLESALERS: Wholesalers (and retailers) who use form WPB-547 (PD-1X) to apply for priority assistance in obtaining scarce goods are cautioned not to order supplies of this form for more than immediate needs. A simplified version of this form is under consideration and probably will be effective sometime in January.

SILVER: Permitted uses of Treasury silver for embroidered insignia and braid on officers' uniforms is defined in direction No. 1 to conservation order M-199. This direction was made necessary by the revocation of preference rating order P-131, which heretofore controlled this material.

FOOD MACHINERY: Approved orders for food processing machinery are defined in an interpretation to order L-292 to include orders which bear a rating of AA-5 or higher and which are assigned on specified forms. These forms usually include the name of the supplier and valuation of the processing machinery covered by the order. However, it is not necessary for the purchaser to confine his purchase to the supplier named by him providing that the model eventually obtained is substantially the same in size, operation and function, and has the same value and quality as the model originally stated in the application.

WPB RULES: Rules, regulations or orders of WPB apply to deliveries and use of materials in the territories and possessions of the United States after their effective dates, unless the order or regulation specifically states that it is limited to the continental United States or to the 48 states and the District of Columbia.

NAILS: Manufacurers of asphalt shingles, asphalt roll roofing, asphalt siding, asbestos shingles, asbestos siding, or cork board may use the MRO symbol to purchase steel nails to be delivered along with such products to be used in applying them, if orders for such nails call for delivery to the manufacturers after Dec. 31, 1943. The MRO procedure may not be used, however, by such manufacturers to purchase more nails than are needed to apply the products delivered nor may such manufacturers increase the amount of steel nails delivered with any unit of such products over the quantity delivered with such unit during 1943.

After Dec. 31, 1943, any manufacturer who can purchase his steel nail requirements under this direction, No. 14, to CMP regulation No. 5 must not get them under order M-21-b-2, relating to steel warehouses and dealers, or under any other order or regulation of WPB.

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L ORDERS

HEATING BOILERS: Gas-fired low-pressure heating boilers have been brought under the simplification restrictions of schedule III of order L-42. Fusible plugs, tri-cocks and metal jackets (except for gas-fired burner boiler units necessary as a functional part of the boiler) are prohibited for low-pressure heating boilers fired by solid, liquid or gas fuel. (L-42)

CASKETS: Manufacturers of caskets now are permitted to use ½-pound more steel than they have been using for joining hardware and to resume the use of wool for outside covering of caskets. By increasing the amount of steel that may be used for joining hardware to 3½ pounds and by decreasing the amount that may be used for nails, screws, hinges, catches, and the like from 2 pounds 2 ounces to 2 pounds, it has been possible to permit manufacturers to use a maximum of 24 ounces of steel for casket handle arms and attaching plates. (L-64)

LOCOMOTIVES: All WPB controls have been removed over used locomotives and used industrial cars. Limitation order L-97-b has been revoked while control over new railroad and industrial cars has been consolidated under order L-97-a. Control over new locomotives remains under L-97, from which restrictions covering used locomotives have been removed. (L-97, a, b)

GARDEN RAKES: Each manufacturer of garden rakes now is restricted to 60 per cent by weight of the volume of garden rakes produced in 1940 or 1941, whichever is greater. Production in 1944, it is estimated, will be 121,100 dozen compared with 220,000 dozen in 1943 and 201,900 dozen in 1942. (L-157)

WATER HEATERS: Reference to "water backs" has been deleted from the definition of "direct fired water heater" under order L-185 since they are parts of stoves and, as such, are controlled by order L-23-c. All hot water storage systems have been brought under the jurisdiction of the Plumbing and Heating Division, WPB. (L-185)

VALVES: Flow diversion valves manufactured for use in the pasteurization of milk have been exempted from the restrictions of schedule I of limitation order covering industrial type instruments. (L-272)

M ORDERS

ALUMINUM: WPB has removed the requirement to secure authorization to cover delivery of restricted bauxite to manufacturers of alumina or abrasives or to cover delivery of alumina to manufacturers of aluminum and abrasives. Method of securing authorization to deliver restricted bauxite and alumina to persons who intend to use it for purposes other than the manufacture of alumina, aluminum or abrasives. The person who desires a specific authorization to accept delivery of restricted bauxite or alumina is required to send his order to the Aluminum and Magnesium Division of WPB together with a statement of the specific purpose for which the material is to be used, together with a statement that the amount ordered will (or will not) raise his inventory in excess of a 60-day supply. (M-1-h)

Restrictions on the use of aluminum have been eased to permit its employment in the manufacture of buses and the fabrication of collapsible tubes. (M-1-i)

ANTIMONY: Antimony will be released from allocation after Jan. 1, 1944. Deliveries from persons other than the Metals Reserve Co. may be made or accepted by any person without specific authorization from the WPB. Quarterly reports will be required in order to permit the board to observe the position of the metal. (M-112)

TITANIUM OXIDE: Preference ratings below AA-2 for pure titanium dioxide have been voided by WPB, except on military orders. The purchaser is required to certify to military orders, thus validating whatever rating the purchase carries. Non-military orders not bearing an AA-2 rating are to be filled as non-rated orders to the extent that supplies are available. (M-353)

P ORDERS

WATER WELL MATERIALS: A new order, P-148, assigns an AA-3 rating and a CMP allotment number S-4 for the purchase of materials by water well drillers. The rating and allotment number are valid only for the drilling, casing and repairing of wells supplying water for agricultural, domestic, or other use in rural and suburban areas.

The order does not cover pipe for laying on the surface, except for routing water from the well to the pump; and it does not apply to pumps or pump parts. The allotment number S-4 is invalid for the purchase of either copper or aluminum in the forms listed at the end of CMP regulation No. 1. Inventories of materials procured under the order are restricted to a 60-day supply. The rating and allotment number are not to be used for maintenance and repair of water-well drillers' equipment. The order does not cover irrigation or drainage pumps, wind mills, deep or shallow well domestic water systems, power pumps, or water-well casing not fabricated by pipe mills. No items appearing on list A or B of priorities regulation No. 3 may be bought through application of the rating or allotment

number. Where special applications for materials or parts are required by any other WPB order. they take precedence over provisions of P-148. Where ratings higher than AA-3 are needed for a particular kind of material, application should be submitted on form WPB-541 to the nearest WPB field office. (P-148)

PRICE REGULATIONS

ANTIMONY: Specific dollars-and-cents ceiling prices have been established in a new price schedule, No. 497. The order also covers 15 antimony compounds. For 99-per cent metal (99 to 99.8%) maximum delivered price is 14.50c plus carload freight from Laredo, Tex., to buyer's receiving point; for metal 99.8% and over, with maximum arsenic 0.05% and no other single impurity in excess of 0.1%, 15c. The 14.50c price applies also to 99.8% metal and over, not meeting specifications for the 15-cent maximum price. For all antimony not meeting the specifications of the two principal grades, the ceiling is 13.25c per pound of antimony content. For all sales of less-than-carload lots, producers or producers' agents may add the following differentials: ¼c per pound for 10,000 lb. up to a carload; ½c for 224 lb. to 10,000 lb.; 2c for amounts less than 224 lb. On sales by dealers, distributors or jobbers, add ½c, 1c and 3c, respectively. Additional charge of ¼c may be added on any sale or delivery of antimony metal packed in cases or boxes.

Maximum prices for antimony oxide, antimony sulphide, antimony pentasulphide, needle antimony, ground antimony sulphide, granulated antimony sulphide, antimony fines, antimony trichloride, antimony oxychloride, antimony fluoride, antimony lactate, antimony pentachloride, antimony potassium tartrate, antimony salt (de Haens Salt) and antimony salts are established at the highest level charged on a delivery made during March, 1942, to a purchaser of the same class; or, if not such delivery was made during that month, the highest offering price. Maximum prices for new sellers must be approved by OPA and must be in line with March, 1942, levels. (No. 497)

Special Allotments Made For Heating System Controls

A special allotment of controlled materials has been provided for the manufacture of certain heating system controls at the request of the Office of Civilian Requirements for the purpose of conserving fuels. Materials were provided for the manufacture of the following domestic temperature controls: 200,000 barometric dampers for space heaters and 400,000 barometric dampers for central heating plants; and the following commercial temperature controls: 5000 control sets composed of outside-inside thermostats, motors, linkages, valves, relays, transformers; 15,000 control sets composed of thermostats (inside) motors, linkages, valves, relays, transformers; 15,000 barometric dampers.

Manufacturers desiring to produce any specified number of the above types of equipment should file immediately a separate CMP-4B application under code No. 594, "Heating System Controls" and mark the application "Fuel Conservation Drive Controlled Materials" in the upper border of the form.

Manufacturers are free to distribute and sell the above listed heating system controls without a priority rating if they are built of "Fuel Conservation Drive Controlled Materials", since they are listed on schedule A of order L-79.

Steel Division Officials Discuss Mill Maintenance, Repair Problems

Tell industry advisory committee members that some machine tool manufacturers have open machining capacity. . . Cite early delivery of slag pots. . . Wire rope orders placed year in advance. . . Chain deliveries lag

STEEL casting deliveries are becoming worse, according to a report submitted by a member of the Steel Mill Maintenance and Repair Industry Advisory committee of the War Production Board at its recent meeting. A plant whose normal capacity is 2100 tons a month is producing only 1300 to 1500 tons a month due to manpower shortage, the report said. Production schedules of that plant and several other plants in the same section apparently are being pushed back constantly.

Other subjects discussed at the meeting included slag pots, wire rope, chain and shipping containers. In connection with the latter, it was felt that control of fiber and fiberboard shipping containers may be eased and that requirements will be met fully.

Three plants have been able to offer 8-weeks' delivery on slag pots and one plant has been able to offer 7-weeks' delivery, replied Frank A. Weidman, WPB Steel Division and government presiding officer of the committee. Several plants offering similarly early delivery are in the committee member's district, he pointed out. With relaxation of demand for machine tools, some machine tool manufacturers have open machining capacity.

Wire Rope Demand Heavy

Production of wire rope has had to be scheduled so far ahead that steel producers must place their orders at least 6 to 12 months in advance, Mr. John P. Barclay, Wire Rope and Strand Section of the Steel Division, told the committee. The chief difficulty experienced by steel producers is their inability to obtain delivery of wire rope in the specified lead time as set up in schedule III of CMP regulation No. 1.

The actual lead time required by most producers is at least two to three times the specified lead time. This means that orders placed requesting delivery in 75 or 105 days, or sooner, are extended to four, five, and six months and, in some cases, beyond.

It was suggested at the meeting that orders for usual requirements should be placed for at least 12 months in advance. This would assure the steel producer of entering the wire rope producer's schedule for the later months in which an opening existed for the entry of the order under CMP regulations.

For the earlier months in which schedules are fully loaded, the Wire Rope and Strand Section will arrange for the placement of that portion so as to satisfy the steel producer's schedule of requirements. This requires only temporary relief in the immediate months in which difficulty is experienced, and in later months no difficulty should be experienced providing the steel producer maintains his order placement at least 12 months in advance. Special emergency requirements can be satisfied by a directive on some producer who can meet the delivery imposed on the emergency need for wire rope.

The Wire Rope and Strand Division will do its utmost to see that wire rope requirements of steel mill maintenance and repair are met, even to the point of issuing a directive upon a specific supplier, if satisfactory delivery cannot be obtained otherwise, Mr. Barclay assured the committee.

Facilities Are Expanded

There are 18 producers of wire rope and additional facilities are being brought in. Demands are increasing, however, at a greater rate than production. With the advance of military operations in Europe and development of lend-lease orders for equipment in territory formerly occupied by the Axis, production has had to be increased from 14,000 to 15,000 tons a month in 1942 and to about 25,000 tons a month now.

One committee member reported that requirements for all the popular sizes and some of the less popular sizes for general mill use are fairly well covered but that about 20,000 feet of 6 x 20, one-inch rope will be required for ore bridges and docks at the opening of the next lake navigation season, about the middle of March, 1944. Producers should know their average monthly requirements for a full year ahead and as far in advance as 1945.

Chain deliveries are from 6 to 10 months behind now, depending upon size. Best service can be obtained by staggering orders over as long a period as possible.

Authority of WPB Regional Offices Extended Further

War Production Board regional offices have been authorized to approve or deny construction projects involving production machinery and processing equipment when the dollar value involved is less than $10,000.

EVEN WHEN there was PLENTY of manpower

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The battery of Mult-Au-Matics you see here has been steadily at work since 1938. It has made many different automobile parts for its maker. Right now, it is helping to build well-known airplane engines.

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By A. H. ALLEN Detroit Editor, STEEL

MIRRORS of MOTORDOM

Industry re-employing veterans discharged from armed services. . . . More attention is being paid to civilian goods requirements. . . Ford to mix some anthracite slack with low-volatile coal to improve coke quality

REHABILITATION of war veterans is one of those things which industry has had on its list of postwar "musts," but it is turning out that the problem is at hand right now. Literally thousands of soldiers, sailors and marines are being repatriated for a variety of physical and mental reasons; their re-absorption into industry with which they may have been familiar in prewar days is one of the best ways to clear up the neuroses with which many of these veterans are beset.

About 10 per cent of the 10,268 men inducted into the armed services from 16 Fisher Body plants have been re-employed, and in addition another 300 returned servicemen, not former employes, are now at work for Fisher. In the Detroit area 470 former employes had returned to work as of the first of November.

Men released through medical discharges are generally well recovered from injuries sustained in action. The offer of immediate employment helps to bolster mentalities which active campaigning may have frayed around the edges. A carefully supervised program of fitting such men to jobs within the limits of their capacities is one essential to successful rehabilitation.

Attention Turning to Civilian Needs

Another rehabilitation which impends is in the field of civilian requirements, many of which have been shut off in the interests of war production. Now that materials are more readily available and war contracts are tapering in some categories, attention is turning to civilian needs. A Civilian Requirements Committee, keyed to advise the WPB of local needs for consumer goods, commodities and services under wartime conditions and also to handle major civilian supply problems, has been established for the Detroit region, and is the first of 104 such groups to be set up throughout the country.

As outlined by James E. Wilson of the local WPB office, the committee will make recommendations on the need for production of essential civilian goods and, by means of surveys and reports reveal where shortages are affecting the war effort. As the war requirements picture changes, these reports will reflect conditions rapidly to the WPB. The committee acts as a co-ordinating group between producers and distributors of civilian products. Personnel includes representatives from the FHA, OPA, ODT, WMC, WLB and WPB, plus others from representative civic associations, utilities, labor and industry. Industrial members are associated with leading electrical, plumbing and hardware jobbers here.

Partial substitution of anthracite slack for low-volatile coal, a measure scheduled for adoption shortly, will effect a saving of 225 tons of coking coal daily at the Rouge plant of Ford Motor Co. In addition, tests show an improvement in the quality of the resulting coke. The saving represents 5 per cent of the total tonnage of coal coked daily at the Rouge.

Formerly regarded as impractical for coking purposes, since coke made exclusively from anthracite slack is lacking in metallurgical and structural properties, laboratory tests revealed that when it is fused in small quantities with other coal anthracite imparts added toughness to the coke.

Ford uses tens of thousands of tons of high-volatile coal from the Pond Creek mines in eastern Kentucky. Low-volatile coal, used in lesser amounts, comes from western Virginia, while all anthracite slack is being shipped from Scranton, Pa., mines.

25,500,000 AUTOS

Almost two years after the automobile assembly lines were stopped, about 24,500,000 cars remain in use by private owners, and about another million are in storage and in the hands of dealers, a total about equal to the entire supply at the beginning of 1940, according to Charles L. Dearing, director of the Office of Defense Transportation's Division of Review and Special Studies.

This represents a net loss of from 2,000,000 to 2,500,000 cars scrapped during two years of war, since there were some 28,000,000 private automobiles when the war began.

War production at Nash-Kelvinator plants for the year ended Sept. 30 in dollar volume was approximately $185,000,000, or close to half a million dollars daily, making the year the greatest in history of the company. The total exceeded by $63,000,000 the previous 1941 high. Projecting current production into the months ahead, it is estimated that the next 12-month period should see a total of $350,000,000 produced.

Nash reached its peak propeller production schedule two months ago, and top output of the big Pratt and Whitney engine will come sometime next year. Schedules also call for mass production of helicopters sometime during the coming year. Despite the record gross volume of business for the past year, N-K profits were only $286,000 beyond those of a year ago, amounting to $4,115,550.

General Motors announces its 116 plants are now turning out war material at a rate exceeding $12,500,000 worth daily. In terms of dollar value, production for this year will just about double that for last year, but in terms of physical volume, will be 2.4 times last year's total, indicating the degree to which costs have been reduced. Almost half of the additional production achieved in 1943 represents new contracts entered into this year or late in 1942.

GM employment now averages around 500,000, including 114,000 women. It is interesting to note that out of this half-million employes, 40,000, or 8 per cent, are working in GM plants outside the United States—in Canada, England, Australia, India, New Zealand, South Africa and Egypt.

There is a lot of argument and speculation over the postwar future of the Army's jeep, and its forthcoming airborne successors, for which the Army, by the way, would like a good name. Estimates indicate that there have already been produced close to 600,000 of the little rough-and-tumble cars, and battle casualties still will leave a substantial portion of them usable, if anyone wants them.

Considered opinion is that only limited numbers of them will ever find popular acceptance in this country. The jeep fundamentally was designed to travel where the going is roughest, where trails take the place of roads. The postwar United States likely will see renewed emphasis on superhighways and extension of paved roads into remote areas, so there is not much point to "roughing it" on super highways with a jeep. However, in many sections of the world—South America, China, Africa, Russia, for example—the jeep should find ready acceptance.

Plan To Produce Postwar Jeep

The Willys-Overland people, even without the enthusiastic J. W. Frazer, who has now been succeeded in the presidency by Board Chairman Ward Canaday, still are all out for the jeep or some vehicle like it in this country. They are even making plans to offer civilian versions of the jeep in various styles, and foresee a large market in rural areas.

This department's bets are still on the full-size car and not the jeep. From the standpoint of comfort and roadability, the Army's midget just cannot compete, as any soldier who has had to ride in one all day will groaningly attest. The decentralizing and suburbanizing of the United States which should follow the war will demand automotive transportation which is fast, comfortable and presentable.

Incidentally, arguments over how the jeep came to be called thus should be set at rest with the authoritative disclosure that the name evolved from the initials G. P. the Army Quartermaster Corps applied to the original Dodge general-purpose command-reconnaissance car. It was the original jeep, and when the new American Bantam-Ford-Willys creation began to be received in quantities, the name switched to the smaller car and has stuck since. Originally supposed to

have been built to weight limit of 1325 pounds, the jeep was rushed through under pressure and came out closer to 2000 pounds. At the time, the Army was not too concerned about the weight, merely wanting a rugged vehicle in quantities, and the jeep quickly proved itself by wearing out the toughest Army drivers over obstacle courses. Early tests were marred by only one untoward incident—a test driver became marooned in a water obstacle because of a too-slow start and had to be towed out.

Standardize Gas for Vehicles

War Department announces that an all-purpose all-weather gasoline of 80-octane rating has been made standard for all Army Ground Forces vehicles, ranging from jeeps to tanks. It was developed through three years of experiment by the fuel and lubricants division of the Quartermaster General's office working in cooperation with the Ordnance Department and the oil and automotive industries.

It was formerly necessary for the Army, in every procurement of gasoline, to specify the exact area in which it would be used, and the time of year, thus precluding a flexible supply system in the various theaters of operation. Also it made impossible, in the event of an emergency, the rerouting of a shipment of gasoline destined for one area to another area with different climate. Three years ago, three different octane ratings were used in gasoline—91-octane aviation gasoline for tanks, 80-octane and 72-octane. In the first move toward standardization, tank engines requiring 91-octane were redesigned to operate with 80-octane. Because they could not be lowered much further without sacrificing efficiency of performance, it was decided to standardize on 80-octane for all vehicles.

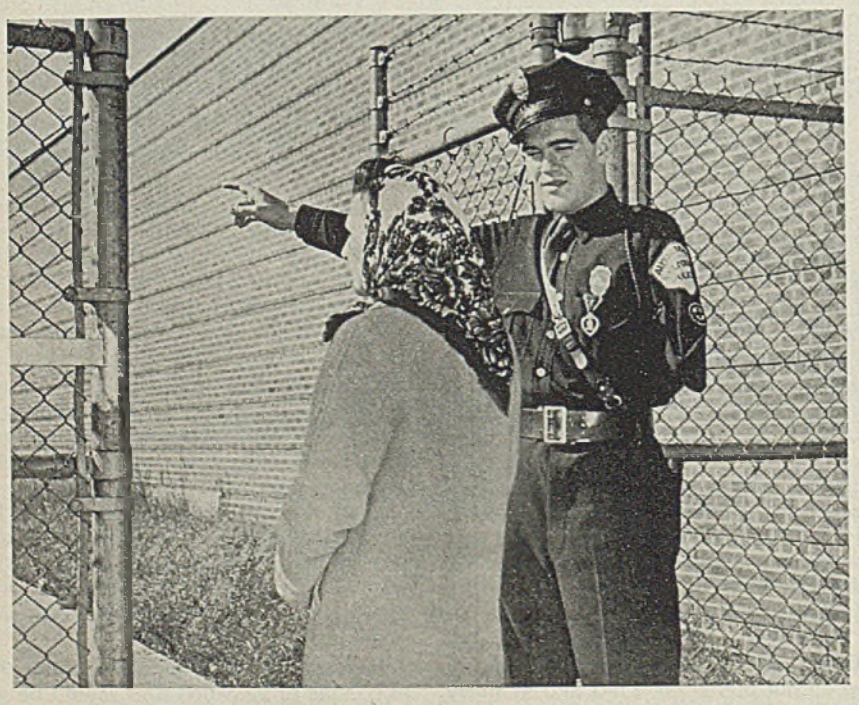
New gasoline specifications also take care of the problem of stability, a factor which is not so important in civilian gasoline as in military fuel because the rate of consumption of the former is high enough to avert the necessity of long storage. Furthermore, there is little storage of civilian gasoline in containers as small as the 55-gallon drums and 5-gallon cans the Army requires for field use.

One of the largest continuous nickel plating installations ever built has been erected in a Detroit plant in connection with a secret war assignment.

Albion Malleable Iron Co., Albion, Mich., has been granted a DPC loan of $1,500,000 for improving and mechanizing its foundry to permit doubling production of malleable castings for trucks with minimum increase in manpower requirements.

Considerable grumbling is heard over Detroit being designated a No. 1 critical area for manpower, precluding the placing of additional war contracts here. Many are convinced the district's plants could take on a sizable chunk of additional orders.

Two Packard engineers have just returned from a flying visit to England where they inspected Rolls-Royce operations with a view to exchanging information on British and American practices. It is a safe bet they gave more than they absorbed.



DISABLED VETERAN AT WORK: With jobs for disabled veterans slated to become one of the pressing problems of the third year of war, Studebaker Corp., South Bend, Ind., discloses it already has hired six wearers of the Purple Heart in addition to several ex-servicemen with medical discharges for reasons other than combat wounds. Here Paul Krouse, 19, whose left arm was amputated as a result of a gunshot wound received as he was carrying the litter of a comrade, directs a newcomer to the plant employment office

War Department Organizes Readjustment Division

Contract Termination Branch and the Redistribution and Salvage Branch of Headquarters, Army Service Forces, have been brought together in a new division to be known as the Readjustment Division, the War Department has announced. The new division is headed by Col. D. N. Hauseman, Ordnance Department, who has been chief of the Philadelphia Ordnance District.

Manpower Situation Shows Improvement on West Coast

A saving of 97,000 workers required for West Coast shipyards as a result of the operations of the West Coast manpower program has been announced by Paul V. McNutt, chairman, War Manpower Commission. At the same time, aircraft employment, the decline of which in June, July and August had threatened production and led to inauguration of the plan, turned upward. Two of the most critical plants have asked to have their referrals reduced.

Predicts Postwar Diesel Engine of Lower Cost

Certain fundamental diesel engine requirements can be accurately predicted—that the marine diesel of the future must be built in less weight, require less space and be provided at a lower first cost, Gordon Lefebvre, president and general manager, Cooper-Bessemer Corp., Mt. Vernon, O., told the Society of Naval Architects and Marine Engineers meeting at New York recently.

He stated the greatest stride in the reduction of weight and space has been made by an increase of rotative speed and by the employment of higher ratings, particularly through supercharging and that this type of engine has already fully demonstrated its reliability. He added that engines have been developed which will operate even at 1000 r.p.m. and at high supercharged ratings while handling heavy bunker fuels.

Mr. Lefebvre analyzed the trend in marine diesel design and construction and discussed at length the major uses expected in the postwar period based on five factors: Experience, past performance, stable peacetime needs, postwar shipping outlook, and the predictions of some of the leading architects and marine engineers.

What will users want in POSTWAR Machine Tools?

1. VERSATILITY will be a primary requirement of many machine tools sold in the postwar period . . . but versatility achieved without sacrificing high production rates and low production costs. Following every war, old products become obsolete and new products are developed with startling speed. Manufacturers must have machines which can be quickly and easily adapted to new purposes.

Exceptional versatility is characteristic of many machines equipped with Vickers Hydromotive Controls. The hydraulic method of control and power application is inherently the most flexible. There are more than 5,000 Standardized Vickers Units that can be combined to exactly supply every hydraulic power and control function:

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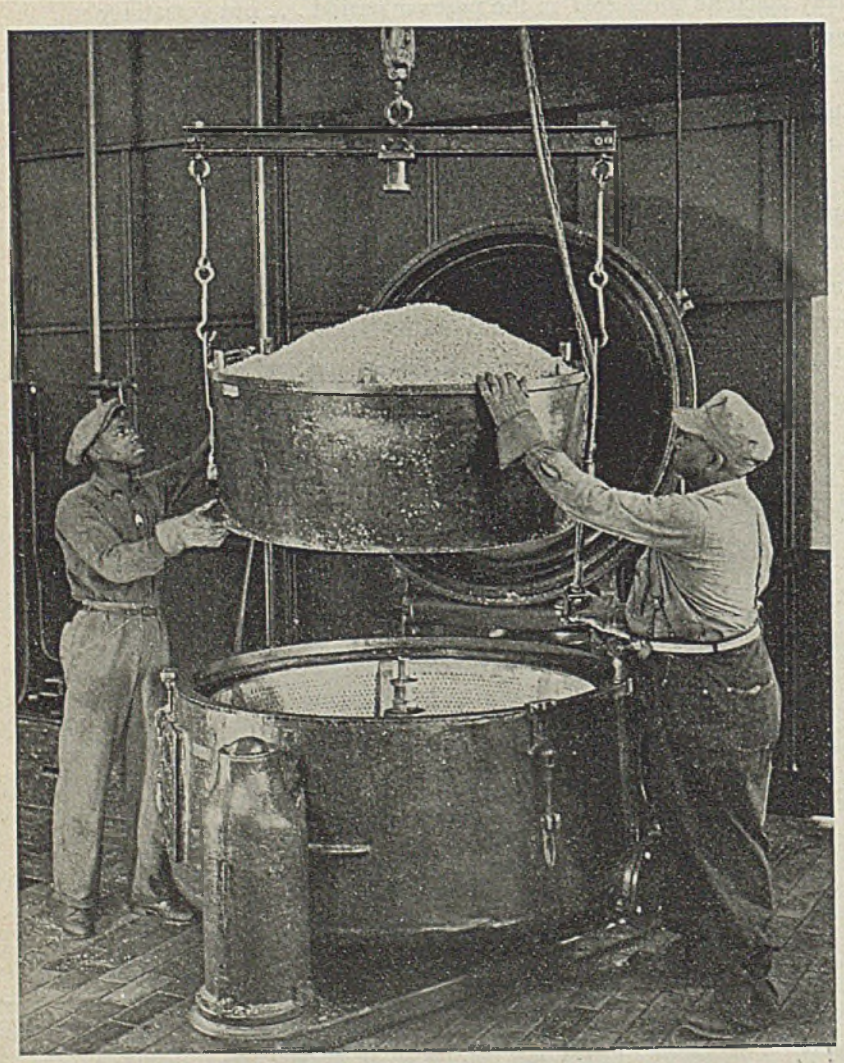
WING TIPS

Breathtaking aircraft production record of November all the more noteworthy in view of the fact unit weight of combat craft has been climbing steadily and now is over 8000 pounds. Some slowing down thought likely

PRODUCTION of 8789 airplanes in November set a new record for the American aircraft industry and its co-ordinated suppliers, bringing current output to an annual rate of better than 105,000 units and pointing 1943 production to a total exceeding 85,000. This breathtaking achievement is all the more noteworthy when it is realized that the unit weight of combat aircraft has been climbing steadily this year and is now well over 8000 pounds. Mounting numbers of heavy 4-engine bombers, over 1000 of which were completed in November, are the answer.

By the end of this year the industry can look back at a war production record which will show assembly of over 170,000 airplanes in five years, and ahead to a year which, barring sudden termination of military activities in Europe, should see airplane output pass the 120,000 figure. However, it would be a bad gamble to bet on any such eventuality, even though physically it could be done easily. The difficulties attending the deployment, staffing and servicing another 100,000 combat planes, plus the doubtful need of any such tremendous quantities, would seem to forecast a slowing of current production levels. Changeovers to new models also will have a retarding effect.

Analyzing the figure of 1000 heavy bombers, built in November, makes apparent the large share which Ford's Willow Run bomber plant is contributing. The two principal heavy bombers now being supplied are the B-24 Liberator and the B-17 Flying Fortress, with perhaps a handful of Boeing's new B-29 included. The Fortresses are being supplied by Boeing, Douglas and Vega (now known as Lockheed plant A) on the West Coast, while the Liberators are streaming from Consolidated plants in San Diego, from Douglas, North American and Consolidated plants in the Southwest, and from Willow Run—the latter supplying knockdowns for assembly in the Southwest. If the total output of all these plants is 1000 a month, then Ford must be supplying nearly a third of them, flyaways and knockdowns, from the Michigan bomber hatchery, a fact which must confound some of the old-line aircraft builders.



SALVAGE INSTRUMENT: Centrifuge at the Pratt & Whitney aircraft engine machining plant of Chevrolet is an effective salvage instrument, reclaiming about 850 gallons of cutting oil daily. Approximately 11 tons of aluminum chips and 3000 pounds of magnesium chips pass through machines like this each day. The inner chamber rotates at 600 r.p.m., throwing cutting oil clinging to the chips through the perforations in the side of the container into a sump. Aluminum chips and the 50 tons of steel chips collected daily are shipped to smelters

Not many of the new Boeing B-29 bombers, for long-range, high-speed, high-altitude work have yet been organized into battle echelons, but under the driving force of Brig. Gen. K. B. Wolfe they will soon appear over Europe and elsewhere. General Wolfe—affectionately known as "K.B." to his friends and associates in the industry and in the Air Forces, and likely to be known more appropriately in time as "K.B-29."—is devoting about all his time to this project, including both manufacturing and operational phases. Keen-eyed spotters in various sections of the Midwest have seen the new ship in flight and report it resembles closely an oversize Flying Fortress. But it embodies many surprises not found in the familiar B-17.

Concentrate on One Super-Bomber

Originally the B-29 was not the only super-bomber being planned by the AAF for early combat work. Consolidated had a similar ship in the test phases and reportedly was going to build it at San Diego. However, the Air Forces in recent months has decided to concentrate on fewer models and more of them, so apparently the Consolidated bomber has been tabled for the time being. Furthermore, a crackup in the early test stages did not help progress any.

Another large 4-engine pressurized airplane—the Lockheed Constellation or C-69—which early this year entered the preliminary production stage, ostensibly for later use as a troop transport and hospital ship, now has been sidetracked in favor of concentrating men, machines and materials at the Lockheed Burbank, Calif., plant on "der Gabelschwanz Teufel" as the Germans call the deadly P-38 pursuit and long-range escort plane. A new hangar at the Union Air Terminal in Burbank was being fitted out for building the Constellation, and a number of them were started, but a five-fold expansion in orders for the P-38 resulted in suspension of the big 4-engine job. The Constellation was fitted with Wright R3350 radial engines, each developing around 2200 horsepower.

Similar engines were installed in the

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Army's supersize flying laboratory, the Douglas B-19. Nothing has been heard of this tremendous craft since its initial flight on the West Coast a couple of years ago, but travelers past the Wayne county airport near Detroit have seen it parked there for a long time now. It is reportedly being fitted with four of the new Allison 3420 engines, 24 cylinders each, for test purposes. Great things are heard of this engine's possibilities, one comment being to the effect it will develop something like 3300 horsepower on bursts. The 3420 designation represents cubic inches of displacement, just as the R3350 designation on the 18-cylinder Wright radial connotes its displacement. Thus the 24-cylinder Allison has 70 cubic inches more displacement than the high-power Wright radial. These two engines, plus a new Pratt & Whitney for which the P&W plants at Hartford are now retooling, are the last words in present high-horsepower engines.

Conceivably engine designers in the aircraft field may progress to the point where they can get 1 horsepower for every cubic inch of displacement, but this goal is some distance off. Nevertheless, progress made with the original Allison 1710 engine in stepping horsepower up from about 800 to the present 1325 rated, and perhaps 1600 on bursts, indicates the trend.

With the enormous power being built into air engines, principally by strengthening their components to permit raising crankshaft speeds, the question becomes how to translate such horsepower into tractive effort of the propeller. Present answer seems to be the six-blade counter-rotating propeller, with its concentric shafts and intricate gearing. It is logical to look for more propeller installations of this sort, particularly on pursuit ships where a steep rate of climb and effective utilization of "burst" horsepower are more in demand than on bombers.

Skygazers around the Cleveland airport in recent weeks have been given the treat of witnessing preliminary test flights of the new General Motors pursuit ship which is being rushed into production. Designed by Don Berlin and his staff of engineers of the Fisher Aircraft Division of GM, this plane has been kept highly secret, although it has been under development for the better part of a year. First tests were merely runaway hops, or straight runs down a concrete apron with the plane being lifted off the ground a short distance. These were followed by the usual sequence of regular tests at altitude. In one of the first tests, the plane was said to have been off the runway in 6½ seconds at half-throttle.

Expects Drop in P-40 Production

Berlin was designer of the now defunct Curtiss P-40 pursuit plane, which despite its performance deficiencies by today's standards, was still the only fighter in quantity production when the Japs struck at Pearl Harbor two years ago. The AAF Materiel Command feels the P-40 has reached the limit of its developmental possibilities and after this year will be produced only in small numbers for operational training and replacement in theaters where it has proved effective. It seems reasonable to expect that Berlin's new design will embody some of the basic characteristics of the P-40, but on a larger scale, with greater rate of climb, higher speed, higher altitude, much better armament. His tieup with General Motors would seem to make it certain the plane will be Allison-powered as was the original P-40.

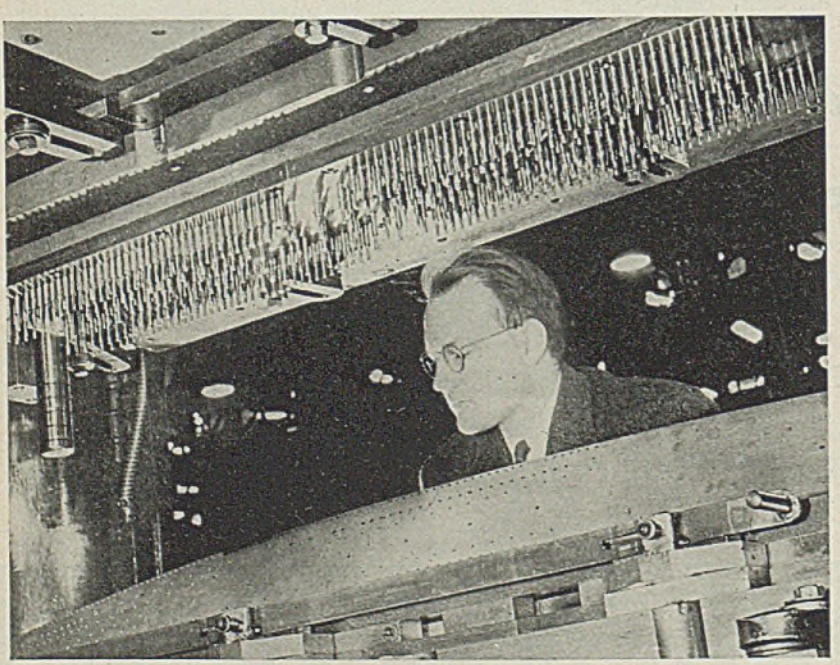
Another outdated pursuit plane, which to some extent shared the climb deficiency of the early P-40, is the Bell Airacobra or P-39. Bell Aircraft plants in Buffalo for some months have been in process of retooling for a new model fighter which will embody a low-drag wing and Allison engine with two-stage supercharger making it efficient at any altitude up to 38,000-40,000 feet. About half the total production of the P-39 Airacobra has gone to Russia where the plane has been particularly effective as a ground-strafing tank-buster, supplementing the activity of the famous Russian Stormovik fighter plane, said to be one of the best armored cannon-bearing (75-millimeter) and rocket bomb planes in the war. The new Bell fighter has been assigned an AAF identification number.

Still unmentioned in official comment on new aircraft is the Northrop night fighter which was under development early this year. Reportedly it was to make extensive use of magnesium sheet in its fuselage skin, but lack of any recent information on the plane suggests it may have been dropped by the AAF.

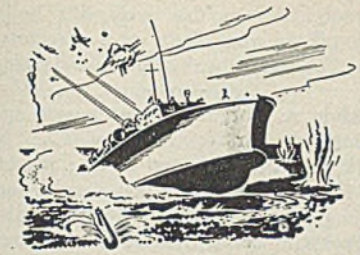
Another minor aircraft mystery which is now cleared up is the status of the Consolidated P4Y two-engine patrol bomber which this spring was supposedly going into production at a New Orleans plant taken over by Consolidated Vultee at the request of the Navy Department, after cancellation of the Nash-Kelvinator contract for building Sikorsky flying boats at that location. There was nothing particularly secret about this plane. One had been built by Consolidated on the West Coast and it was known simply as the Model 21.

Analysis of the postwar possibilities of export and import freight by air, compiled by a University of Chicago economist, is discouraging to say the least. After studying scores of commodities which conceivably might be handled profitably by air transport, he concludes that 150,000 tons a year is the maximum to be expected, including both exports and imports. This volume could be handled easily by a fleet of fewer than 500 Clipper planes. Even assuming air freight rates could be cut from the present 40 cents a ton-mile to, say, 15 cents, ocean-going freighters would hold a 50 to 1 advantage over air transport.

The outlook for requirements to satisfy even a broad expansion of domestic air travel and air express is not much brighter. With an assortment of 200,000-odd airplanes in the hands of the military services, it seems likely that there may be 25,000 or more which can be converted readily, even assuming new engines are needed, to commercial transport uses. On top of this there will be a likely surplus of perhaps 250,000 complete spare engines and propellers.



THIRTY TIMES FASTER: With 388 closely co-ordinated punches in this Boeing-designed punch press, bomb bay walkway parts for Flying Fortresses can be turned out 30 times faster than previously. Tool Planner John Crabill of the Seattle plant of Boeing Aircraft Co. checks the punch die in operation. NEA photo

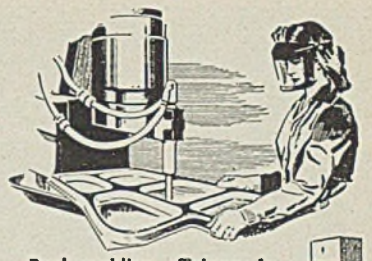


Fresh food on the high seas during long, heavy-action periods away from port is the result of compact, efficient refrigeration.

Self-Contained
¼ h.p. Refrigerating Unit

Cool, clean air protects the life of the wounded in Army hospitals. Special aircraft refrigerators safeguard serums and plasma.

Aluminum
Aircraft Refrigerator

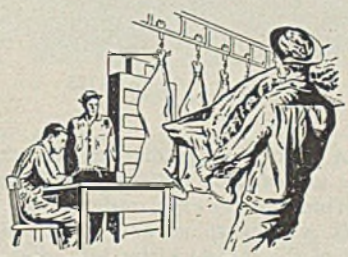


Peak welding efficiency is made possible by cooling of welding tips with water or brine held at the right temperature.

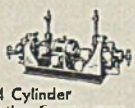
Spot Welder
Tip Cooling Unit

Tool life is increased and rejections are fewer when cutting oils used in high-speed machining are properly cooled.

Refrigerating Unit



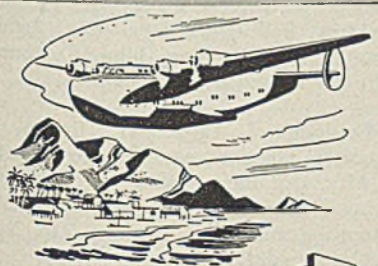
The health of our armed forces is protected by dependable refrigeration in cantonments, huts, barracks, and on ships.



14 Cylinder
Refrigerating Compressor

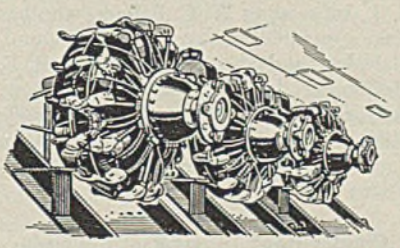
Super accuracy in gauge rooms is possible when the air is clean, dehumidified, and maintained at a constant temperature.

3 h.p. "Packaged"
Air Conditioner



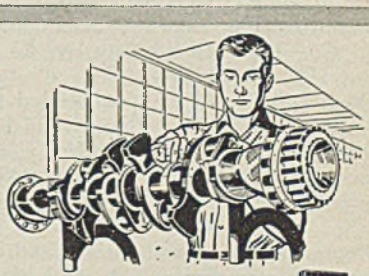
Protection in the tropics against the ravages of humid atmosphere and vermin is necessary to preserve food and equipment.

Portable Panel
Refrigeration Unit



Identical performance of aircraft engines is assured by operation tests with carburetor air kept at the same temperature.

14 Cylinder
Air Conditioning Compressor



Clean, dry atmosphere is vital for machining sensitive metal surfaces where a spot of rust would ruin high-precision products.

5 h.p. "Packaged"
Air Conditioner

★ CHRYSLER AIRTEMP AT WAR ★

From tiny, fractional horsepower to big 75 horsepower units, Chrysler Airtemp Radial Compressors are performing a major war job on both the production and battle fronts.

The science of air control is built around the compressor. Chrysler Airtemp's *exclusive* Variable Capacity Radial Compressor provides a new efficiency and accuracy in indoor climate regulation. The radial cylinders cut in or out automatically, one at a time, to meet varying load requirements. This flexibility eliminates the peaks and valleys resulting from abrupt starting and stopping of ordinary compressors . . . holds temperature and humidity at a constant level.

Years spent in building delicate mechanisms, have developed high-precision, versatile skills at Airtemp, now devoted to war production. Backed by Chrysler Corporation research and engineering, when peace comes, these skills will again create heating, cooling and refrigeration units for homes and commercial use that will set new, high standards of efficiency and performance.

The lessons learned during peace in free competitive enterprise—freedom of the individual to produce and compete—today bring strength to a nation at war.

War Products of Chrysler Corporation

Tanks • Tank Engines • Navy Anti-Aircraft Guns • Army Anti-Aircraft Guns • Bomber Fuselage Sections • Bomber Wings • Bomb Racks • Bomb Shackles • Fighter Landing Gears • Aluminum Alloy Forgings • Aluminum Alloy Castings • High-Powered Aircraft Engines • Cycleweld Cement • Wide Variety of Ammunition • Anti-Tank Vehicles • Command Reconnaissance Cars • Troop and Cargo Motor Transports • Ambulances • Weapons Carriers • Gyro-Compasses • Navy Pontoons • Marine Tractors • Harbor Tugs • Marine and Industrial Engines • Smoke Screen Generators • Air Raid Sirens and Fire Fighting Equipment • Powdered Metal Parts • Cantonment Furnaces • Tent Heaters • Refrigeration Compressors • Field Kitchens • and Other Important War Equipment

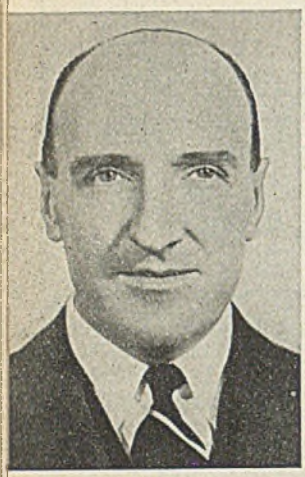
Tune In Major Bowes every Thursday, C B S, 9 P. M., E. W. T.

Chrysler Corporation

PLYMOUTH • DODGE • DE SOTO • CHRYSLER • AIRTEMP • AMPLEX

BACK THE ATTACK—BUY WAR BONDS

MEN of INDUSTRY



THOMAS T. WATSON

W. I. RODGERS JR.

G. K. HAYES

Thomas T. Watson has been appointed director of research, Lukens Steel Co., Coatesville, Pa., and its divisions, By-Products Steel Corp. and Lukenweld Inc. **D. Bruce Johnston** was named assistant to Mr. Watson and **Samuel D. Lemmon** was appointed research metallurgist for Lukens.

—o—

W. I. Rodgers Jr. has been named assistant to the chief engineer, Mack Mfg. Co., Long Island City, N. Y.

—o—

Douglas Millard, who has headed the sales organization for both fuel and fuel by-products, Colorado Fuel & Iron Corp., Denver, since 1931, has been elected a vice president.

—o—

George L. Craig, metallurgist and research engineer, Calumet & Hecla Consolidated Copper Co., Detroit, has been appointed director of research.

—o—

Joseph H. Jones, formerly associated with the metallurgical department of Republic Steel Corp.'s Alloy division, Massillon, O., has been appointed superintendent in charge of Republic's new Gun Bloom works, Canton, O.

—o—

Edwin E. Davis has been named assistant manager of orders, Jones & Laughlin Steel Corp., Pittsburgh.

—o—

Dr. Richard F. Miller has been appointed development engineer in stainless and alloy steels, department of technology and research, Carnegie-Illinois Steel Corp., Pittsburgh.

—o—

James D. Cunningham, president, Republic Flow Meters Co., Chicago, has been elected a director of Allis-Chalmers Mfg. Co., Milwaukee, succeeding **Charles W. Cox**, who resigned because of ill health.

—o—

Frank M. Folsom, who resigned Dec. 1 as chief of the procurement branch of the Navy Department, has been elected a vice president and director of Radio Corp. of America, New York. A former Montgomery Ward executive, Mr. Folsom will be in charge of the company's R.C.A. Victor Mfg. division, Camden, N. J., assuming his duties Jan. 1. **George K. Throckmorton** has resigned as an R.C.A. vice president and director and head of the R.C.A. Victor Mfg. division because of ill health, but will continue as a consultant to the company.

—o—

G. K. Hayes has been appointed assistant manager of the Cleveland branch, John A. Roebling's Sons Co., Trenton, N. J., succeeding **W. C. Palmer**, who has been appointed manager of sales, Round, Flat Wire and Specialties division. **B. F. McClancy**, former assistant manager, Wilcox-Rich division (Battle Creek, Mich.), Eaton Mfg. Co., has joined John A. Roebling's Sons Co. as industrial relations manager.

—o—

Charles Hook Jr., assistant to the president, Rustless Iron & Steel Corp., Baltimore, has been appointed an industry member of the National War Labor Board, Air Frame Panel, Washington.

—o—

Paul Barnhart has been named secretary and treasurer of Riverside Metal Co., Riverside, N. J., and **J. C. Blake**, former priority manager at Riverside, has been appointed general sales manager.

—o—

O. O. Lewis has been appointed assistant general sales manager, Fairbanks, Morse & Co., Chicago, and **G. N. Van Epps** succeeds him as branch manager in Atlanta, Ga. **V. O. Harkness** has been named manager of the company's Diesel Engine Sales division, Chicago; **H. J. Renken** has been appointed manager, Dallas, Tex., branch and continues as manager of the Oil Field division, Dallas; and **J. S. Peterson** has been named Cincinnati branch manager, succeeding the late Stanley Eaton.

—o—

Ward M. Canaday, chairman of the board, Willys-Overland Motors Inc., Toledo, O., has been elected president. Mr. Canaday joined the company in 1916 and assisted the late John N. Willys in pioneering the first automobile credit sales company. During World War I Mr. Canaday served on the War Industries Board, headed by Bernard M. Baruch, and in the early 30s he was one of the organizers and directors of the Federal Housing Administration.

—o—

Alvin A. Borgading, purchasing agent, American Car & Foundry Co., New York, has been elected a vice president of the company. Other newly-elected vice presidents are: **R. A. Williams**, former Cleveland district sales manager, who will assist **William L. Stancliffe**, vice president in charge of sales; **John A. V. Scheckenbach**, who has served as assistant vice president in charge of operations since 1929, and **Edmund D. Campbell**, general mechanical engineer.

—o—

J. H. Williams, for many years blast furnace superintendent of the Neville Island plant, Pittsburgh Coke & Iron Co., Pittsburgh, has been appointed superintendent of blast furnaces, Duluth works, American Steel & Wire Co., Cleveland. **G. D. Sells** has been named assistant superintendent of blast furnaces. **Bruce W. Bennett** has been appointed assistant general manager of sales for American Steel & Wire and will be in charge of the New York office, succeeding **Frederick Connell**, retired.

—o—

Ralph E. Sharp has been appointed manager of sales, Wire & Wire Products division, Bethlehem Steel Co., Bethlehem, Pa., succeeding **John F. Hazen**, who has retired because of ill health.

—o—

Frederick J. Lupke Jr., former assistant production manager, Ross Heater & Mfg. Co. Inc., Buffalo, has been appointed manager of the company's newly-opened office in Detroit, 715 New Center building.

—o—

A. G. Hendrickson and **George E. Geyer** have been appointed welder and electrode sales representatives, Harnischfeger Corp., Milwaukee.

—o—

Eleanor H. Irvine, formerly manager of the women's personnel department, Endicott, N. Y., plant, International Business Machines Corp., New York, has been appointed assistant manager of the personnel department of that plant.

—o—

Harry Weaver, previously foundry engineer, Caterpillar Tractor Co., Peoria, Ill., has joined Brillion Iron Works Inc., Brillion, Wis., as foundry engineer.

—o—

Robert L. Giebel, president, Giebel Machine Tool Co., New York, received a citation from the Army Ordnance Department for "distinguished service to his country" as chairman of the machine tool panel of the New York Ordnance District.

—o—

H. Mansfield Horner, previously vice president in charge of manufacturing, United Aircraft Corp., New York, has been elected president, succeeding **Eugene E. Wilson**, who is relinquishing the presidency in order to devote his entire time to his duties as vice chairman. **William P. Gwinn** has been named acting

general manager of the corporation's Pratt & Whitney division, and Raycroft Walsh, formerly senior vice president, has been made a vice chairman.

—o—

M. M. Clark, former manager of bar and semifinished materials bureau, Metallurgical division, Carnegie-Illinois Steel Corp., Chicago, has become associated with Metal Parts & Equipment Co., Chicago, as sales engineer.

—o—

N. R. Richardson and A. C. Dyer have been elected vice presidents of the Electric Controller & Mfg. Co., Cleveland. Mr. Richardson also continues in his post as production manager, and Mr. Dyer continues as sales manager. Last week STEEL erroneously reported Mr. Richardson as sales manager, and Mr. Dyer as production manager.

—o—

Arthur Simonson, vice president in charge of all foundry operations, Falk Corp., Milwaukee, has been appointed to the newly created position of special foundry consultant. Thomas F. Scannel has been named general sales manager for the corporation, and John S. Wilkinson has been made assistant sales manager in charge of foundry sales.

—o—

K. C. Gardner, president and general manager, United Engineering & Foundry Co., Pittsburgh, has been appointed a member of the Pittsburgh Ordnance District Advisory Board. Mr. Gardner's appointment fills the vacancy created by the recent death of George T. Ladd.

—o—

Otto E. Zahn, formerly acting general superintendent, American Foundry Equipment Co., Mishawaka, Ind., has been appointed assistant works manager.

—o—

R. B. Sayre has been appointed Memphis district manager, Graybar Electric Co. Inc., New York, succeeding O. B. Chandler, who died recently.

GEORGE M. EBERT

Who has been named director of finance, Airplane division, Curtiss-Wright Corp., New York, as announced in STEEL, Dec. 6, p. 98.

—o—

Ralph G. Caulley has been appointed director of purchases, Fruehauf Trailer Co., Detroit. Before joining the Fruehauf company ten years ago Mr. Caulley had been assistant district manager in Detroit for Republic Steel Corp., Cleveland.

—o—

G. J. Stegemerten, staff supervisor of industrial methods engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed expert consultant to Secretary of War Henry Stimson.

—o—

George L. Spence, Central division manager of manufacture in Chicago for American Can Co., New York, and Preston A. Champney, general traffic manager for the company, are retiring this month. Both men have been associated with American Can Co. since its organization in 1901.

C. H. REINERT

Who has been appointed manager of operations, Steel & Tubes division, Republic Steel Corp., Cleveland, noted in STEEL, Dec. 6, p. 98.

—o—

J. R. Comstock, formerly general superintendent, Globe Iron Co., Jackson, O., has been appointed blast furnace superintendent, Pittsburgh Coke & Iron Co.'s Neville Island plant, Pittsburgh.

—o—

Ben Eggers, former blast furnace superintendent, Jackson Iron & Steel Co., Jackson, O., has been appointed general superintendent, Globe Iron Co., Jackson, O.

—o—

Clark H. Johnston, former assistant superintendent in charge of operations, New Castle, Pa., plant, United Engineering & Foundry Co., Pittsburgh, has been appointed general superintendent.

OBITUARIES . . .

CHARLES P. ROGERS

Charles P. Rogers, 78, chairman of the board, Beals, McCarthy & Rogers Inc., Buffalo, died there Dec. 4. Mr. Rogers had been affiliated with the company since 1880.

—o—

Murray Charles Beebe, 67, head of the research department, Lea Mfg. Co., Waterbury, Conn., died in New Haven, Conn., Nov. 28.

—o—

William Walliser, 77, vice president, Chicago & North Western railway, died in West Chicago, Ill., Dec. 2.

—o—

Anton A. Dreis, 75, for 43 years secretary, A. F. Wagner Iron Works, Milwaukee, died recently.

—o—

W. F. Weinhardt, 50, vice president and general manager, Henkel Clauss Cutlery Co., Fremont, O., died Nov. 28.

—o—

John V. Culliney, 78, retired, formerly general superintendent, American Iron & Steel Mfg. Co., Lebanon, Pa., which is now a part of Bethlehem Steel Co., and later manager of Lake Erie Iron Co., Cleveland, died recently in Bethlehem, Pa.

—o—

W. C. Williamson, 84, president and a founder of Williamson Heater Co., Cincinnati, died recently.

—o—

Martin V. Kehoe, retired treasurer and director, Hall Mfg. Co., Cedar Rapids, Iowa, died in that city recently.

—o—

J. Wesley Bean, 73, general manager, Star Brass Works, Kalamazoo, Mich., died there Nov. 26.

—o—

Clement R. H. Cunningham, founder and president, Crucible Steel Casting Co., Lansdowne, Pa., died Dec. 5.

—o—

Emanuel A. Barnett, 49, secretary-treasurer, Steel Materials Co., Detroit, died recently in Miami Beach, Fla.

Dominion Starts To Unwind Maze Of War Controls in Industry

Intimations given that resumption of manufacture of certain civilian items planned. . . Restrictions removed on export of carbon and alloy steel and wrought iron. . . Limitations on use of scrap aluminum lifted

TORONTO

KEY departments of the Canadian government in setting up and maintaining the country's war economy—the Department of Munitions and Supply and the Wartime Prices and Trade Board—have started to unwind the maze of controls instituted over the past four years. Initial steps are two in number:

(1) Removal of all restrictions upon the use of scrap aluminum and of all export restrictions upon carbon steel, alloy steel and wrought iron. Restrictions also are removed from certain types of structural steel and grinding balls.

(2) Intimation that resumption of manufacture of a certain number of civilian items of high degree of essentiality is being planned, and will commence virtually immediately. The first item, it is stated, will be washing machines.

Lifting of restrictions upon scrap aluminum and other articles affected—some of them only for export—is being accompanied by the termination as well of any permit regulations to which they have been subject. An official explained that the course which the goverment will follow, now that a steadily increasing portion of the country's war production is becoming available for civilian goods, will be to program certain items to which a high degree of essentiality is attached.

Once an item achieves a place on this essential list, it will enjoy priorities second only to that which will still be given to war production itself.

Officials of the Department of Munitions and Supply discourage the idea the lifting of restrictions will result in an immediate flood of goods for the civilian market.

C. D. Howe, Minister of Munitions and Supply, states the easing of restrictions is in keeping with the government's policy in making available for civilian use any materials no longer in critical supply. Similar orders will be issued from time to time whenever it is possible to permit more extensive civilian use of materials. He emphasized that the types of steel freed of restrictions are employed chiefly in stationary structures such as large buildings, bridges, towers, tanks and machinery installations. Builders need no longer obtain permits from the Steel Controller to purchase the structural steel types now on the open market, but they will still need a license from the Construction Controller if they intend to build a plant costing more than $2500 or a building costing more than $500.

Removal of Metals Control and Wartime Prices and Trade Board restrictions on scrap aluminum also applies to secondary aluminum ingots derived from scrap. The rescinding of the structural steel order applies only to new, used, or second-hand, plain or fabricated steel plate, one-eighth of an inch or thicker, and any new, used, or second-hand steel shapes, steel bars, steel rail or steel wire reinforcing mesh or expanded ferrous metal reinforcing mesh of 16 gage or heavier. The thinner sheet steels are not affected by the rescinding order.

Predicts Postwar Prosperity

Mr. Howe, speaking in Montreal, stated a period of postwar prosperity in Canada is assured, pointing out the problems of unemployment are capable of solution. He said the prime essential of the conversion period will be continuance of close partnership between government, manufacturer and worker. Future employment in factories cannot be maintained at present levels, but there are alternatives.

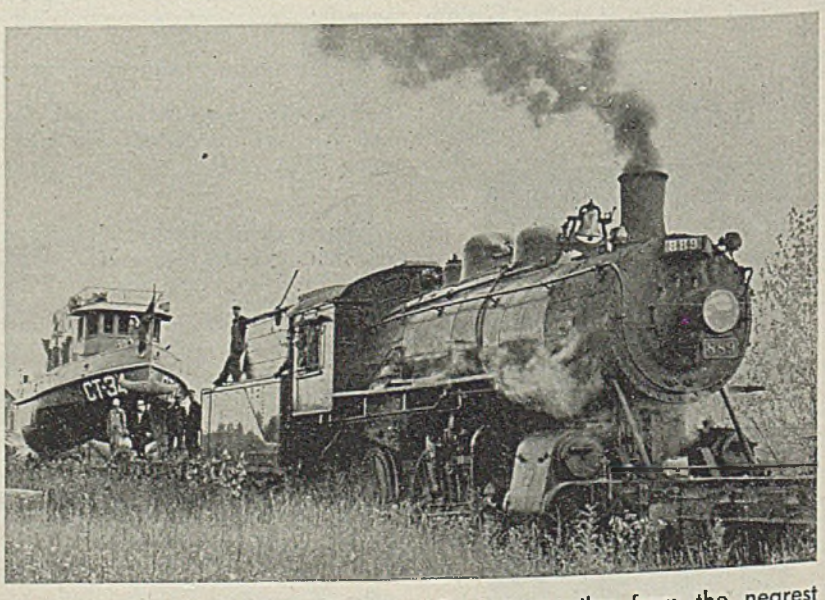
Mr. Howe stated the discussion of postwar policy and problems, does not mean that the end of the war is near. "The only circumstance that could bring the war to a quick end is the internal collapse of Germany. Assuming that the internal collapse of Germany does not occur, the heaviest fight of the war has yet to come. Nevertheless our munitions program has reached and possibly passed its peak. The work that remains is in replacing wastage and developing and producing new and improved weapons."

The war against Japan, expected to continue beyond the European conflict, would be important in slowly converting from war to peacetime production, and a large naval program is likely to continue to meet Pacific requirements, Mr. Howe said. However, certain plants making explosives and filling shells must close, and plane production must be curtailed sharply.

In addition, new industries developed during the war hold possibilities. The synthetic rubber industry will be capable of supplying Canada's full peacetime requirements of rubber. The program as a whole indicates larger employment in factories than in prewar years. Large number of workers will be absorbed in agricultural, base metal and gold mining, and in lumbering. A large scale program of public works also is available for release on short notice.

New Blast Furnace Blown in By Algoma Steel in Ontario

The new No. 5 blast furnace of the Algoma Steel Corp. Ltd., Sault Ste. Marie, Ontario, was blown in Nov. 29. The stack is said to be the largest blast furnace in the British Empire. It has a 25-foot hearth and is rated at 1200 net tons per 24 hours. J. H. Bell, for many years blast furnace superintendent of the plant but now retired, applied the torch.



TUGS BUILT INLAND: At Trenton, Ont., two miles from the nearest waterway, a tug a week is being constructed for overseas war service. When completed, they are loaded on railway flat cars and hauled to the water's edge for launching. Too small to cross the ocean alone, they are loaded aboard mother ships for transportation to the war zones. NEA photo

October Steel for Sale at New High

Best month of year, plates leading at 143 per cent. . . Bars in slight decline, with sheets above September. . . Year's total promises all-time record

PRODUCTION of steel and iron for sale in October totaled 5,785,294 net tons, against 5,655,610 tons in September, according to the American Iron and Steel Institute. This is a new high record for the year and exceeds the average for first quarter, when the institute's report did not give separate monthly figures.

For ten months the total production was 55,684,197 tons, which would indicate a total for the year of more than 66,500,000 tons, compared with 64,813,972 tons made during all of 1942.

October production also included 796,050 tons of pig iron and ferroalloys for sale, 94,985 tons of ingot molds and 16,084 tons of other iron products, including bars, pipe and tubes.

Output of various products varied from September, plates totaling 1,116,437 tons, at 143 per cent of capacity, compared with 1,074,646 tons, at 142.4 per cent in September. Bar production totaled 1,080,175 tons, at 86.4 per cent, in October, slightly below 1,080,918 tons, at 89.4 per cent, in September. Sheet output was larger, 750,650 tons, 65.5 per cent of capacity, in October, compared with 697,074 tons, 62.9 per cent, in September. Hot-rolled strip totaled 138,666 tons in October, 132,486 tons in September, but cold-rolled strip dropped to 96,928 tons in October from 109,903 tons in September.

During October 451,321 tons of steel were shipped to other members of the industry for further conversion, compared with 405,429 tons in September. In the ten months such shipments totaled 4,191,764 tons.

Companies included in these statistics numbered 183 and represented 98.8 per cent of total output of finished rolled products in 1942. Export figures are banned by government regulations.

AMERICAN IRON AND STEEL INSTITUTE
Capacity and Production for Sale of Iron and Steel Products

OCTOBER - 1943 (period)

		Number of companies	Items	Annual Capacity Net tons	Production for Sale—Net Tons: Current Month: Total	Current Month: Per cent of capacity	Current Month: Shipments: Export	Current Month: Shipments: To members of the industry for conversion into further finished products	Year to Date: Total	Year to Date: Per Cent of capacity	Year to Date: Shipments: Export	Year to Date: Shipments: To members of the industry for conversion into further finished products
STEEL PRODUCTS	Ingots, blooms, billets, slabs, sheet bars, etc.	44	1	xxxxxxx	763,679	xxx		240,443	6,896,327	xxx		2,048,045
	Heavy structural shapes	10	2	5,412,580	345,064	75.0		xxxxxxx	3,175,537	70.4		xxxxxxx
	Steel piling	4	3	338,000	3,149	11.0		xxxxxxx	30,483	10.8		xxxxxxx
	Plates—Sheared and Universal	21	4	9,189,740	1,116,437	143.0		3,657	10,677,930	139.5		32,726
	Skelp	7	5	xxxxxxx	61,449	xxx		40,546	658,318	xxx		396,271
	Rails—Standard (over 60 lbs.)	4	6	3,629,260	178,558	57.9		xxxxxxx	1,564,847	51.8		xxxxxxx
	Light (60 lbs. and under)	6	7	309,690	12,004	45.6		xxxxxxx	141,721	54.9		xxxxxxx
	All other (Incl. girder, guard, etc.)	2	8	102,000	1,072	12.4		xxxxxxx	19,061	22.4		xxxxxxx
	Splice bar and tie plates	13	9	1,120,270	54,385	57.1		xxxxxxx	518,128	55.5		xxxxxxx
	Bars—Merchant	40	10	xxxxxxx	606,508	xxx		80,575	5,934,663	xxx		797,340
	Concrete reinforcing—New billet	15	11	xxxxxxx	28,900	xxx		xxxxxxx	350,283	xxx		xxxxxxx
	Rerolling	16	12	xxxxxxx	4,897	xxx		xxxxxxx	67,506	xxx		xxxxxxx
	Cold finished—Carbon	23	13	xxxxxxx	155,474	xxx		xxxxxxx	1,473,131	xxx		xxxxxxx
	Alloy—Hot rolled	20	14	xxxxxxx	243,174	xxx		31,279	2,544,920	xxx		354,604
	Cold finished	19	15	xxxxxxx	35,928	xxx		xxxxxxx	386,536	xxx		xxxxxxx
	Hoops and baling bands	5	16	xxxxxxx	5,294	xxx		xxxxxxx	75,597	xxx		xxxxxxx
	TOTAL BARS	63	17	14,719,525	1,080,175	86.4		111,854	10,832,636	88.4		1,151,944
	Tool steel bars (rolled and forged)	17	18	200,840	12,507	73.3		xxxxxxx	153,534	91.8		xxxxxxx
	Pipe and tube—B. W.	15	19	2,231,040	112,397	59.3		xxxxxxx	1,103,615	59.4		xxxxxxx
	L. W.	8	20	845,400	48,232	67.2		xxxxxxx	469,612	66.7		xxxxxxx
	Electric weld	8	21	1,149,250	90,902	93.1		xxxxxxx	866,122	90.5		xxxxxxx
	Seamless	15	22	3,082,400	196,143	74.9		xxxxxxx	1,824,857	71.1		xxxxxxx
	Conduit	7	23	190,000	3,662	22.7		xxxxxxx	47,470	30.0		xxxxxxx
	Mechanical Tubing	11	24	597,800	61,919	121.9		xxxxxxx	622,463	125.0		xxxxxxx
	Wire rods	22	25	xxxxxxx	104,308	xxx		16,937	1,001,653	xxx		188,738
	Wire—Drawn	41	26	2,356,550	168,837	84.3		2,118	1,655,917	84.4		44,606
	Nails and staples	19	27	1,116,640	62,740	66.1		xxxxxxx	679,261	73.0		xxxxxxx
	Barbed and twisted	15	28	482,280	20,735	50.6		xxxxxxx	203,625	50.7		xxxxxxx
	Woven wire fence	16	29	778,060	26,825	40.6		xxxxxxx	208,348	32.1		xxxxxxx
	Bale ties	12	30	128,420	7,587	69.5		xxxxxxx	92,525	86.5		xxxxxxx
	All other wire products	8	31	78,220	4,604	69.3		xxxxxxx	49,253	75.6		xxxxxxx
	Fence posts	11	32	112,065	7,445	78.2		xxxxxxx	38,075	40.8		xxxxxxx
	Black plate	10	33	339,700	38,421	133.1		-	278,915	98.6		-
	Tin plate—Hot rolled	4	34	483,620	-	-		xxxxxxx	10,597	2.6		xxxxxxx
	Cold reduced	10	35	3,841,340	151,331	46.4		xxxxxxx	1,830,796	57.2		xxxxxxx
	Sheets—Hot rolled	25	36	xxxxxxx	512,352	xxx		18,766	4,944,169	xxx		170,996
	Galvanized	14	37	xxxxxxx	70,289	xxx		xxxxxxx	677,812	xxx		xxxxxxx
	Cold rolled	14	38	xxxxxxx	138,911	xxx		xxxxxxx	1,242,967	xxx		xxxxxxx
	All other	16	39	xxxxxxx	29,098	xxx		xxxxxxx	298,882	xxx		xxxxxxx
	TOTAL SHEETS	28	40	13,497,570	750,650	65.5		18,766	7,163,830	63.7		170,996
	Strip—Hot rolled	22	41	3,201,690	138,666	51.0		17,000	1,287,457	48.3		158,438
	Cold rolled	39	42	2,059,740	96,928	55.4		xxxxxxx	975,289	56.8		xxxxxxx
	Wheels (car, rolled steel)	5	43	424,820	19,262	53.4		xxxxxxx	187,987	53.1		xxxxxxx
	Axles	6	44	453,470	14,192	36.8		xxxxxxx	134,370	35.6		xxxxxxx
	Track spikes	11	45	308,350	11,102	42.4		xxxxxxx	116,594	45.4		xxxxxxx
	All other	5	46	xxxxxxx	19,927	xxx		xxxxxxx	167,044	xxx		xxxxxxx
	TOTAL STEEL PRODUCTS	159	47	xxxxxxx	5,785,294	xxx		451,321	55,684,197	xxx		4,191,764
	Pig iron, ferro manganese and spiegel	26	48	xxxxxxx	796,060	xxx		388,721	7,552,313	xxx		3,740,045
	Ingot moulds	5	49	xxxxxxx	94,985	xxx		xxxxxxx	831,956	xxx		xxxxxxx
IRON PRODUCTS	Bars	10	50	170,110	7,841	54.3		543	82,071	57.9		3,204
	Pipe and tubes	2	51	106,000	6,954	77.2		xxxxxxx	72,187	81.8		xxxxxxx
	All other	1	52	56,000	1,289	27.1		-	11,850	25.4		-
	TOTAL IRON PRODUCTS (ITEMS 50 to 52)	11	53	xxxxxxx	16,084	xxx		543	166,108	xxx		3,204

Huge Outlet for Steel Seen in Needed Highway Construction

Thousands of miles of war-neglected roads must be rehabilitated. . . Building of superhighways, grade elimination projects, etc., costing billions, pointed to as source of employment for millions long after the war

By J. M. KURTZ
Assistant Editor, STEEL

POSTWAR "dreamers" and commercial artists envision in the peacetime period sleek, streamlined automobiles traveling on a maze of inter-regional superhighways stretching to every corner of the nation. But "down-to-earth" planners realize that a national superhighway system will emerge gradually and will be made possible only with the aid of federal funds.

The war-neglected roadbuilding program, which will cost billions of dollars and will employ millions of workmen building new highways and returning present highways into prewar condition, will be one of the important postwar outlets for steel.

Scarcity of steel and other war vital materials during the past two years necessarily has limited roadbuilding largely to maintenance and roads constructed to meet emergency military needs. Hundreds of thousands of tons of steel will be demanded by construction equipment manufacturers after the war to provide roadbuilders with the latest types of machinery to complete the enormous job which lies ahead.

One of the newer uses for steel in the postwar highway program will be that of prefabricated steel highways. First installation of a steel roadway has been made on an experimental basis at Darien, Conn. The technique calls for laying steel mats, similar to airplane landing mats used in many theaters of war, and filling the interstices with sand and then applying a coat of road oil.

Figures compiled by the United States Public Roads Administration in 1940 reveal the enormous roadbuilding program which the country will undergo in the peacetime era. This department estimated that about 106,560 miles, or about 20 per cent of the state highways, must be rebuilt, relocated, or widened and nearly 22,000 bridges must be rebuilt or widened at a total cost of approximately $4,000,000,000.

Needs Vastly Greater Today

But that was three years ago; today the needs are vastly greater. Rate of depreciation adds approximately 17,000 miles a year to the list of urgently needed construction. Thus, as of the first of the coming year, the total mileage awaiting major reconstruction will be more than 150,000 miles, with a total cost of nearly $5,000,000,000.

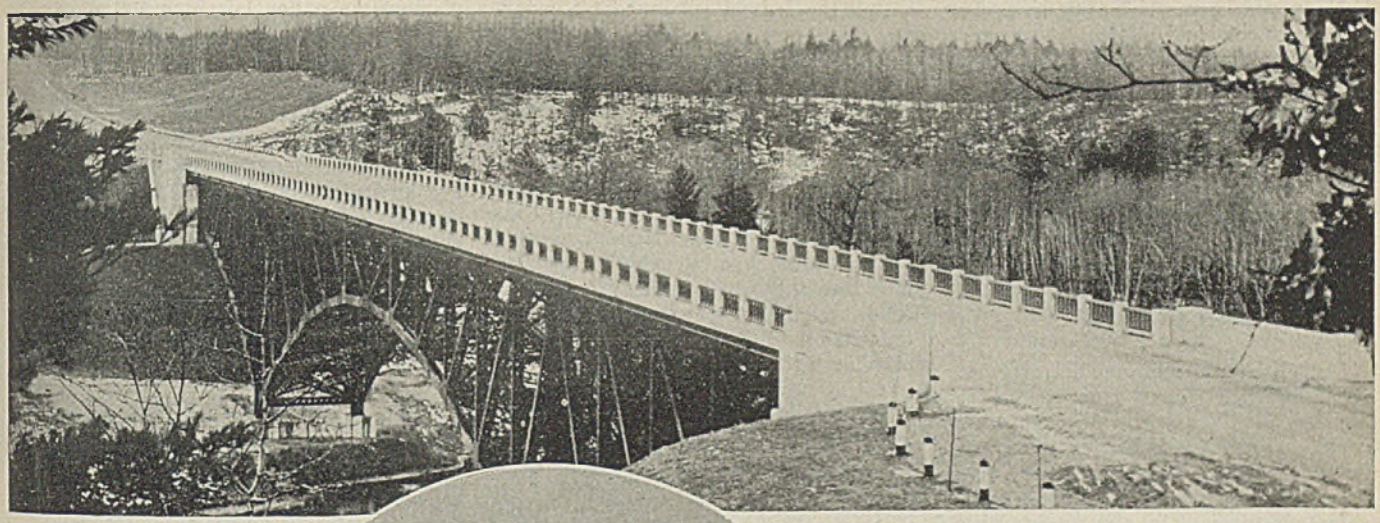
As enormous as the figure appears for roadbuilding, that is only part of the job. On state highway systems alone, there are about 17,000 railroad crossings. To eliminate merely 5000 of the more dangerous crossings would cost in the neighborhood of $1,000,000,000.

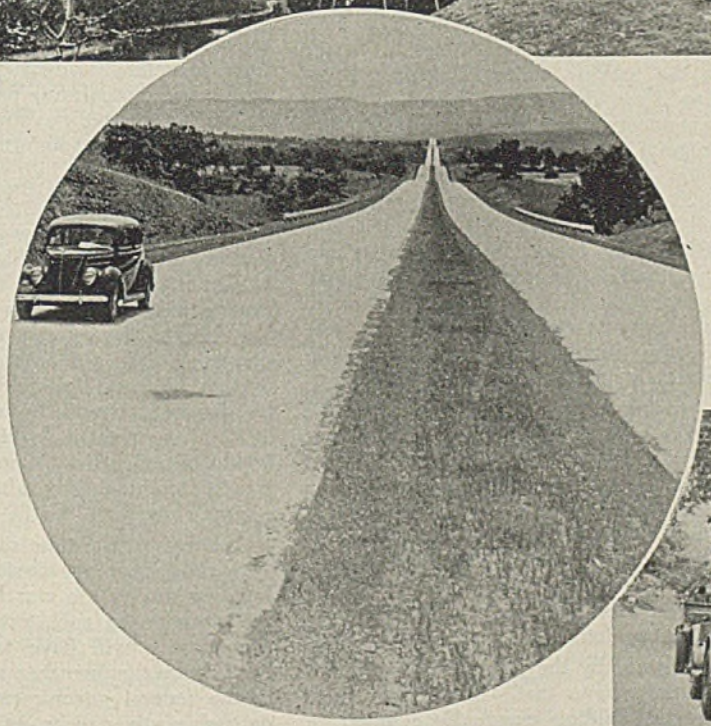
In Pennsylvania, a $263,000,000 roadbuilding program includes plans for breaking traffic bottlenecks in Philadelphia and Pittsburgh. This is only a fraction of the amount already laid aside by the states. Many such building plans are still in a development stage and remain unreported.

Many government officials are pointing to the roadbuilding needs of the country as a means of providing employment for a part of the 20,000,000 workers that will be unemployed as a result of the upheaval expected when war production ends. Express highways, which provide non-stop, safe and speedy travel between large centers of population, are regarded as an excellent investment for the expenditure of federal money.

The American Road Builders' Association is urging a $3,000,000,000 a year roadbuilding program for five years as a shock-absorber against the unemployment problem which the nation is expected to face at the war's end. Much of this money would be placed at the disposal of the Public Roads Administration, which has under study an interregional highway system spreading through every section of the nation.

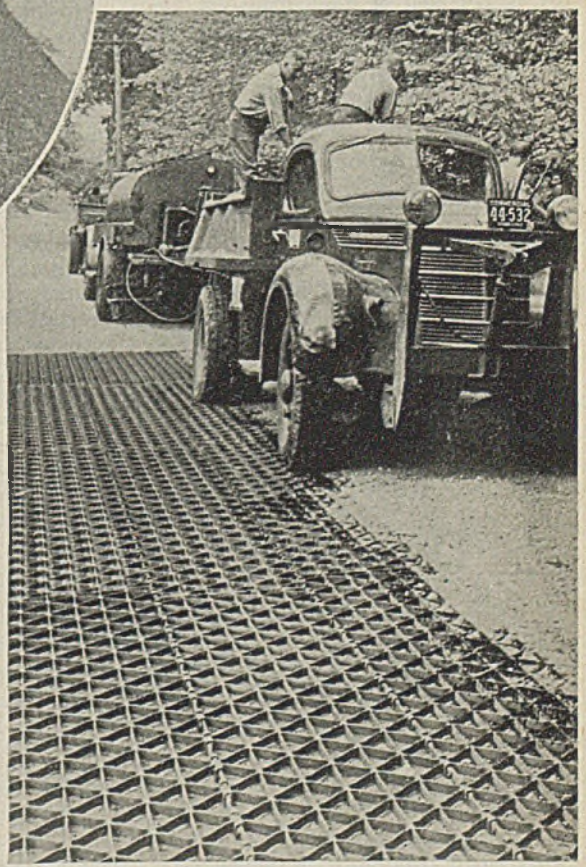
Much of the 27,000 mile system includes existing routes. However, a great deal of modernization would have to be done on present highways, particularly in the vicinity of large cities, every one of which is touched. Some of the major problems in building the net-





Roadbuilding projects like the one left, above, are expected to provide work for many in the peacetime era

Bridges are an important adjunct of roadbuilding programs. This bridge, above, indicates the tonnages of steel used in construction



Many superhighways similar to the Pennsylvania Turnpike above will be constructed in the postwar period

Prefabricated steel highways are being tested now to prove their practicability. The roadway at the right was installed at Darien, Conn.

work would be construction of additional traffic lanes, separation of opposing traffic and separation of grades at railroad and busy highway intersections. This system alone includes 14,000 miles of express highways the cost of which would total $2,500,000,000.

With a great demand for automobiles accumulating during the war, automotive industry executives believe there will be more automobiles on the nation's roads after the war than ever before in the country's history. This will create a demand for superhighways like the Pennsylvania turnpike. Express highways apparently will be the only answer to high traffic volume and the by-passing of cities, towns, and villages will be necessary, with adequate connections.

The Pennsylvania turnpike, extending for 160 miles from the outskirts of Harrisburg to the outskirts of Pittsburgh, carried prewar traffic which greatly exceeded engineers' estimates. Although many officials were dubious about the toll method of paying for the bond issue, motorists during its first year of operation contributed a total of $2,406,571. Cost of the highway was covered by a bond issue of $40,800,000 and a PWA grant of $29,250,000.

A yearly expenditure of $500,000,000 is believed necessary to construct railroad separations and to reconstruct and repave existing streets in cities where traffic volume is heaviest. It is estimated that there are 250,000 miles of streets in the nation's cities, which are only about 8 per cent of the total road mileage, yet they carry 30 per cent of all traffic. Due to the lack of funds, only about 95,000 miles of these streets have

been paved, some 110,000 have low type surfaces, and 45,000 miles have merely been graded and drained and have no surfacing.

Metropolitan areas are the country's most traffic congested and warrant considerable attention in postwar plans. There is an enormous expense involved in construction of underground and overhead passes to eliminate traffic bottlenecks. But this work will be a "must" as highway engineers predict that traffic will be far more congested in the postwar period than ever before.

Many of these metropolitan areas are preparing their plans. They realize that highway facilities in and near cities that could not cope with prewar traffic will fail completely in the postwar years unless streets designed to handle an enormous increase in cars are constructed. Metropolitan highway construction, it is estimated, would involve an expenditure of $1,000,000,000 yearly to adequately meet the approaching need.

County, township and village roads have been badly neglected over the years. Totaling 2,400,000 miles, this vast network supplements the state highway stems. Over these roads pass an annual production of about $12,000,000,000 of farm produce, thus serving some 6,000,000 farms throughout the country. Yet 42 per cent of these roads are unpaved, adding to the farmer's excessive car operations cost. A minimum yearly program of $400,000,000 is urged for the improvement of county and local roads.

A study of 71 counties revealed that of the 5800 schools located in that area, 4000 are still on dirt roads. Only 45,000 miles of the 2,400,000 miles of county and local roads are of high type pavement. Some 99,000 miles have a low type bituminous surface, 788,000 miles are of a non-treated surface and subject to dust and mud, and 613,000 are merely graded and drained. The remaining 861,000 miles are classed as primitive.

The recent introduction in Congress of bill S.1498, which would set up within the federal government a separate administration independent of the Public Roads Administration, is regarded as an effort to lay the groundwork for postwar roadbuilding. The new agency would be known as the Rural Local Roads Administration and the bill if passed would authorize $1,125,000,000 solely for construction of rural "all-weather type" roads. Heretofore, secondary roads have been built either by local authorities with their own or WPA funds, by the state with federal funds or with state funds obtained through gasoline taxes.

Provides Spark to Nation's Economy

A number of economists declare that the construction industry may be considered the economic catalyst or spark to the nation's entire economy. Freedom from depression, they believe, is dependent largely upon the construction program. As an example, they cite some figures on construction. In the 1926-1933 period, private construction fell from $9,000,000,000 to $1,000,000,000 and the nation's economy went into a tailspin. They contend that public construction should be regulated so as to take up its share in employment. The highway program is regarded as a vitally important part.

Studies of ten different types of public works projects by the Bureau of Labor Statistics revealed that road and street projects provided the most on-site and off-site employment. Highway projects are more quickly started and completed than any of the other classes of projects with a maximum labor force occurring sooner, thus throwing a greater amount of money into circulation more quickly.

A study by the Public Roads Administration shows that $100,000,000 spent on roadbuilding eventually resulted in business transactions totaling around $315,602,700. Thus, a yearly expenditure of $3,000,000,000 for the first five years after the war by the same token would mean a business volume of $9,468,081,000 each year. This would greatly supplement the national income and would result in the employment of a great number who will be searching for work when the war ends.

When the highway construction dollar is placed into circulation it fans out to the benefit of many industries, thus having a far reaching effect on national economy. About 7.6 per cent of each dollar is spent for iron and steel, 18 per cent for plants and equipment, 17 per cent for transportation, 9 per cent for cement, 8 per cent for aggregate quarrying, 7.6 per cent for retail trade, 6.4 per cent for insurance and taxes, 4.5 per cent for wholesale trade, and 4 per cent for petroleum products. The remaining 18 per cent is expended for such items as metallic ore mining, coal and coke, power, explosives, advertising, rubber, nonferrous metals, forestry products, pipe brick, and agricultural products. These figures are based on studies made by the Public Roads Administration to show the various channels into which the highway construction dollar flows.

In 1938 at a congressional road committee hearing in Washington, Thomas H. MacDonald, public roads commissioner, told the group what would probably happen if road construction and reconstruction ceased on the Federal Aid System. All medium and low type roads, he declared, would be nonexistent by 1955. The remaining high type roads would be reduced to about 27,000 miles by 1960 and shortly after would disappear entirely.

Although at the time such a condition appeared impossible, the stoppage of roadbuilding during the war has aggravated the situation to such extent that large expenditures will have to be made to rehabilitate the country's system. Whether the federal government will embark on such postwar plans, as urged by various groups, remains to be seen. But there is little question that it would bolster the national economy and provide jobs for the army of unemployed which may face the country once the war has ended.

They Say:

"Government must understand that you don't increase purchasing power by taking a dollar from somebody and handing it to somebody else; that the individual should be stimulated to his greatest productive capacity; that there should be revision of tax laws to stimulate the investment of risk capital to give jobs to men; that we must have the maximum amount of private enterprise and the minimum amount of government regulation, consistent with our complicated modern economic society."—**Eric Johnston**, president, United States Chamber of Commerce.

° ° °

"Americans have created for themselves a standard of living above that of any other country, but two costly wars have taught us that this is not enough. Political peace depends upon the economic welfare of other nations as well as our own, and the road to economic welfare lies through increasing standards of living."—**R. W. Gallagher**, president, Standard Oil Co. of New Jersey.

° ° °

"With the development of the arts in recent years, and with application of these new arts to the building of future railway equipment, there will be a tremendous expansion in the number of passengers carried by the railroads, especially for long-distance travel."—**Edward G. Budd**, president, Edward G. Budd Mfg. Co.

° ° °

"There is growing need of awareness, the growing need of expanding our knowledge and interest beyond the strict confines of what may be called our particular calling. Preparedness for war has its counterpart, as never before, in a due preparedness for peace."—**Joseph G. Parr**, president, Trust Co. of New Jersey.

Oliver Company Intensifies Ore Research Plans

Centralizing activities in West Duluth, Minn., to experiment with greater use of lower grade iron ores

NEW research facilities at Duluth, Minn., will enable the Oliver Iron Mining Co., subsidiary of the United States Steel Corp., to continue and intensify its pioneering program of research in the interest of general improvement of Lake Superior iron ores used by the corporation's steel producing subsidiaries.

The company has been carrying on for many years a program designed to study ways and means of improving iron ores currently being mined and to make experimental investigations of the concentration of lower grade iron ore formations for future use. In addition, the corporation's research department has conducted a long range program of experiments with a view toward conservation of natural resources through greater use of lower grade iron ore.

A four-story fireproof building in West Duluth has been purchased by the Oliver company and will be remodeled to meet requirements for centralizing the research activities of the company.

Controllers Institute Elects 11 New Members

Eleven executives from the metal industries recently were elected to membership in the Controllers Institute of America, New York city.

The new members are: Ralph H. Ackerman, Mid-States Steel & Wire Co., Crawfordsville, Ind.; Owen K. Bell, Soule Steel Co., San Francisco; Austin H. Bennett, Mississippi Valley Structural Steel Co., Decatur, Ill.; Warren W. Cowden, Andrews Steel Co., Newport, Ky.; Lester M. Elliott, AGA Metal Tube Co., Elizabeth, N. J.; Albert B. Hetzer, Edwin B. Stimpson Co., Brooklyn, N. Y.; George H. Maslin Jr., American Chain & Cable Co. Inc., Bridgeport, Conn.; Paul E. Newey, Ceco Steel Products Corp., Omaha, Nebr.; Herbert D. Rathbun, John A. Roebling's Sons Co., Trenton, N. J.; C. T. Redmond, Columbia Steel Co., San Francisco, and M. M. Rosenberg, American Smelting & Refining Co., New York city.

Employes Honor Gleason Works President on Birthday

More than 2000 employes of the Gleason Works, Rochester, N. Y., honored James E. Gleason, president of the company, on his seventy-fifth birthday recently when they presented him with gifts, including an album with their signatures.

Mr. Gleason was born on Nov. 25, 1868, at Rochester. He worked with his father, the late William Gleason, on the designing and building of lathes and planers manufactured by the Gleason Tool Co. which was founded in 1865. In 1905 he took out patents on a two-tool bevel gear generator which cut both sides of bevel gear teeth at the same time. In 1913 he developed the spiral bevel gear planer, used widely in automobile plants.

He was president of the National Machine Tool Builders' Association from 1926 to 1927. At present he is president of the Gleason Works and director of the Lincoln-Alliance Bank & Trust Co. and vice chairman of the board. He holds many other important offices and has been a member of many industrial associations. Mr. Gleason has been awarded many medals for significant achievements in his field.

Additional War Plants Granted Production Awards

The Army, Navy and Maritime Commission recently announced the granting of awards for excellence in production to the following war plants:

American Bantam Car Co., Butler, Pa.
Atlas Powder Co., Paducah, Ky.
Diamond Wire & Cable Co., Chicago Heights, Ill.
Electronic Enterprises Inc., Newark, N. J.
George K. Garrett Co. Inc., Philadelphia.
B. F. Goodrich Co., American Anode Inc., Akron, O.
Hart-Carter Co., Peoria, Ill.
Holzer-Cabot Electric Co., Boston.
J. R. Simplot Dehydrating Co., Caldwell, Idaho.
Southern Alkali Corp., Corpus Christi, Tex.
Western-Newell Mfg. Co., Freeport, Ill.
Bendix Aviation Corp., Eclipse-Pioneer division, Teterboro, N. J., receives star.
Independent Pneumatic Tool Co., Aurora, Ill., receives second star.
Greenfield Tap & Die Corp., Greenfield, Mass.
Soule Steel Co., San Francisco.
Manhattan Rubber Mfg. division, Raybestos-Manhattan Inc., Passaic, N. J.
Four Wheel Auto Drive Co., Clintonville, Wis.
Gray Stamping & Mfg. Co., Plano, Ill.
Frank G. Hough Co., Libertyville, Ill.
Kochring Co., Milwaukee.
Tennessee Eastman Corp., Kingsport, Tenn.

BRIEFS . . .

International Harvester Co., Chicago, has multiplied the firing life of 20-millimeter automatic aircraft cannons through improvement of 12 critical parts of the weapon.

—o—

General Electric Co., Fort Wayne Works, by substituting 40,000 pounds of noncritical material, has saved more than 63,000 pounds of critical copper and brass in electric motors.

—o—

Winchester Repeating Arms Co., New Haven, Conn., has developed a new type of noncorrosive carbine cartridge which leaves no damaging deposit in the barrel when fired and reduces gun barrel cleaning.

—o—

Climax Molybdenum Co., New York city, announces the change of the address of its Pittsburgh office to 479 Union Trust building.

—o—

West Virginia Rail Co., Huntington, W. Va., changed its corporate name to West Virginia Steel & Mfg. Co., effective Nov. 24.

—o—

American Screw Co., Detroit, has moved its offices from the General Motors building to the Stephenson building.

—o—

Wade Mfg. Co. and Woodruff & Edwards Inc., Elgin, Ill., have joined forces to mark a new source of supply for plumbing drains, marine fittings and similar specialties. The new organization will be known as the Wade Mfg. Co., division of Woodruff & Edwards Inc., with main offices and plant at Elgin, Ill.

—o—

Manhattan Rubber Mfg., division of Raybestos-Manhattan Inc., Passaic, N. J., observed its fiftieth anniversary recently.

—o—

Universal Wheel & Abrasive Corp., Chicago, has published a catalog showing the wide range and types of grinding wheels.

—o—

Cooper-Bessemer Corp., Mt. Vernon, O., through the use of skilled foundry techniques has saved 850 tons of critical high tensile steel in its production of war products.

—o—

Indoor Climate Institute, Detroit, has published a 30-page brochure inviting its members to participate in a national program designed to create a great new force in the home heating and cooling field.

—o—

Genesee Tool Co., Fenton, Mich., has added six new branch offices at 710 Harries bldg., Dayton, O.; Penton bldg., Cleveland; 601 Tower bldg., South Bend, Ind.; 1506 Toledo Trust bldg., Toledo, O.; 1217 Grant bldg., Pittsburgh, and at 1109 Fletcher bldg., Indianapolis.

—o—

Acme Steel Co., Chicago, was recently awarded the Army Ordnance banner for meritorious production.

—o—

Greene, Tweed & Co., New York city, has purchased the Asbestos Fibre Spinning Co., North Wales, Pa.

—o—

Richmond Radiator Co., Uniontown, Pa., reports that negotiations have been completed for the purchase of the United States Sanitary Mfg. Co., Monaca, Pa.

—o—

Heil Engineering Co., Cleveland, has developed a new type lead anode for electroplating.

THE BUSINESS TREND

Uncertainties Numerous; High Output Continues

APPROPRIATELY, as American industry passes the second anniversary of the Pearl Harbor raid, comes word that November aircraft output exceeded October's by several hundred planes and that shipyards are working at full speed on the new type, faster Victory ships. Industry is tenaciously maintaining high levels of production, in spite of an atmosphere of uncertainty with respect to war order cutbacks and cancellations as well as changes in military requirements.

With revised estimates of manpower needs cutting well over a million workers from the earlier figures, and only certain industries and areas recording shortage of help, the manpower problem diminishes as a production brake. In a few cases shortages of materials for components are delaying output programs. The wave of union wage demands following in the wake of the coal miners' victory, and some degree of "war weariness" among workers plus their growing interest in plant jobs not likely to be terminated by peace, are among the problems confronting industry.

AUTOMOTIVE PRODUCTION—War Production Board's program for production of 123,492 civilian trucks in 1944 will not be traveling on a clear track. For one thing, backlogs of heavy-duty military vehicles are now on production lines of all the automobile plants equipped to build them. Also, mass-production methods applicable to light trucks are ordinarily not adapted to heavier civilian vehicles; these are built on a more or less custom basis which requires many more hours per unit. Shortage of labor and materials in plants making parts for light civilian trucks is another bottleneck, with axles and transmissions important components on the list of delayed parts.

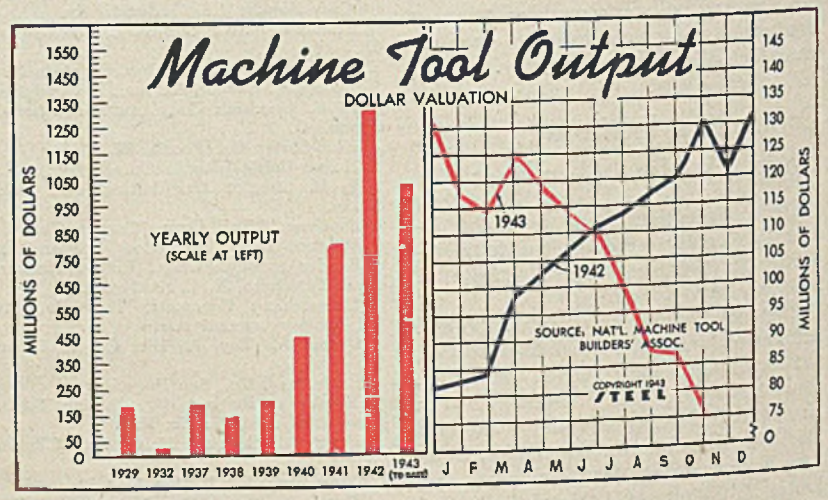
Completion of new facilities now under construction will ease the situation. However, in view of problems confronting the program, substantial output of civilian trucks can hardly be expected before the second quarter.

ENGINEERING CONSTRUCTION — Volume of construction in continental United States totaled $203,632,000 for November. This total is 5 per cent higher than the figure for October, which was $193,379,000, but 67 per cent lower than the sum of $607,622,000 reported for November of 1942. Private construction, totaling $73,195,000, attained the highest volume since October, 1941; it was 55 per cent above the October figure and 138 per cent higher than the total for November of last year. Increases in November by construction types are: Public buildings, 2 per cent; commercial building and large-scale private housing, 29 per cent; unclassified construction, 80 per cent.

For the 11 months of 1943 to date total construction volume amounted to $2,885,384,000, or an average of $61,391,000 for each of the 47 weeks. This volume was 67 per cent below the $8,932,207,000 reported for the equivalent period of 1942.

RAILROAD NET INCOME—October net earnings of class I lines, after interest and rentals, show a decline for the fifth consecutive month, with an estimated total of $76,600,000, compared with $135,538,275 for October of 1942. For the 10 months ending Oct. 31, 1943, net income of these railroads totaled $778,800,000, against $709,230,885 for the corresponding period of 1942. For the 12-month period terminating Oct. 31 of this year the rate of return on property investment averaged 5.59 per cent, compared with a rate of 4.92 per cent for the 12 months ending Oct. 31 of last year.

MACHINE TOOL SHIPMENTS—October shipments of machine tools, totaling about $76,000,000, were around 11 per cent below the September total of $85,842,000. Backlog of unfilled orders declined to about $286,000,000.



FIGURES THIS WEEK

INDUSTRY	Latest Period*	Prior Week	Month Ago	Year Ago
Steel Ingot Output (per cent of capacity)	98.5	99.0	99.5	99.5
Electric Power Distributed (million kilowatt hours)	4,560	4,403	4,414	3,883
Bituminous Coal Production (daily av.—1000 tons)	2,075	2,117	1,638	1,811
Petroleum Production (daily av.—1000 bbls.)	4,329	4,413	4,389	3,918
Construction Volume (ENR—unit $1,000,000)	$52.2	$36.5	$35.2	$103.1
Automobile and Truck Output (Ward's—number units)	17,880	16,775	19,585	19,935

*Dates on request.

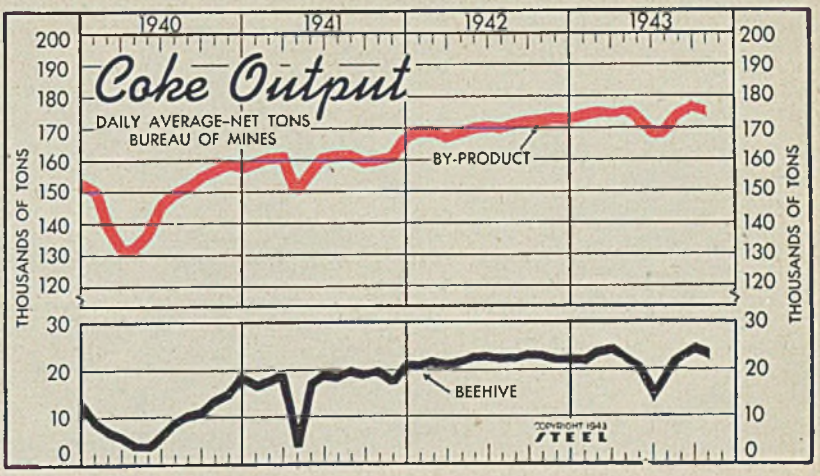
TRADE				
Freight Carloadings (unit—1000 cars)	837†	820	841	740
Business Failures (Dun & Bradstreet, number)	35	43	42	148
Money in Circulation (in millions of dollars)‡	$19,940	$19,796	$19,354	$14,848
Department Store Sales (change from like week a year ago)‡	+21%	+14%	+12%	+30%

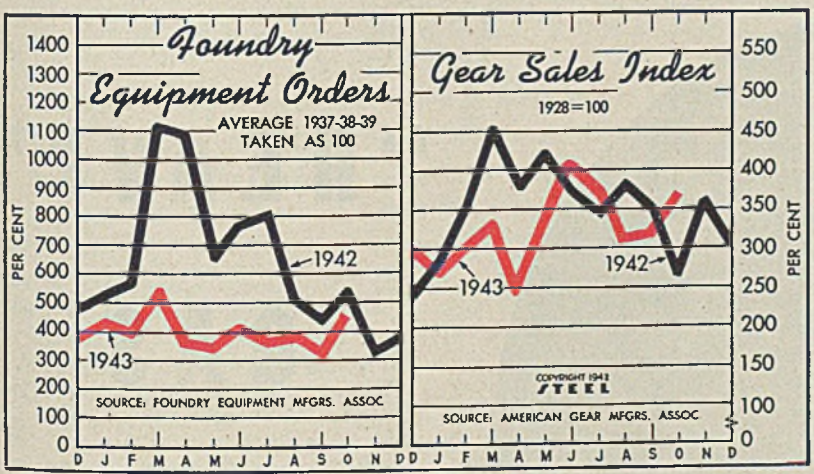
†Preliminary. ‡Federal Reserve Board.

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





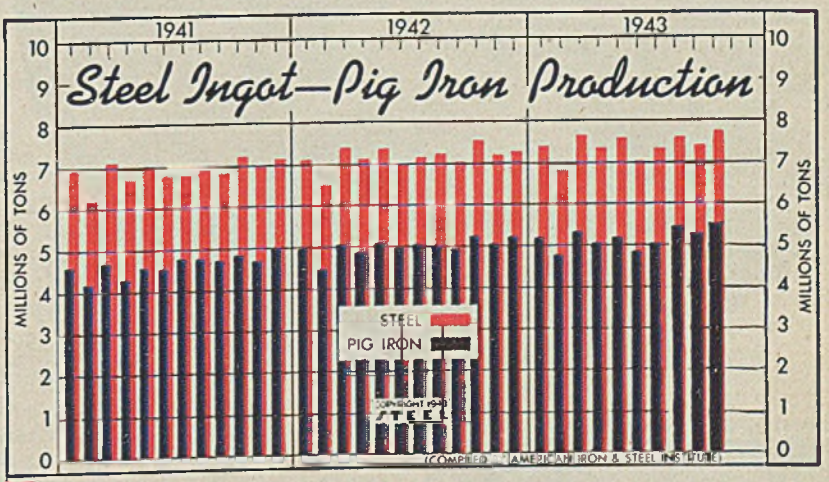
Foundry Equipment and Gear Sales

	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
Year	.....	646.7 Ave.	...	355

Iron, Steel Production

(Net tons—000 omitted)

	Steel Ingots		Pig Iron	
	1943	1942	1943	1942
Jan.	7,424	7,112	5,194	4,983
Feb.	6,826	6,512	4,766	4,500
Mar.	7,670	7,392	5,314	5,055
Apr.	7,374	7,122	5,035	4,896
May	7,545	7,382	5,173	5,073
June	7,027	7,022	4,836	4,935
July	7,376	7,148	5,023	5,051
Aug.	7,562	7,233	5,316	5,009
Sept.	7,489	7,067	5,226	4,937
Oct.	7,778	7,584	5,324	5,236
Nov.	.....	7,184	.....	5,083
Dec.	.....	7,303	.....	5,201
Total	.....	86,061	.....	59,959



FINANCE

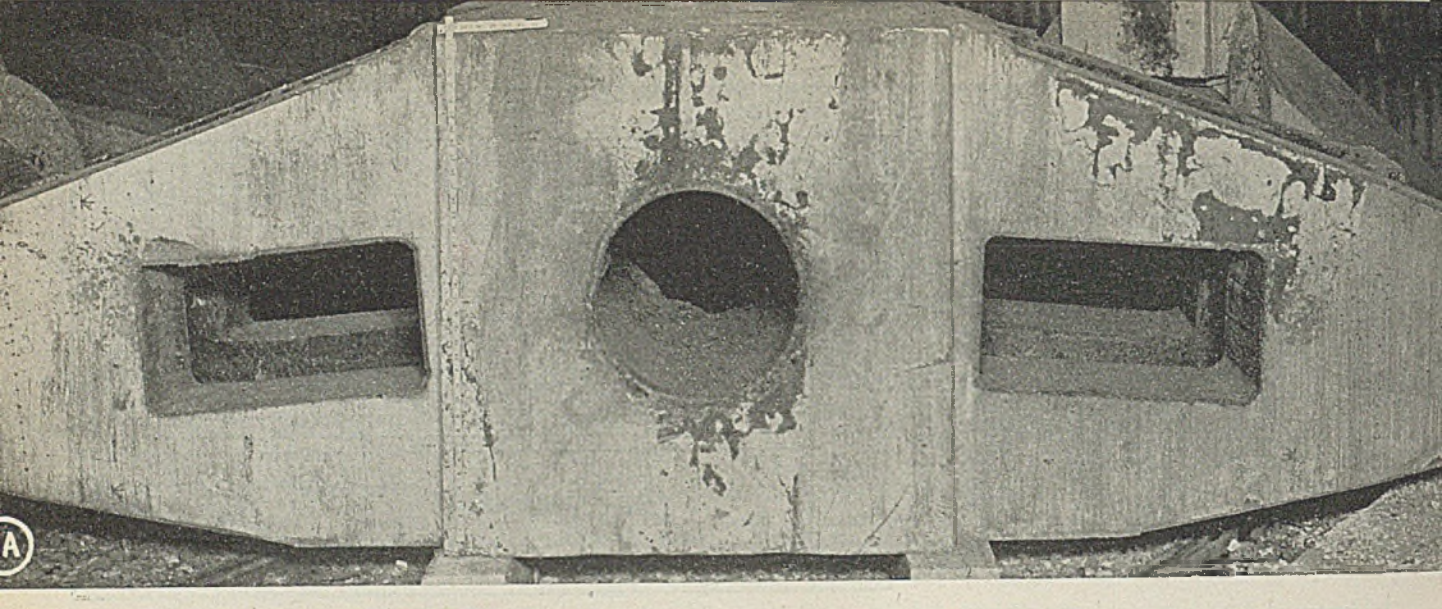
	Latest Period*	Prior Week	Month Ago	Year Ago
Bank Clearings (Dun & Bradstreet—millions)	$7,668	$8,718	$8,631	$7,644
Federal Gross Debt (billions)	$170.1	$169.9	$169.0	$101.9
Bond Volume, NYSE (millions)	$48.6	$32.9	$44.7	$43.1
Stocks Sales, NYSE (thousands)	3,701	2,799	4,007	2,980
Loans and Investments (millions)†	$51,462	$51,989	$52,982	$37,939
United States Government Obligations Held (millions)†	$37,377	$37,857	$39,218	$24,581

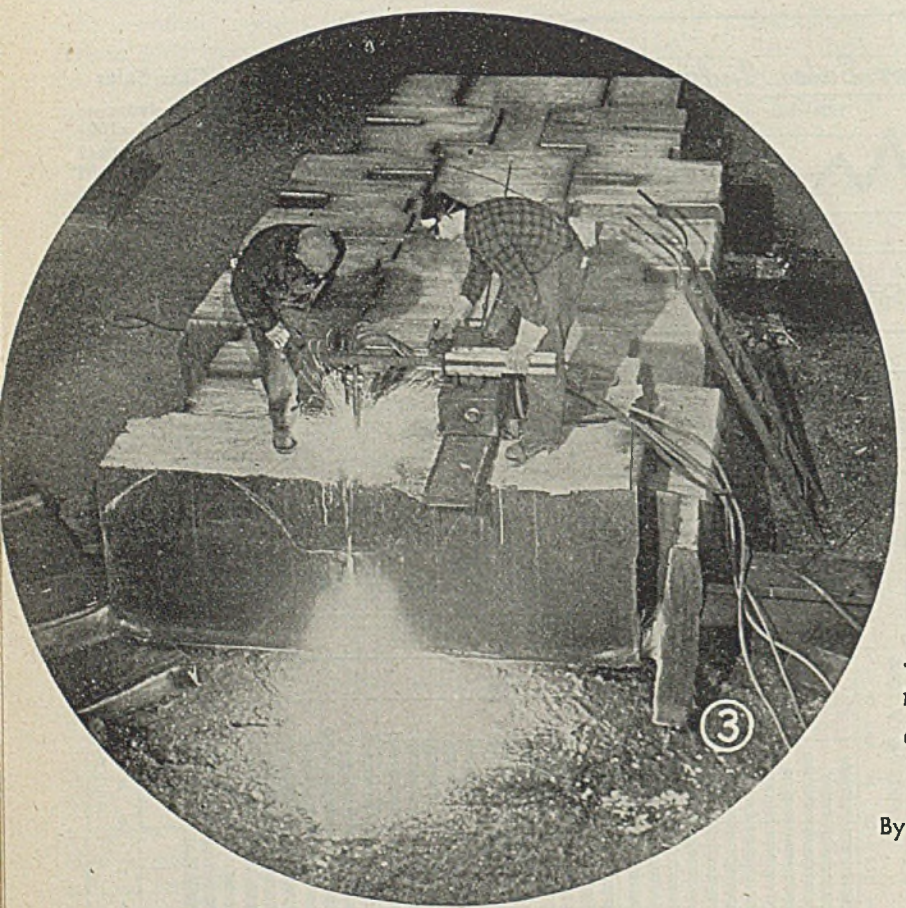
†Member banks, Federal Reserve System.

PRICES

STEEL's composite finished steel price average	$56.73	$56.73	$56.73	$56.73
Spot Commodity Index (Moody's, 15 items)†	244.8	243.6	244.8	232.3
Industrial Raw Materials (Bureau of Labor index)‡	111.1	111.3	111.8	103.8
Manufactured Products (Bureau of Labor index)‡	100.3	100.3	100.3	99.7

†1931 = 100; Friday series. ‡1926 = 100.

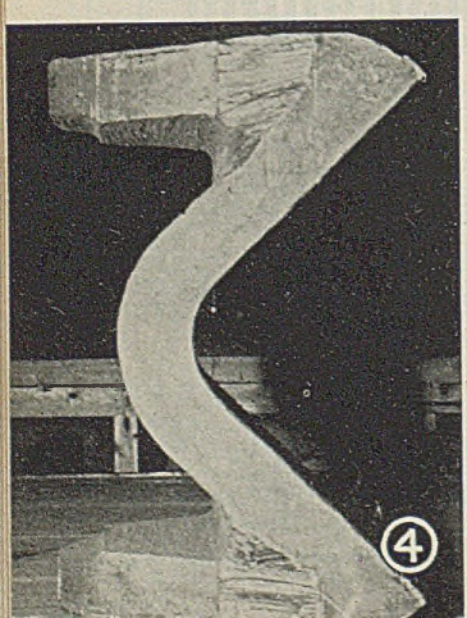




"HEAVY" GAS CUTTING

. . . . now being done on sections up to 42 inches thick; 54-inch sections also are cut

By R. L. DEILY
and
E. BENYO
Bethlehem Steel Co.
Bethlehem, Pa.



PRESENT needs for fast delivery of heavy steel products make it mandatory to flame cut sections, in almost unlimited thicknesses on a production basis. Thus lancing has been eliminated, both due to the expense involved, and because of the poor tolerances attendant upon the operation. It was necessary to develop, or adopt, new technique and equipment to accommodate torch cutting of heavy sections.

A primary requisite for production cutting of heavy sections is adequate oxygen and fuel gas supply. The oxygen must be piped either from a plant or a trailer truck. The important consideration is to have a uniform supply with unfailing pressure and ample volume. This means that all unnecessary restrictions must be avoided, and particularly that pipe and regulator sizes must be large enough to handle the maximum momentary loads. Fuel gas is most generally acetylene, and in our case this is supplied by medium pressure generating plants.

A typical installation of oxygen and acetylene lines is in a shop which has a heavy scarfing load at the south end, an intermediate area of general maintenance cutting and various operations of machine cutting at the north end. In this shop the oxygen main line pressure is kept at a minimum of 160 pounds per square inch, maximum 200 pounds per square inch, except at the scarfing bed where it is reduced to 130 pounds per square inch

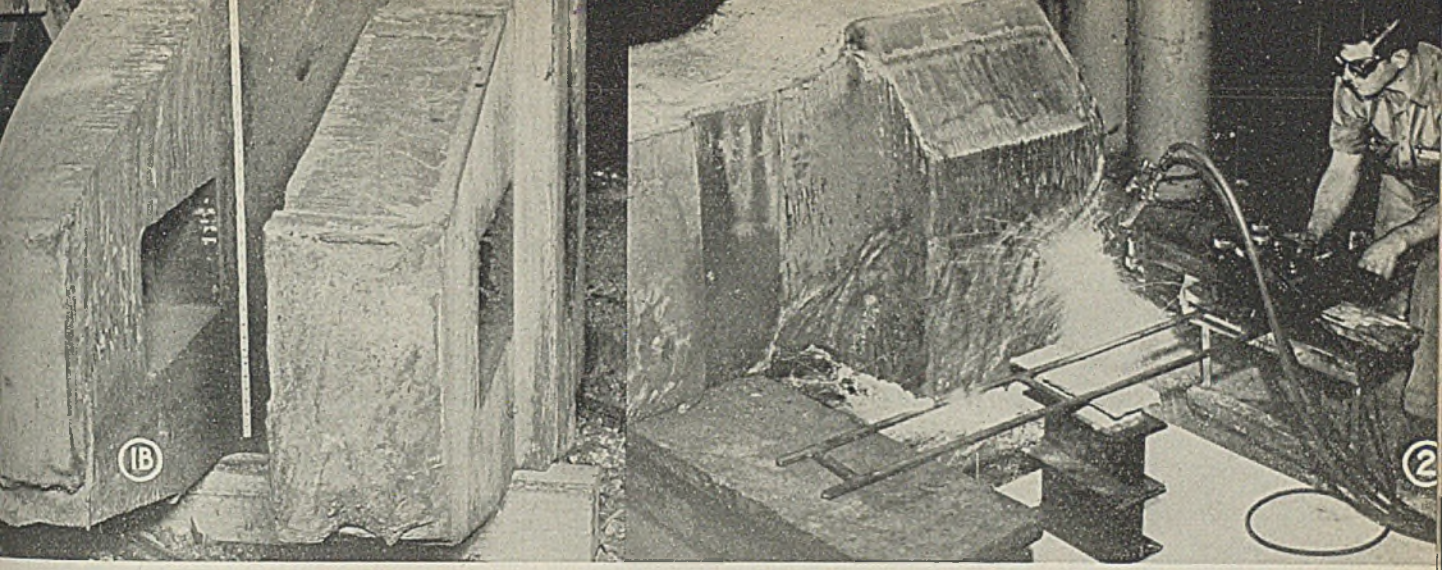


Fig. 1A—Marine part torch cut to shape. Note at A detail of 14-inch diameter hole through a 36-inch section. At 1B is shown a 37-inch cut on this same part viewed from the end

Fig. 2—Closeup showing bevel cutting of flange end of large crankshaft

Fig. 3—Cutting through 42-inch section of crankshaft

Fig. 4—Adapter bit completely torch profiled from solid forged steel block 30 x 30 x 52 inches

average. Acetylene pressure is maintained at 15 pounds per square inch, throughout the shop.

It should be noted that the size of the feeder pipe line is 3 inches, even for the relatively short run of 1850 feet in this shop. The branch lines are 2½ and 2 inches, and drops are generally 1 inch. The relatively large station valve on these drops is the only screwed connection. All connections in the line, except for unions and valves, should be welded to simplify erection, prevent leaks and to streamline the flow. It is always preferable to bend the pipe rather than to employ welded sections at changes in pipe direction. We also have found it necessary to adopt very large pipe sizes and relatively high oxygen pressures in order to guarantee the large constant volumes of oxygen needed for heavy cutting.

In our acetylene plants the generators are linked by various yoke arrangements to insure steady flow from any two generators that may be on the line. The 500-pound double-rated generators are installed in a brick fireproof construction building with carbide storage room adjacent, the floor of which is at a high elevation, level with the filling platform in the generator room. The two main plants have a capacity of 750,000 cubic feet of acetylene each per month, although their momentary capacities are higher. On some cutting applications we have used propane supplied from manifold cylinders.

The pipe-line header arrangement of both oxygen and acetylene used to supply a multiple torch cutting machine comprises an oxygen drop of 2-inch diameter with a line pressure of about 170 pounds per square inch, and a 2-inch acetylene drop with a line pressure of 15 pounds per square inch. The five oxygen and four acetylene stations will supply four torches for normal cutting, or two large torches, plus standby stations for lancing or for a hand-cutting torch if required. This setup is typical of all large operation stations.

From a paper presented at the annual meeting of the American Welding Society, Chicago, Oct. 18-21, 1943.

Torch Tips Must Be Adequate

Torches are the next consideration and they must have tips with sufficiently large orifices to do the work. A standard two-hose torch, using ⅜-inch oxygen and 5/16-inch acetylene hose of 75 feet, is satisfactory for thicknesses up to 28 inches, but not preferable over 20 inches. A three-hose torch should be used, with a ½-inch cutting oxygen supply hose for thicknesses from 20 to 54 inches and over. In such oxygen setups, a pressure gage should be used primarily as a volume indicator, since pressure is not important except as it affects the volume of oxygen in relation to the capacity of the equipment. This gage should be on the outlet side of the valve or the inlet side of the torch. The torch should have a capacity of approximately 6000 cubic feet per hour. The tips should be of a suitable range in size and made to provide sufficient preheat for the particular work undertaken.

Observations of experimental heavy cutting prove the preheat flames to be of paramount importance. They must be of sufficient volume to result in a flame that will extend almost to the bottom of the cut. Otherwise, excessive drag will begin at the depth limit of maximum heat penetration. If the torch and associated tips and equipment do not supply enough preheat flame, they may be supplemented with an auxiliary preheating torch for supplying the deficiency.

In our early efforts to cut 32-inch alloy steel we employed equipment previously used successfully for cutting 28 inches depth. But we found that we could penetrate no further than 25 inches in the 32-inch thick material. The introduction of postheating enabled the equipment to successfully cut the 32 inches and heavier thicknesses. This experience has resulted in our increasing the amount of preheat in our torches. Today the same torch, with increased preheat capacity, is capable of cutting 42 inches thickness without postheating.

We have used two types of equipment meeting the foregoing specifications, both of which will cut relatively heavy sections. One of these outfits employs acetylene as its fuel gas, the other propane. Both are capable of cutting upward of 40 inches under normal conditions. While propane is a very effective fuel gas for heavy cutting, there is sometimes difficulty in returning to the same flame adjustment when usng large volumes. The difference in adjustments is not as sharp and apparent with propane as with acetylene. The proper mixture

(*Please turn to Page* 118)

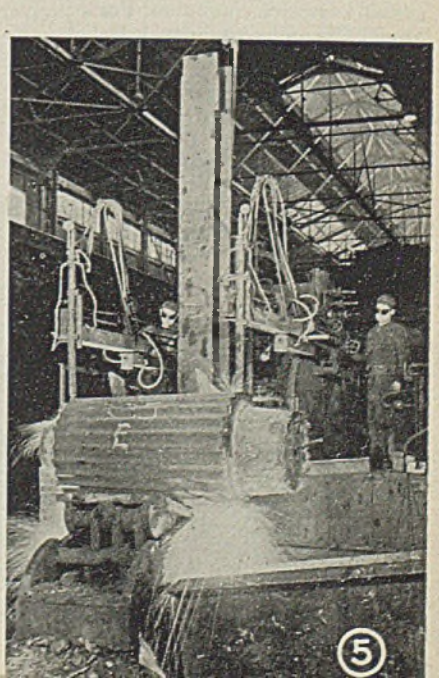


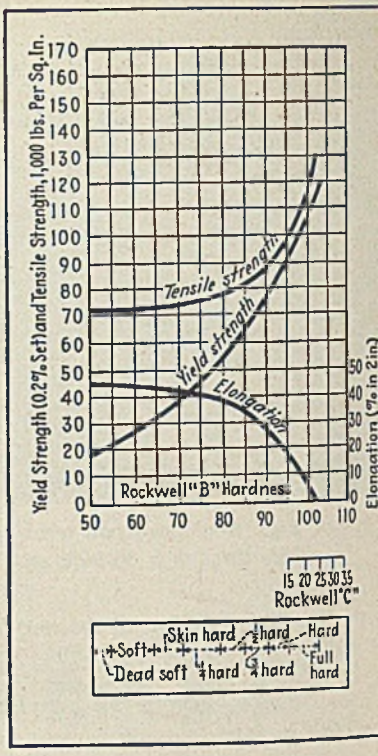
Fig. 5—Corrugated alloy steel ingot during cropping operation with torch setup

The Spot Welding of . . . .

NICKEL and NICKEL ALLOYS

Properties of nickel, Monel and Inconel are detailed and important factors in spot welding these materials are analyzed. For other articles on spot welding, see STEEL, March 29, 1943, "Metallurgy of Spot Welding"; July 12 and 19, "Spot Welding Aluminum"

By HAROLD LAWRENCE



IT IS INDEED fortunate that the three common nickel materials—nickel, Monel and Inconel—can be fabricated by spot welding. Thus the valuable strength and corrosion resisting attributes of these materials can be utilized in a host of manufactured products fabricated by resistance welding. Before going into the details of spot welding procedures, the chemical constitution and uses of the three nickel materials will be reviewed briefly.

NICKEL—Wrought nickel is about 99.40 per cent pure nickel plus less than 1 per cent of cobalt, which is not determined separately. It contains also small amounts of copper, iron, manganese, carbon, silicon and sulphur. In addition to its well known resistance to corrosion, it possesses excellent physical properties. Furthermore these mechanical properties give a good account of themselves at both elevated and sub-zero temperatures. Although the strength of nickel can be increased by suitable cold working, it does not respond to age hardening. Besides being fabricated by spot welding, all of the other widely used welding processes are suited to the joining of nickel.

MONEL is an alloy of copper and nickel containing 63 to 70 per cent nickel and up to 30 per cent copper with the remainder largely iron and manganese. In its resistance to corrosion, Monel is superior to either nickel or copper under certain corrosive conditions. For example, Monel is more resistant than nickel under reducing conditions while it proves to be more resistant than copper under oxidizing conditions. Monel, like nickel, has quite good physical properties. It may not be age hardened although cold working increases its strength.

INCONEL is an alloy of nickel, chromium and iron containing about 79.5 per cent nickel, 13 per cent chromium and 6.5 per cent iron. In this alloy, the outstanding corrosion resistance and mechanical properties of nickel are further improved through the heat-resisting properties imparted by the chromium. At temperatures up to 2000 degrees Fahr., the resistance to oxidation and the ability to withstand repeated heating and cooling make Inconel useful in the construction of exhaust manifolds for airplanes and miscellaneous parts for heat-treating furnaces. Cold working is employed to increase the strength of Inconel which does not respond to age hardening.

Although nickel, Monel and Inconel have been reported to be unresponsive to age hardening, this must not be construed to mean that these materials cannot be annealed. As with so many metals, the nickel-bearing alloys, and nickel itself, may be softened after cold working by a suitable annealing cycle. It is not possible, however to increase strength by heat treatment as is done with steel and with some of the other nickel materials.

For ready comparison the chemical analyses of the wrought form of nickel, Monel and Inconel are reported in Table I. And in Figs. 1, 2 and 3 will be found the common mechanical properties of the three materials in sheet or strip form.

SOME USES OF NICKEL AND NICKEL ALLOYS—Before considering the technical aspects of the spot welding of these materials, let's review some typical applications. Nickel is widely employed in the chemical industry where its fine mechanical properties and outstanding resistance to certain corrosive materials make it suitable for the fabrication of evaporators, jacketed kettles, heating coils and other processing equipment. Often it performs as a lining in steel vessels where its corrosion resistance serves to protect the color and purity of food products and pharmaceuticals alike. In the electrical industry nickel has become popular in contact parts where it demonstrates unusual ability to withstand arcing. Nickel forms an important element in radio tubes where it is fabricated by spot welding.

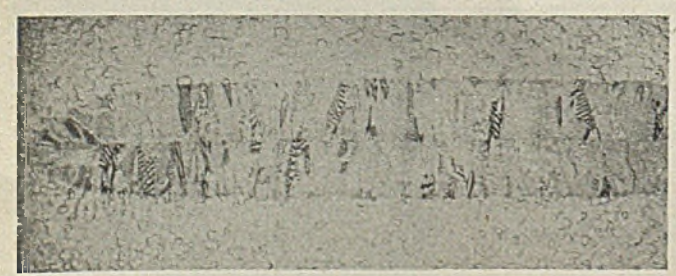
Like nickel, Monel is found in many types of chemical units where a rustless, corrosion-proof, structural material is needed. Applications include valves and pump parts, turbine blades, laundry machines, food service equipment, sinks and drainboards in residential kitchens, salt driers, processing equipment and a large number of other industrial and marine applications.

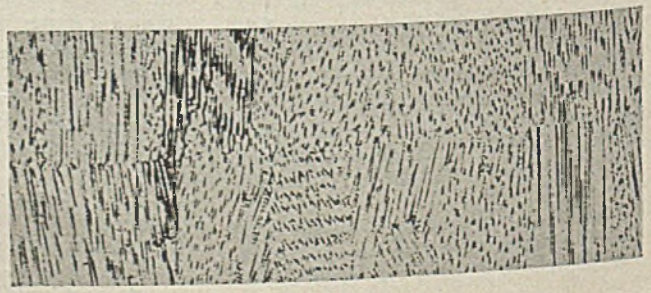
Inconel finds special application in elevated temperature service, is particularly useful in airplane exhaust manifolds. Inconel springs are found in high temperature designs where retention of strength and stiffness is most advantageous.

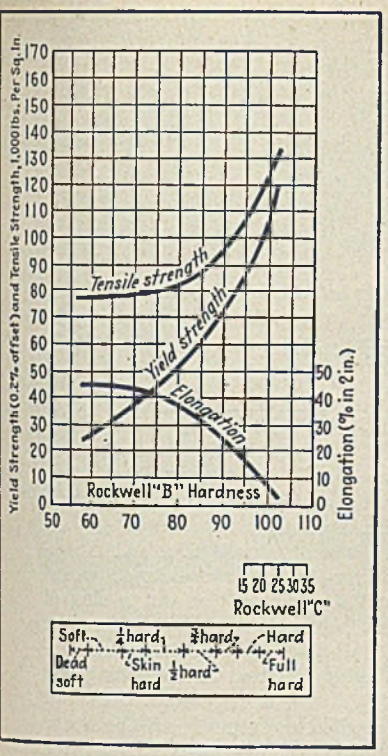
SPOT WELDING CONDITIONS—The five important variables to be controlled in spot welding are pressure, current, time, electrode material, size and shape of the electrode.

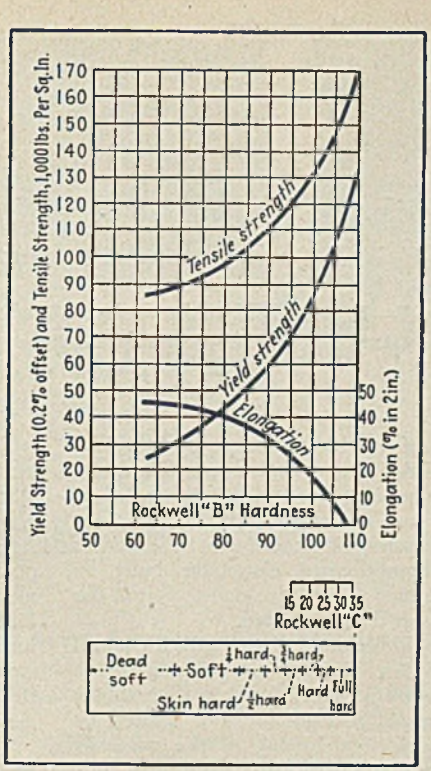
PRESSURE—The pressures required for the successful welding of nickel and high nickel alloys are in the neighbor-

Fig. 5—Typical weld in 0.062-inch nickel sheet at recommended welding conditions; left, at 12 diameters; right, at 100 diameters shows center of weld









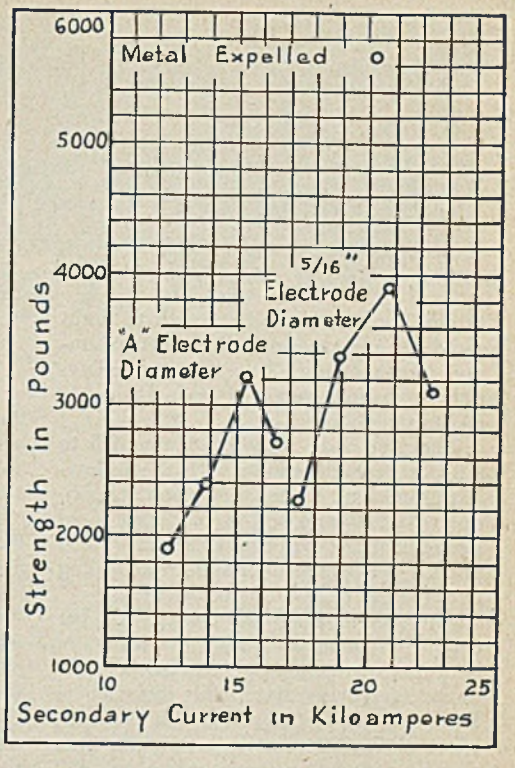


Fig. 1 (Left, opposite page)—Average tensile properties of nickel sheet and strip

Fig. 2 (Above left)—Average tensile properties of Monel sheet and strip

Fig. 3 (Above center)—Average tensile properties of Inconel sheet and strip

Fig. 4 (Above right)—Strength-current relationships for 0.062-inch annealed Monel sheet, using ¼ and 5/16-inch flat electrodes at 40,000 pounds per square inch electrode pressure, 12 cycles welding time

hood of those found necessary for welding stainless steel and are, of course, higher than those employed in welding carbon steel. The lower limit of pressure is that which leads to unsound welds while the upper limit of pressure is established by the amount of indentation and distortion that may be permitted in the structure.

When all of the other four factors are in correct balance, the right pressure will bring about a weld nugget or fused spot that is from 50 to 80 per cent of the thickness of the joint when two sheets of equivalent thickness are being joined. When sheets of unequal thickness are being welded, the weld nugget will approximate the thickness of the thinner of the two sheets.

Commercial variations of the nickel materials from melt to melt have been found to require little or no change in welding pressure. Tests conducted on both Monel and Inconel have disclosed that no change in pressure is necessary when welding the one-fourth hard sheet as compared with that specified for the annealed sheet.

CURRENT—Welding current is established by increasing the current until the metal "spits" while making the spot weld. A current setting slightly below this point represents the best weld as determined by strength and metallurgical considerations. Fig. 4 illustrates this relationship as developed by Hess and Muller.

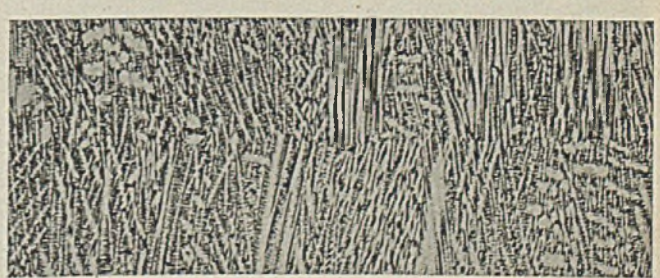
Current conditions need careful regulation. If excessive current is used spitting occurs and a porous weld such as that shown in Fig. 5 is the result. If current is not sufficient, a composite structure like that shown in Fig. 6 will be found.

An investigation has been made as to the permissible variation in current to produce welds of commercially acceptable quality. An arbitrary reduction in strength of 20 per cent was selected. The results, assembled in Table II, point out conclusively that good current control is quite important. It is apparent that the closest control is required by nickel, less control is needed with Monel although the difference is slight and the greatest latitude is permitted with Inconel.

TIME—Considerable leeway is possible in the selection of welding times for nickel and its alloys. The shortest time is preferred when welding nickel because the problem of electrode sticking is intensified by long electrode contact. On the other hand longer times are suggested for the welding of both Monel and Inconel. As these two alloys are harder than nickel, the use of long firing permits the softening of the metal around the electrode during the welding period and allows a good follow-up movement to insure the elimination of porosity. Too long times are to be avoided as both indentation and distortion are thereby increased. To insure consistency, good time regulation should be assured by use of good control equipment such as Thyratron, Ignitron and similar vacuum tube timers.

ELECTRODE MATERIAL—Copper-alloy electrodes possessing at least 80 per cent of the conductivity of copper are recommended. The electrodes should,

Fig. 6—Typical weld, 0.062-inch sheet, at recommended welding conditions; left, one end of weld nugget; right, portion of weld center at 100 diameters



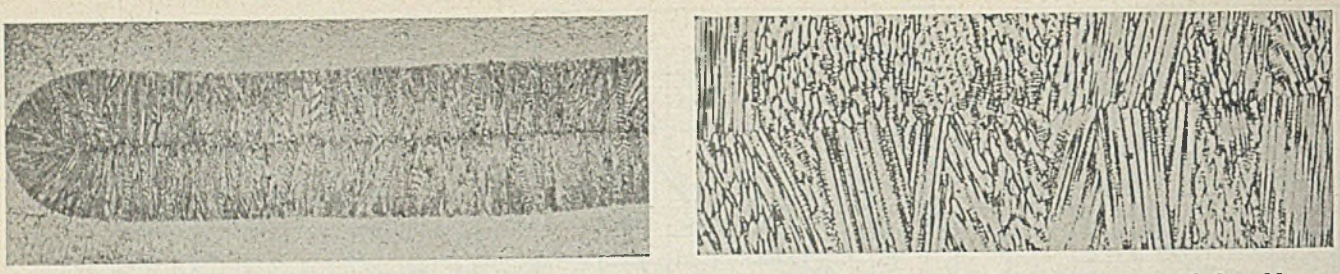


Fig. 7—Typical weld in Inconel 0.062-inch sheet at recommended welding conditions; left, at 12 diameters, shows one end of weld nugget; right at 100 diameters is portion of weld at center

in addition, have good strength to withstand the pressures and heat without undue mushrooming. Two electrode materials have been reported upon favorably by investigators.

The first is an alloy containing 0.5 to 0.6 per cent chromium with the following properties: 82 per cent electrical conductivity, 80 rockwell B hardness, yield strength at 0.2 per cent offset of 70,000 pounds per square inch and an annealing temperature of 500 degrees Cent.

The second electrode contains 0.4 per cent zirconium in place of chromium with the following properties: 85 per cent electrical conductivity, 80 rockwell B hardness, yield strength at 0.2 per cent offset of 73,000 pounds per square inch and an annealing temperature of 450 degrees Cent.

Electrodes should be cooled to permit a satisfactory life and either water-cooling or a refrigerant should perform well. At least 100 welds may be made under the proper welding conditions with either of the above materials before point dressing is indicated.

SIZE AND SHAPE OF ELECTRODE—Experimental work conducted to determine the size and shape of electrodes was pointed at getting a weld that tears around the periphery when pulled apart. Ratios of weld diameter to sheet thickness of 3, 3½ and 4 produced this desirable type of failure in annealed nickel, Monel and Inconel respectively.

Experience indicates that flat rather than dome-shaped electrodes must be used. Dome-shaped tips do not permit the follow up that is needed.

One problem associated with the welding of pure nickel is the sticking of the electrode tips to the work. Although the problem is not serious, it is caused by the mechanical keying of the relatively soft nickel to the tip surface. Changing the angle of approach from the 30 degrees originally tried to 10 degrees brought about a noticeable improvement. Besides a shorter weld time, entirely possible with nickel, the lesser angle of approach to the flat face of the tip reduced the sticking problem to the point where it was negligible. Since neither Monel nor Inconel exhibit any sticking tendencies, the suggestion that soft nickel is the answer appears to be a logical one. Higher pressure, longer times and softer materials will accentuate any sticking proclivities.

TESTING OF WELDS—With nickel materials (as with steel, aluminum and other materials) a quick test is of much benefit in checking the spot welding performance. Although the simple pull or peel test is widely used, it is not recommended for testing nickel spot welds. Pull-out failures that tear out a slug of metal are not critical enough for spot welds joining nickel and its alloys. Instead a quick method of sectioning and examining welds is suggested.

The method consists of scribing a line across the center of the weld, shearing or sawing near this line, smoothing the section by filing or grinding to the line followed by macroetching the surface thus prepared. Concentrated nitric acid may be used for the etchant. Visual examination of the etched section will disclose any flaws and tell much about weld diameter, penetration, structure, porosity and other defects. Besides if the strength-diameter relationship is known from previous tests, a close estimate of weld strength may be made. The test requires no more than 2 minutes after the operator becomes skilled in the technique.

Recommended procedures and resulting strengths for these materials are shown in Table III.

METALLURGY—Figs. 5, 6 and 7 show structure of typical welds in nickel, Monel and Inconel. Sound structures result from the choice of proper welding conditions. The crystal structure is largely columnar as is true of the usual spot weld that has not been subjected to a subsequent heat-treating operation.

Coring occurs in welds made in Monel and Inconel and the explanation is similar to that for 24ST aluminum as was described in STEEL, July 19, 1943. Although the extension appear to be cracks, high magnification reveals the true nature of this constituent. The cored region is completely filled with molten metal that has solidified along the grain boundaries of the parent sheet.

The stressed metal that surrounds the periphery of the weld is the location of the grain boundary melting that leads to coring. With the electrical resistance across the grain boundaries being higher than that through the grains themselves and with localized stresses set up by the

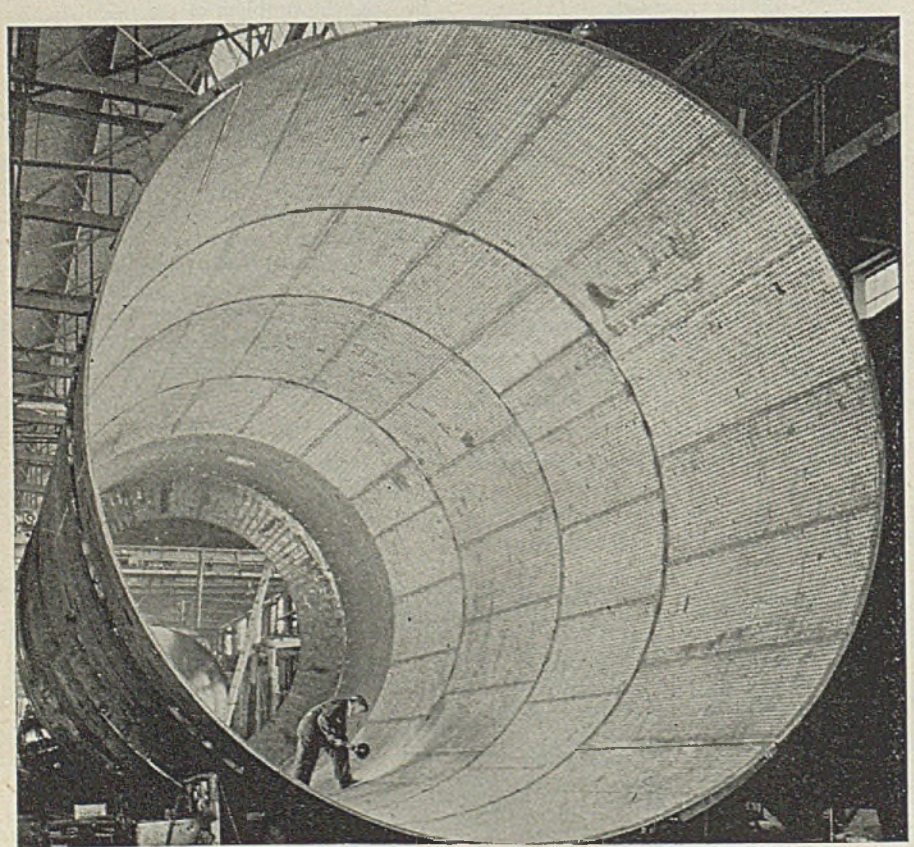
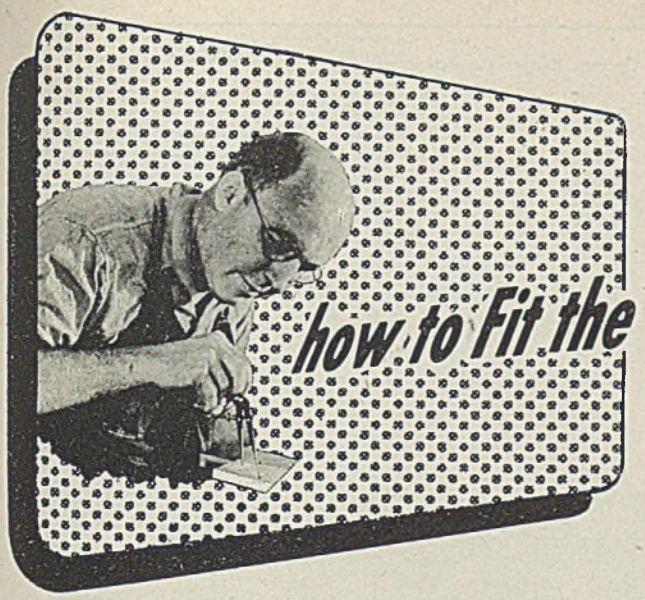


Fig. 8—Section of large fractionating tower "Smith-lined" with Monel sheet attached by spot welds about ¾-inch in diameter. A. O. Smith Corp. photo



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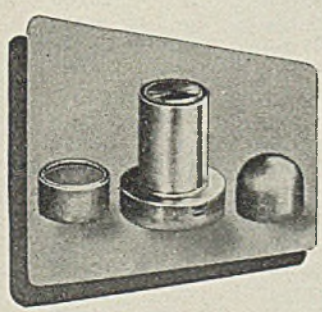

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TABLE I—Chemical Analyses of Wrought Nickel, Monel and Inconel

Element	Nickel	Monel	Inconel
Nickel	99.4*	67.0	79.5
Copper	0.1	30.0	0.2
Iron	0.15	1.4	6.5
Manganese	0.2	1.0	0.25
Silicon	0.05	0.1	0.25
Carbon	0.1	0.15	0.08
Chromium	....	....	13.0
Sulphur	0.005	0.01	0.015

*Includes a fractional percentage of cobalt.

TABLE II—Working Current Ranges Consistent with 20% Reduced Weld Strength

Material	Thickness	% Change in Current Consistent with 20% Reduced Weld Strength	Average % Reduction in Current Consistent with 20% Reduced Weld Strength for Each Material
Nickel	0.021	5.9	
	0.032	6.0	
	0.062	5.5	5.3
	0.093	4.0	
	0.125	4.9	
Monel	0.021	6.2	
	0.032	5.5	
	0.062	10.0	6.4
	0.093	4.8	
	0.125	5.3	
Inconel	0.021	13.7	
	0.032	9.1	
	0.062	10.0	12.1
	0.093	15.2	
	0.125	12.4	

TABLE III—Data for Spot Welding Nickel, Monel and Inconel Sheet

Metal Thickness In.	Flat Face of Electrode Diam., In.	Shape of Electrode Tip	Total Electrode Pressure, Lb.	Unit Electrode Pressure, psi	Firing time, Cycles	Current, Amp.	Strength per Spot Lb.
Recommended Conditions for Spot Welding Nickel Sheet							
0.021	1/8	30° bevel	245	20,000	4	7,760	445
0.032	5/16	10° bevel	829	30,000	4	15,400	950
	1/8	30° bevel	429	35,000	4	9,200	740
	1/8	10° bevel	490	40,000	4	10,000	720
0.062	5/16	30° bevel	2300	30,000	6	31,000	3,250
	1/4	30° bevel	1720	35,000	6	21,600	2,855
0.093	3/8	30° bevel	2765	25,000	12	32,000	5,825
	5/16	30° bevel	2305	30,000	12	26,400	5,015
0.125	3/8	10° bevel	3315	30,000	20	33,700	8,600
	3/8	30° bevel	3315	30,000	20	30,800	8,750
Recommended Conditions for Spot Welding Monel Sheet							
0.021	1/8	30° bevel	184	15,000	12	6,200	570
0.032	5/16	30° bevel	690	25,000	12	10,600	1,290
0.062	5/16	30° bevel	2685	35,000	12	20,700	3,930
	1/4	30° bevel	1962	40,000	12	15,300	3,215
0.093	3/8	30° bevel	2765	25,000	20	22,600	6,800
	5/16	30° bevel	2685	35,000	12	20,000	4,370
0.125	1/2	30° bevel	4910	25,000	30	30,800	10,950
	3/8	30° bevel	3870	35,000	30	21,300	7,800
	3/8	30° bevel	4420	40,000	20	23,900	6,825
Recommended Condition for Spot Welding Inconel Sheet							
0.021	1/8	30° bevel	184	15,000	12	4,040	700
0.032	5/16	30° bevel	690	25,000	12	6,710	1,485
	1/8	30° bevel	368	30,000	12	3,730	1,040
0.062	5/16	30° bevel	3070	40,000	12	12,000	4,340
	1/4	30° bevel	2455	50,000	12	9,300	3,380
	1/4	30° bevel	1962	40,000	20	6,100	3,365
0.093	5/16	30° bevel	3070	40,000	20	12,700	6,850
	3/8	30° bevel	3870	35,000	20	15,000	7,125
0.125	7/16	30° bevel	5270	35,000	30	20,000	10,525
	1/2	30° bevel	5900	30,000	30	21,500	12,000

electrodes, conditions are almost ideal for localized melting to take place at the grain boundaries. Since coring will be found when the current is too low to produce a cast nugget structure, it is evident that the region is not one where a crack has been subsequently filled with metal from the molten nugget.

The spot welding of nickel, Monel and Inconel is readily accomplished without necessitating the use of any special equipment. Cleaning the surface with boiling trisodium phosphate solution followed by rinsing in boiling water assure a good surface condition for welding, though practically this is seldom necessary. Weld strengths are good and control is no more critical than in any other spot welding. With the expanding use of nickel materials in alloy fabrication where the special properties of these materials are well adapted a considerable amount of resistance welding fabrication is to be anticipated.

Investigation of two shop tests—tests that can easily be made to aid in machine setup — disclosed that what is known as the "peel" test appears of little value, the "quick section" test provides a fast efficient method of evaluating welds made in the shop. Failure in the first case usually occurs by tearing or pulling a slug, regardless of the weld condition, therefore is unreliable.

Failure in the "quick section" test is not involved since, as its name implies, a sample weld is sectioned and examined visually. Diameter, thickness, penetration and structure of weld nugget so revealed are excellent indicators of quality and serve well as quality control "indicators". Length of time involved in performing this test is in the neighborhood of 2 minutes. Concentrated nitric acid works well as an etchant for the metals here under consideration.

Planer, Shaper, Slotter In Practical Manual

Planing, Shaping and Slotting, by Fred H. Colvin; cloth, 125 pages, 4½ x 7½ inches; published by McGraw-Hill Book Co. Inc., New York, for $1.25.

This is a concise and practical manual presenting essentials of the use, setting up and operation of planers, shapers, and slotters in clear form for beginners in machine shop work.

Many examples are taken from some of the best known machines of each class, with illustrations of the machines and names of the principal parts. Various kinds of work done on each type of machine are also shown by examples from actual shop practice.

The author classes the shaper and planer as next to the engine lathe and drilling machine in importance in the machine shop, while the slotter, in the same class as the shaper, is not used to the same extent as the others.

Cornell Research Probes Radiant Heating Factors

The various physiological, psychological and engineering factors relating to the comfort and economy of radiant heating and cooling have recently been investigated by Messrs. Mackey, Wright, Clark and Gay of Cornell University under the direction of the University's research committee on panel heating and supported by Consolidated Edison Co.

Part I of the pamphlet "Radiant Heating and Cooling" supplies preliminary engineering data necessary in the study of radiant heat exchanges within a room. Other uses of these data include the study of radiant heat exchange within a boiler furnace and studies of illumination. Charts are presented for angle factors from plane surface to plane surface and from a small sphere to plane surfaces.

It is the purpose of later study to investigate engineering factors in a model room; also to present data obtained from a study of human subjects in a test room to be built in the constant temperature room of Sibley School of Mechanical Engineering at the university.

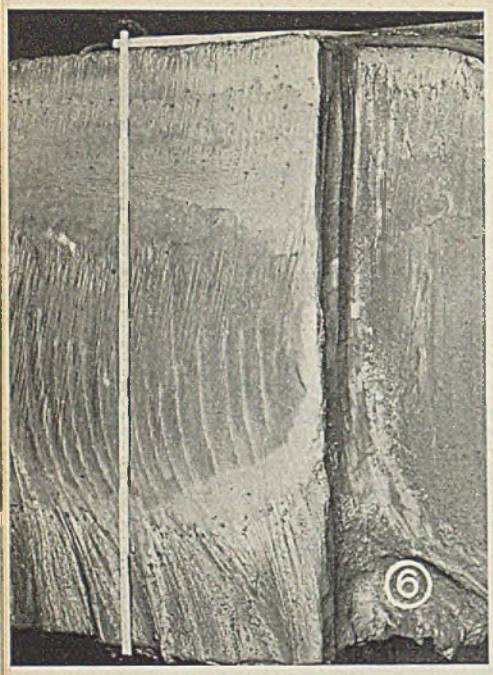


Fig. 6—Detail of cut showing quality in cutting through 41-inch section of crankshaft

"Heavy" Gas Cutting

(*Continued from Page* 111)

and combustion is very important on heavy cutting.

The vehicles used to carry these torches may be standard cutting machines, where these are adequate to do the job, or heavy duty cutting machines where needed. Single-purpose machines may be designed especially for production operations such as cutting ingots. It is important to remember that for massive work requiring portable machines, the machine must be of heavy weight and wide gage because of the load of heavy duty torches and hoses. Where only the smaller machines are available for carrying this heavy equipment, they should be operated in a forward direction only and be counterbalanced to prevent tipping. This precaution is necessary to prevent the operator from being burned, especially if he is unable to quickly shut off the high pressure oxygen supply. Finally, all machines for heavy cutting should have a minimum constant speed of 1 inch per minute or less.

For heavy cutting the technique employed is essentially the same as for lighter work, 6-inch plate for instance. Where heavy sections of large mass are to be cut it will be found helpful to furnace preheat to a temperature somewhere between 200 and 800 degrees Fahr., except where the analysis makes such treatment inadvisable.

In starting the cut on heavy sections it is very important to allow sufficient time for flame preheat. The high-pressure oxygen stream is then opened and the forward motion of the torch started a fraction of a second later. This forward motion of the torch is increased gradually to full cutting speed as the cut progresses.

When these operations are properly timed, the cut will progress steadily down the face of the piece at a constant rate, and without a sharp shelf forming at any point, until it breaks through the bottom. At the instant the cut breaks through, the drag is generally rather long, but it will shorten quite rapidly to normal drag length for the section being cut, once the cut has become completely confined.

Poor Flame Makes Drag

We mention this long drag particularly because it is during this stage that the inexperienced operator will frequently spoil his opportunity of making a successful cut by becoming discouraged and shutting down the operation. Likewise, the inexperienced operator will all too frequently ruin his cut by starting to lance the bottom of the piece before the cut has become established. In most cases, it is best to let the cut run until it has established itself. However, a lance should always be on hand to help in starting the cut if necessary, or to straighten out excessive drag, should such occur.

Insufficient flame preheat will result in the freezing of the work about three-quarters of the way down, giving rise to a severe drag; or a ribbed, uneven surface will result, starting about one-third or one-half the way down. The surface will be similar to that produced by too slow a speed.

Excessive oxygen pressure will chill the cut, cause shelfing and resultant drag and, on encountering inclusions will cause excessive blows, introducing drag. It may also set up excessive turbulence which will interfere with the cut. Generally speaking the lower the pressure the easier the job.

Too slow a speed will result in shelfing, thereby introducing extreme drag. While it is impossible to state speeds for heavy sections because of the number of variables, we know that there is a general tendency to run too slowly. We seldom employ less than 1 inch per minute speed, even on work 54 inches thick.

Sometimes an operator fails to increase the speed to normal until after the start has been completed. Should completion not occur in time, he mistakenly reduces the speed, and this exaggerates the drag in most cases. Instead he should increase the speed, which will generally eliminate the drag. Our drags on 45-inch cuts run as little as 3 inches, mainly at 6 inches, and sometimes as high as 18 inches. It is very easy to run too slow on heavy cutting because speeds are set by observation, and when watching a comparatively wide and long stream of oxidizing metal the variations are not noticed as readily as on lighter work.

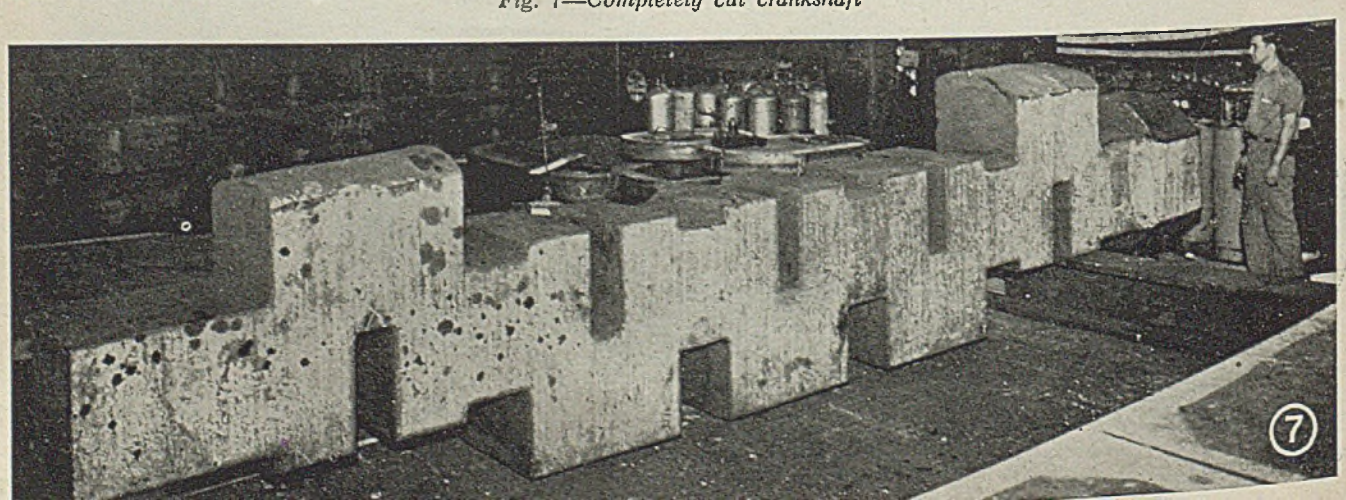
THREE-DIMENSIONAL CUTTING: An interesting problem was presented by the three-dimensional cutting of a forged steel marine part, Fig. 1. The procedure developed for shaping this marine part required a minimum amount of very deep cutting. The slots at each end were cut for their full depth and this was followed by cutting the 14-inch diameter hole in the center through its full 36-inch depth. The four rectilinear holes were cut to their dimensions of 19 inch length, 10 inch width and 10 inch depth. The legs were finally sloped as shown. The original dimensions of this forging were approximately 37 x 36 x 124 inches. Starting points for each hole were obtained by piercing with a lance.

Fig. 4 is an excellent example of what can be done in the way of torch profiling heavy sections. This piece is 30 x 30 x 48 inches long. The walls are approximately 6 inches thick. It was cut from a forged steel block 30 x 30 x 52 inches.

THICK SLABS: In almost every instance our procedure for cutting thick slabs involves the employment of portable cutting equipment. A typical example of this operation is a 17-inch thick alloy steel plate 30 feet long x 12 feet wide which was cut at room temperature using a heavy preheat oxyacetylene tip with the machine traveling at a speed of 3 to 4 inches per minute. Sufficient track was used to line up the entire length of the cut. A drop cut was obtained.

HEAVY CRANK SHAFTS: We believe that the operation which we will now describe, shown in Fig. 3, is without doubt the most outstanding of its kind to date. It is the cutting of two crank-

Fig. 7—Completely cut crankshaft



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Today, aeronautical engineers have packed a horsepower into a few ounces of metal, and more than 2,000 horsepower into a single engine. Tolerances are measured in thousandths of an inch, and bearing smoothness is measured in millionths.

There's a reason for such precision as this. Into the cylinders of that finished engine will pour a torrent of 15-ton explosions at the rate of hundreds of blasts every second during the million miles of flight that is the life expectancy of the engine.

And that, brother, is horsepower!

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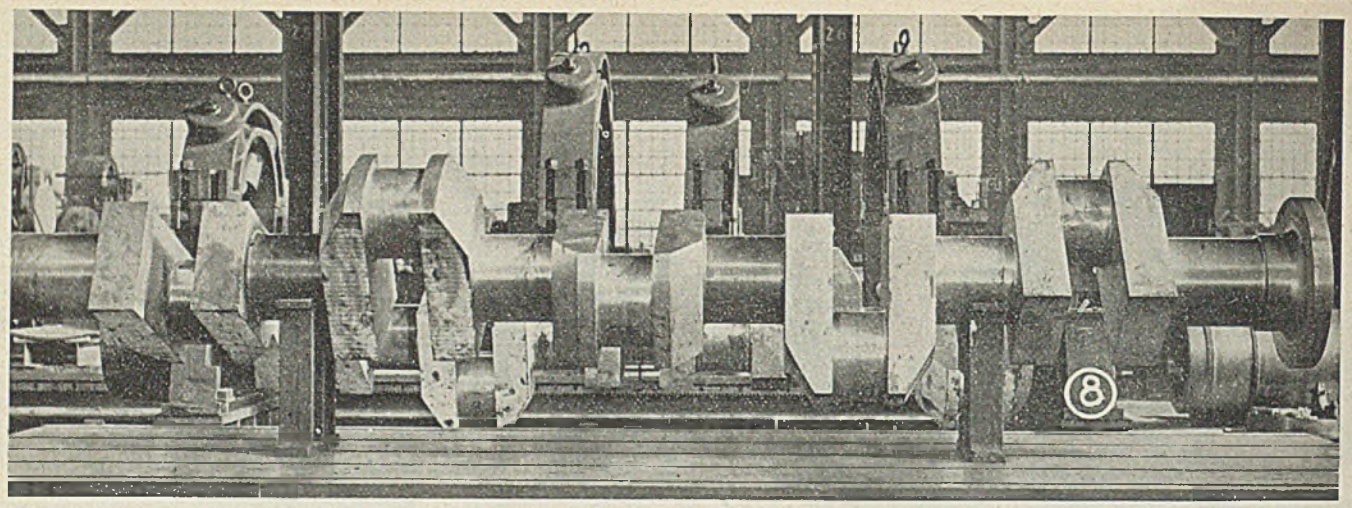


Fig. 8—Crankshaft as finally machined

shafts from one forged slab. The slab is 25 feet long, 10 feet wide and 25 to 28 inches thick in the main body and as much as 38 to 42 inches thick on the flange end. Because of its great mass, it is furnace preheated to 400 degrees Fahr. before cutting.

The crankshaft contours are laid out near the edge of the slab with three of the throws to the outside and the other two throws to the inside. The center section of the slab is scrap. A heavy duty straight-line cutting machine is employed for the work.

This job has been performed with both the oxyacetylene and the oxypropane flame, the latter being used prior to the time of acquiring proper equipment for acetylene. The speed is 2 to 2½ inches per minute on the 28-inch thick cut. In the case of the propane the pressures at the control valves are 90 pounds per square inch cutting oxygen, 40 pounds per square inch propane and 120 pounds per square inch preheat oxygen.

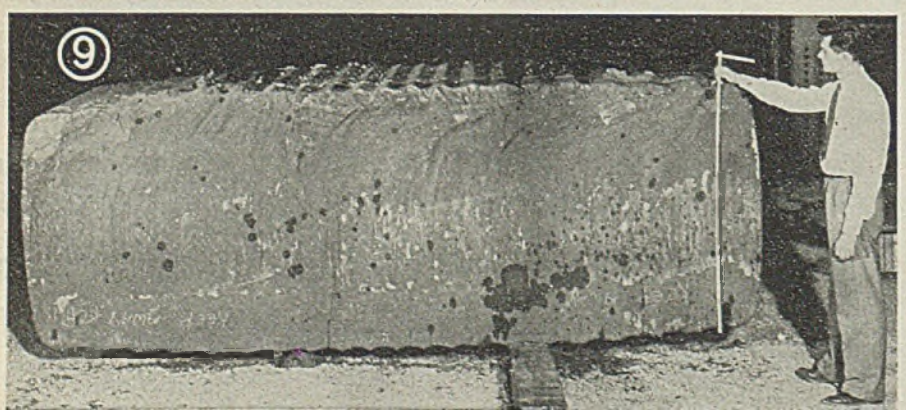
In Fig. 3 the operators are cutting through the 42-inch thick section, which necessitates racking up and in on the S-shaped forged lift of the flange. All transverse motions, requiring a distance of 18 inches in and out, were racked by hand, an operation requiring expert control to maintain an even speed of about 2 inches per minute. The close-up in Fig. 2 shows the machine setup for bevel cutting the heavy 42-inch thick flanged end so as to reduce the machining time for turning. Fig. 6 shows a close-up view of a cut through a 41-inch section.

The crankshaft blank as seen in Fig. 7 has now been turned over on its edge with the three-throw side downward and a clear view of the flame-cut contour of the shape as well as the forged face is seen. From here it is taken to the furnace for annealing, after which it is set up on a spindle and the bearings between the throws are rough turned. It is again taken to the furnace and heated, and the throws are then twisted to their proper angle, followed by further heat treatment. It is finally returned to the machine shop for finish machining on the bearings as well as other faces. The completed job is illustrated in Fig. 8. Note the flange dimensions at the right end which had the original forged dimension of 42 inches thickness.

CROPPING AND CUTTING INGOTS: In Fig. 9 a 51-inch thick ingot cut is shown. The ingot is upside down, the bottom of the cut being on top. It demonstrates the ability of oxygen cutting stream to adjust itself by intervals from an excessive to a normal drag without auxiliary aid. This was not a premachining cut and no attempt was made to maintain tolerance. However, the cut was well within 2-inch machining tolerance should machining have been necessary in this instance.

Ingot cutting is necessarily a production operation and every effort has been made to perfect a procedure providing the greatest speed and insuring the best quality of cut obtainable. One of our main problems is the cropping of the ends of corrugated ingots ranging from 29 to 32 inches in diameter. These ingots are first stripped and are received at variable temperatures. Then they are put into an equalizing furnace and soaked to a uniform temperature of 1100 to 1500 degrees Fahr. The first setup consisted of a portable machine on an overslung track, but the high heat made working extremely difficult. As a result perfect cuts were not always secured. Further, only one end could be cropped at a time, and, with this inconvenient setup, the production amounted to only 8 ingots per 8 hour day.

Fig. 9—Cut through 51-inch section of ingot



An ingot cutting machine was accordingly designed, and it is seen in Fig. 5 cropping both ends simultaneously. This machine will follow the circumferential contour automatically within 10 per cent and the balance is adjustable manually and accurately during the operation. One end will accommodate diameters from 26 to 36 inches in 2-inch increments for the depth of the cut; the other end from 16 to 26 inches in diameter. Eight to ten minutes are required to completely drop the crop into the scrap boxes below.

This machine can handle four ingots per hour or 30 to 32 per 8-hour day. Only two operators are required. As a safety measure the operator's efforts must be co-ordinated for releasing the ingot after cropping. The operator at the right controls an air valve for releasing the dumping cylinder mechanism beneath the ingot. However, the operator at the left must release the safety before such action takes place.

A ground-operated electric crane on a monorail picks up the ingot as it is discharged from the nearby equalizing furnaces and carries it to the cropping machine position at the holding and dumping tray. The same equipment removes the ingot after cropping and dumping.

SUMMARY: Although there is still much to be learned concerning the technique and perfected procedure for heavy cutting, it will be evident from the examples illustrated in this paper that this important phase of machine gas cutting is now acceptable as a production operation on thicknesses up to 42 inches without the employment of a lance.

In brief summary we point out that the essentials for successful heavy cutting are adequate oxygen and fuel gas supply, torches with sufficiently large orifices to provide ample preheat and cutting oxygen flow; sufficiently heavy machines of wide gage to provide for carrying heavy torch equipment at slow and constant speed; carefully trained operators, who are methodical and exact in their workmanship; and finally, perfection in technique and procedure.

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AN ENGINEERING APPROACH TO THE SELECTION, EVALUATION AND SPECIFICATION OF

METALLIC MATERIALS

The meanings of conventional tests for metals are explained by the author in the fourth installment of his report for the War Metallurgy Committee—Such measures as hardness, tensile strength and ductility values rarely can be used directly in design—Earlier discussions appeared in STEEL for Nov. 22, Nov. 29 and Dec. 6, 1943

By H. W. GILLETT

CHAPTER IV

The Meanings of the Conventional Tests

Hardness Tests

Hardness testing is the simplest of all testing procedures. If a part must be "file-hard", trying to scratch it with a standard file serves as a go, no-go test. Hardness testing that gives a numerical value, is normally made by squeezing into the specimen, under a definite load, an indentor that is much harder than the specimen and then measuring the size of indentation one way or another.

Conversion charts for the approximate transference of a figure obtained by one indentation method to that which would be obtained by another, are given in handbooks (References 1 and 6), as are charts for approximate translation of hardness figures into terms of tensile strength.

In a way, hardness tests are of the "lbs./sq. in." type. A hardness test does tell considerable about "pounds", and a series of hardness indentations tells a lot about uniformity of the "square inches"; hardness tests will also tell much about uniformity of materials and of final parts from lot to lot. Thus, in testing armor plate, one plate in 100 may be subjected to a firing test, the other 99 may be checked for hardness.

Hardness has strong connotations about machinability, but a hardness value is not itself directly usable in design, because, like the tensile strength, discussed below, it involves deformation far beyond what can be allowed in service.

Determination of Yield Strength

The primary criterion of load-carrying ability is yield strength, the unit load that can be carried without appreciable permanent deformation, so that when the load is released the piece returns to it original, unloaded, dimensions and position.

Yield strength may be determined in tension, in compression or in torsion, depending on how the load is to be applied in service. Tension testing is the easiest, and is usually adequate because steels have about the same yield strength in compression as in tension. Cast iron is much stronger in compression than in tension, but, for any given type of alloy the compressive and torsional yield strengths are usually so directly proportional to the tensile yield strength as to be sufficiently indicated when it is known.

Yield strength is a directly usable, engineering design criterion of static load-carrying ability. It supplies the universal language for appraisal of load-carrying

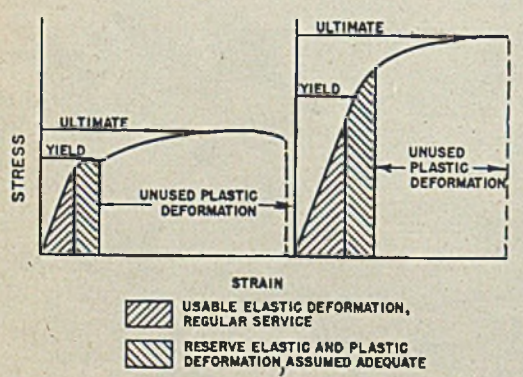


Fig. 14a (Left)—Diagrams for a low-strength and a high-strength steel. The unused plastic deformation is not needed in normal service, even that requiring slight plastic adjustment

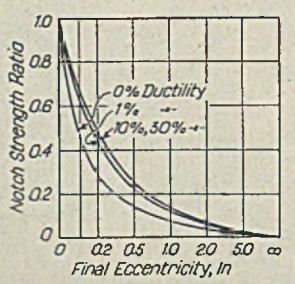
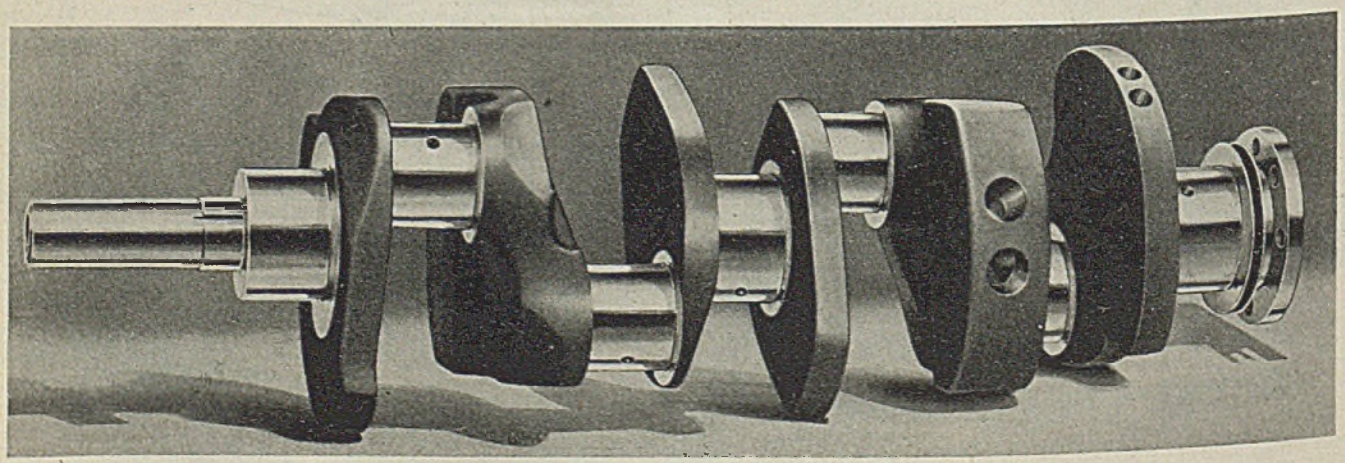


Fig. 14b (Left)—Theoretical relation between notch strength ratio and final eccentricity. (Sachs)

Fig. 15 (Below)—The Ford V-8 cast crankshaft. Specimens cut from the heavy sections show zero elongation in the tensile test, one foot-pound. Charpy notched-bar impact resistance, $^{40}_{a}$—yet millions are in satisfactory service



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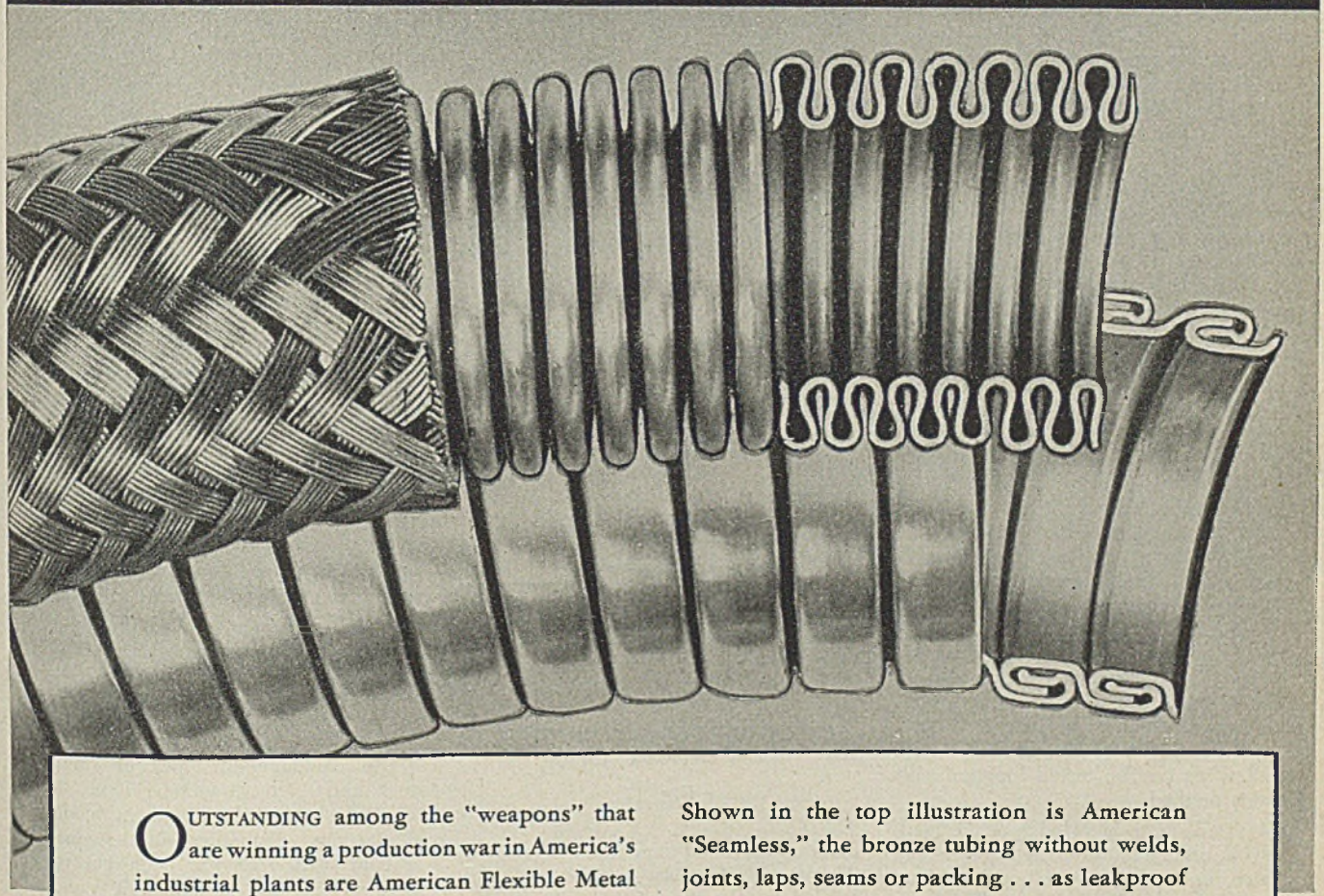

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ability of any material, hence, it is, next to hardness, the test most universally made. Much engineering design is ostensibly based on tensile strength rather than yield strength, because in a given class of the older materials of engineering, the ratio of yield to tensile strength is fairly constant, so either figure served equally well. This is no longer the case, since many of the newer materials, especially heat-treated and alloy steels, have much higher yield strengths than would be expected by applying the old ratio to their tensile strengths, so the design basis has shifted to that of yield strength.

The amount of permanent deformation which the specimen is allowed to undergo, before the yield strength is considered to have been reached in the test, is usually 0.02 per cent, to facilitate testing, since the factor of safety ordinarily insures that the design load, that is calculated from the yield strength, is enough lower so that such a material has no permanent deformation in service. Where closer values are needed, a smaller permanent set, e.g., 0.002 per cent is used in the test.

The drawbacks and limitations of the tensile test are that it is made on a separate specimen, and that the standard specimen with a 2-inch gage length and 0.505-inch diameter needs a piece about 4 inches long over-all and ¾-inch in diameter, so that pieces of small section can be conveniently tested only on specimens taken in the long direction. Subsize round specimens and flat specimens, even of very thin gages, can be tested. Small wires can be tested longitudinally by this method.

With adequate knowledge of the load-carrying ability required by the intended service, and adequate testing to insure that the material used has that load-carrying ability, there would be no need for a generous "factor of safety". The required load-carrying ability is, however, calculated, for tensile stresses, on the assumption of axial loading, uniform loading over the whole cross section. Such loading is hard to secure in practice, the load at some point on the exterior of the piece is higher, by an uncertain amount, than the calculation. The factor of safety is often really intended to take care of this more than of the other unknown factors.

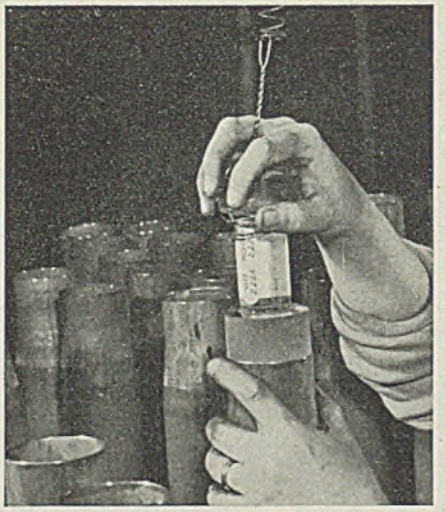


Fig. 16—A glass gage being used to check inside diameter of cartridge cases. Neither ductility nor impact resistance is required in this service [42b]. Official OWI photo

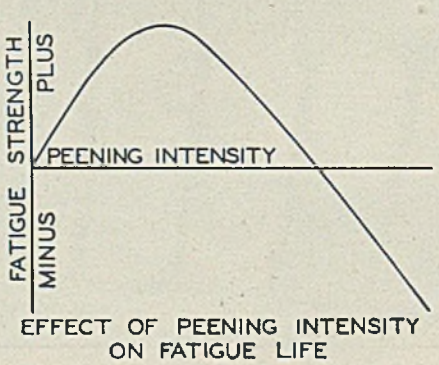


Fig. 17

The yield strength test gives pounds per square inch, but it is important that the "square inch" represents what it is supposed to. Tensile tests of heat-treated steel are generally made on specimens roughed out almost to size, with only a final grinding allowance, i.e., they are heat-treated in about 0.505-inch diameter specimens. In such sections many steels are fully hardenable that are not hardenable in larger section. The yield strength values obtained on the small section are only true for the large section when the large section itself hardens clear through.

Besides this, heavy sections of any sort, heat-treated or not, are likely to be softer at the core than at the outside. Hence, yield strength figures need scrutiny to be sure that they truly represent the whole, or that part of the cross section in which we are interested.

Determination of Modulus of Elasticity

In the course of the determination of yield strength, it is possible to determine the modulus of elasticity, i.e., the reciprocal of the elastic deformation per unit stress. This requires care in testing, a long specimen, and measuring equipment of high sensitivity, for accurate results.

There is little need for routine determinations of modulus, it is a property that we have to take as we find it, for we cannot control it, it is fixed by the nature of the material. All ordinary steels, nearly up to their yield strength, have closely the same modulus of elasticity, the same springiness. It is the yield strength that determines the range within which a steel spring can be loaded, for, whether it has a high or a low yield strength, the modulus of steel comes in the range 27 to 31 million p.s.i. Composition and heat-treatment are not factors that influence modulus to any noteworthy degree.

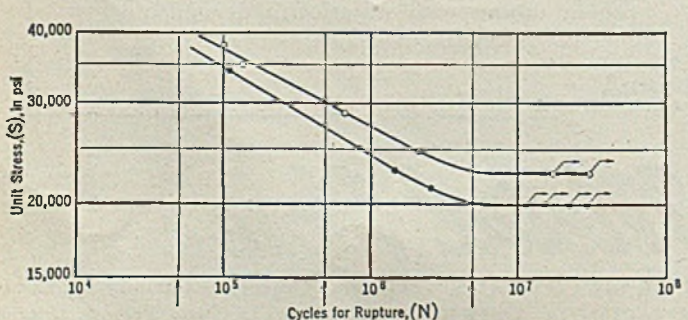
The nonmagnetic types of stainless steel and high-manganese steel show relatively minor deviations in modulus of elasticity, depending on the amount of cold work that has been put upon them. Thus the modulus of stainless steel may range from 25.5 to 29 million p.s.i.

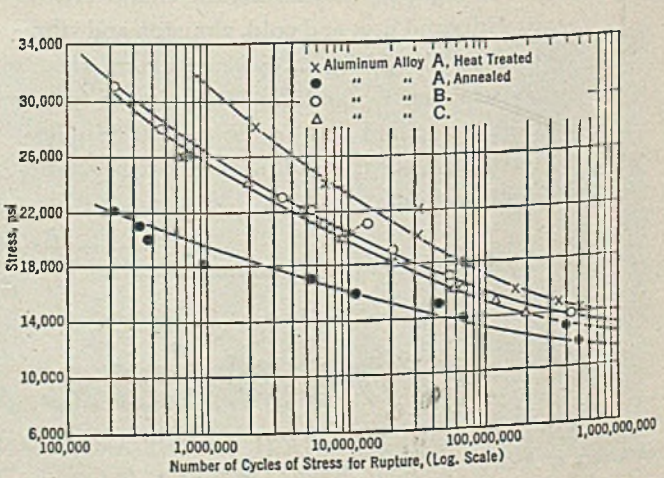
Strong cast irons have a modulus approaching that of steel, weak ones may have one of only 12 million. Many nonferrous alloys have still lower moduli and when stiffness is required by design, the modulus has to be considered when shifting from one type of alloy to another.

However, there need be no uncertainty about stiffness design, for the

Fig. 18 (Below)—Stress vs. number of cycles for rupture on two railway axle steels—arrows denote unbroken specimens. Moore, Lyon, and Alleman [41]

Fig. 19 (Right)—Stress vs. number of cycles for rupture on aluminum alloys. All specimens were broken. The S-N curves do not show an endurance limit for aluminum alloys. Johnson and Oberg [45]





TANK DESTROYER PHOTO BY U. S. ARMY SIGNAL CORPS.

OSTUCO Contributes To Its Fire, Motive and Tractive Power

Developments in fire, tractive and motive power which are found in the tank destroyer have already proved their worth in front line action. What will these developments offer a world at peace? Manufacturers will reveal the answer as their blueprint plans take more definite shape.

Where is OSTUCO's place in this picture? Today OSTUCO seamless steel tubing meets strict demands of artillery, engines and caterpillar tread manufacturers, thus contributing to the tank destroyer's fire, motive and tractive power. When manufacturers' wartime design-engineering ingenuity and production experience are again concentrated on "plowshares," OSTUCO will be prepared to meet hardness, straightness, finish, tolerance and other specification requirements.

If you are working toward a favorable sales position for your products in peacetime you'll find OSTUCO's specialized experience a valuable production asset.

VICTORY REMINDERS: Buy more War Bonds . . . Write to the Men in Service. Get in the scrap . . . Be on the job every day.

THE OHIO SEAMLESS TUBE COMPANY

MANUFACTURERS OF SEAMLESS AND ELECTRIC-WELD STEEL TUBING

SHELBY OSTUCO OHIO

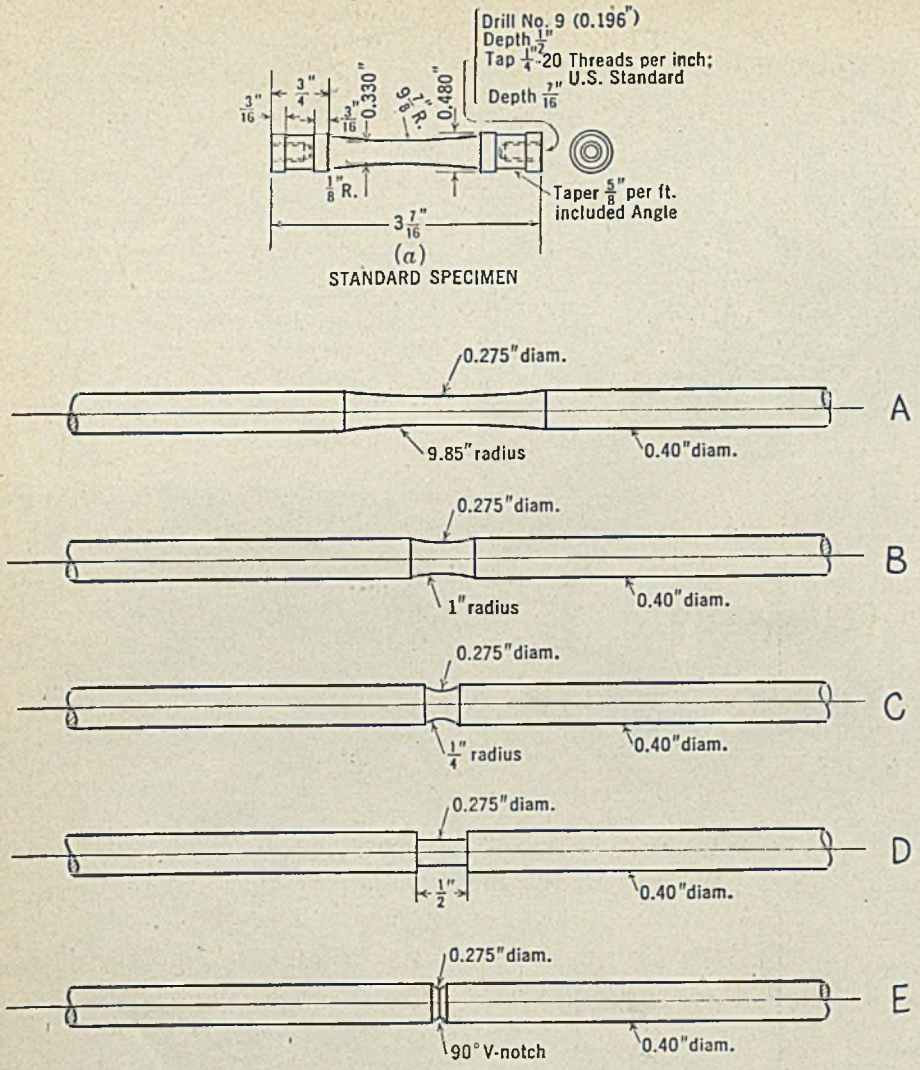


Fig. 20—Fillets and notches used by Moore and Kommers [47]. Shown are fatigue specimens for rotating beam machines. The smoothly radiused specimens a and A are the most free from stress concentration and give highest results. Type a is a short specimen for the R. R. Moore machine. Type B gives nearly the same results as a or A. Type D with the square notch gives data representative of very bad conditions of stress concentration and has two locations of maximum stress instead of one only, as in E

modulus is capable of precise determination, the figures have direct meaning.

Determination of Tensile Strength

If the pull on the specimen used for measuring yield strength is kept up, the specimen starts to yield, to deform permanently, and finally breaks. The maximum load withstood up to fracture, divided by the original area, before deformation, gives the tensile strength.

Cases where the engineer uses tensile strength directly are almost as rare as hen's teeth. Complete rupture in engineering applications only occurs in protective devices, such as shear pins, fuses, bursting disks and the like, or in such things as high explosive shells. Everywhere else, the engineer designs for life, not for failure. In cast iron and a few nonferrous alloys and in fully hardened, untempered steel, there is no true yield, the tensile strength is very little above the yield strength. Engineering steels

Fig. 21 [47a]—Relation between decrease in endurance limit and tensile strength for specimens having the following surfaces: a, polished, b, ground, c, roughened, d, circumferential V-notch, e, rolling skin (decarburized), f, corroded in tap water, and g, corroded in salt water. In these tests a decarburized skin or a corroded surface is indicated to be even worse than a mechanical notch

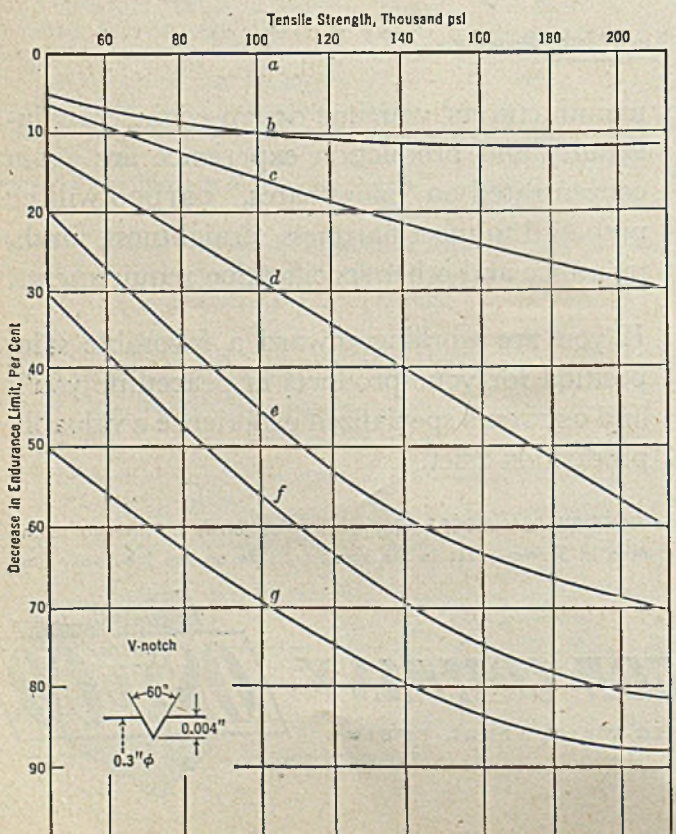
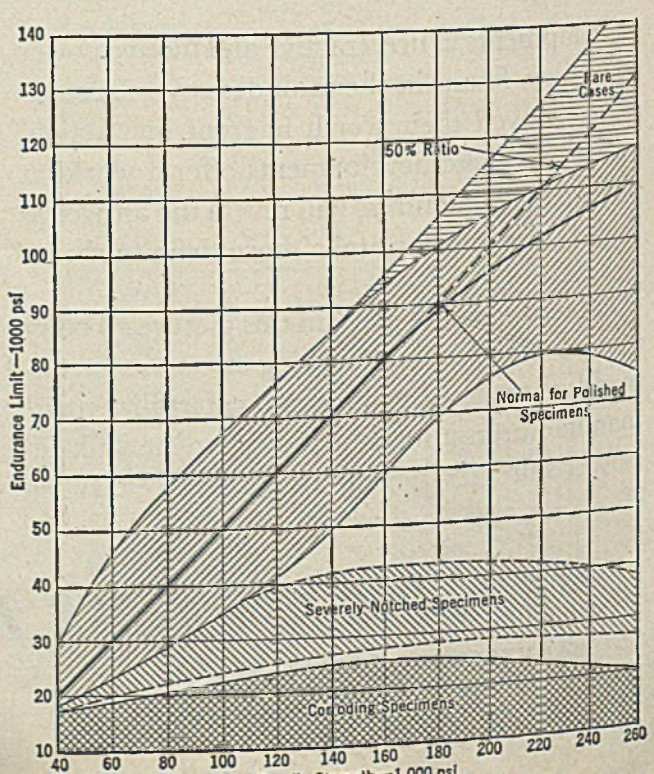
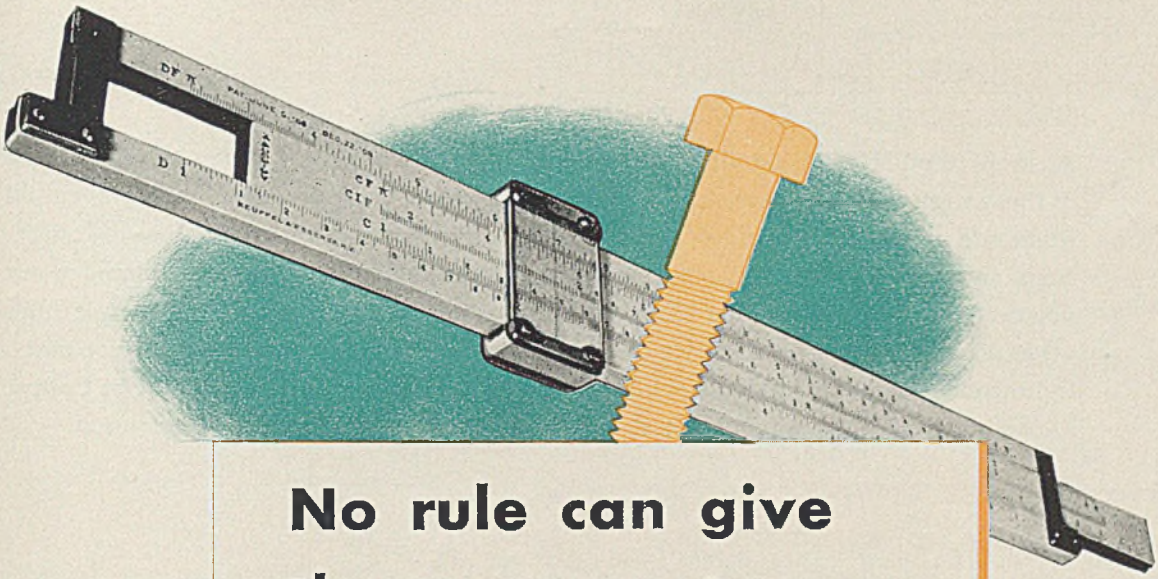


Fig. 22—Diagram indicating the general behavior in fatigue of steel of polished, notched, or corroding specimens, in relation to the tensile strength. This applies to ordinary corrodible steels. (From Reference 5. Note the scatter band.)





No rule can give the answers to ALL metal problems

A HANDY device, the slide rule. Knowing the physical properties of a metal you can find the strength of a bolt, for instance, just like that. But there are *other* things about a bolt material you also need to know: Can it upset cold—or does it hot work easily? Can it be roll threaded? Does it machine readily? Is it rustproof? Will it resist vibration? Is it corrosion resistant—or will outdoor exposure create a constant threat of failure, possibly involving costly equipment?

EVERDUR

An Engineered Metal—for Engineers

A slide rule cannot give you the answers, but there is a metal in the Copper-Silicon Alloy group (Everdur*) that will. In the electrical field alone, millions of Everdur bolts and other items of pole line hardware have been giving dependable service for years in highly unfavorable locations. And for good reason! . . . Everdur was *developed* for structural and engineering uses requiring a workable and weldable metal with the tensile strength of mild steel and the corrosion resistance of copper.

SEMI-FINISHED METAL PRODUCTS

Save your time—your equipment

Other products of The American Brass Company have provided the answer to production of complicated parts of unusual design. Special Extruded or Drawn Shapes in pinion, cam, and many other irregular sections—in copper and nearly all of its alloys, in long mill lengths—suitable for screw machine use or ready for cutting up into assembly parts with little or no machining • Consider also Anaconda Hot Pressed Parts—gas, air and water tight with twice the strength of sand castings—uniform, accurate in dimension, and a wide range of copper alloys from which to choose • Or Anaconda Pressure Die Castings with their adaptability to intricate coring . . . with all the advantages of other types of die castings—*plus* higher strength, greater hardness and toughness, higher resistance to impact and, being copper alloys, possessing freedom from rust and a high degree of corrosion resistance.

ANACONDA
from mine to consumer

Anaconda Copper & Copper Alloys

BRASS, BRONZE, NICKEL SILVER

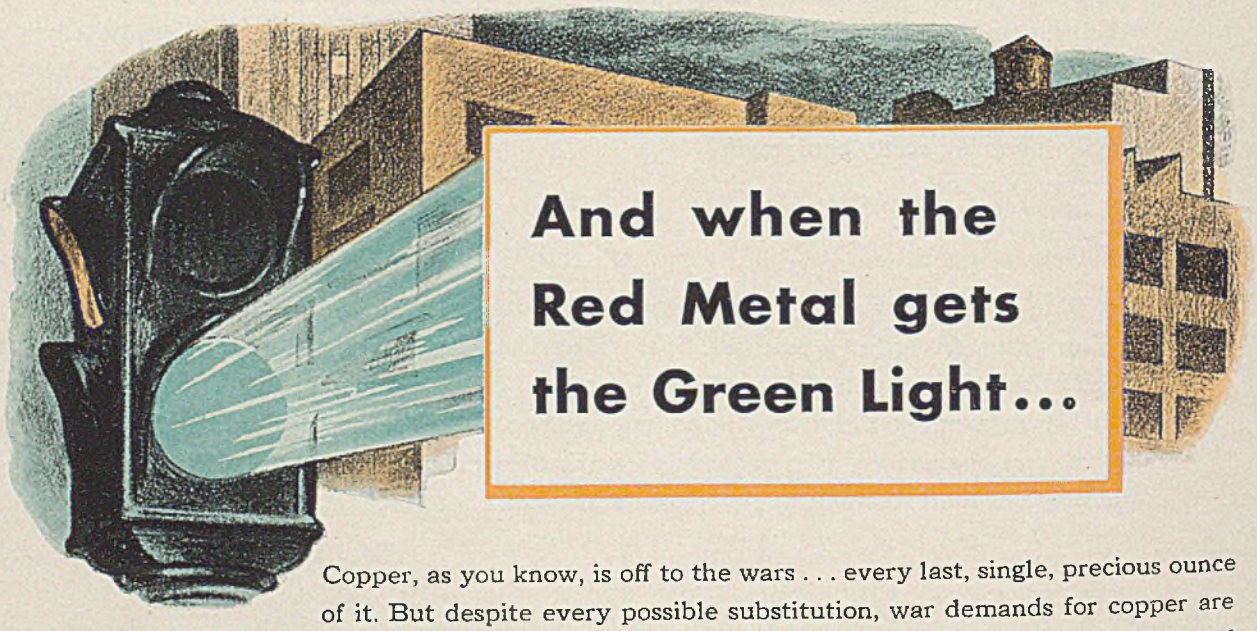
Old Standbys—for Old and New Products

Answers to other metal problems are often found in Brass, Bronze or Nickel Silver. One of these strong, ductile, workable copper alloys, in suitable composition, with temper and grain size adjusted to the need, is more than likely to give the utmost value for operations such as spinning, stamping, cupping, forming, deep drawing, machining—or for whatever metal-working operation your product calls. These time-tried metals offer other economies; in longer life for dies and cutting tools; in greater uniformity of parts; in brazed, soldered or welded assemblies. And, lest you forget, products made of Copper Alloys possess Copper's immunity to rust and provide good resistance to corrosion.

FINDING THE ANSWER . . .

Experience? Research? Special Alloys?

Naturally we don't know all the answers to metal problems, but with the accumulated experience of more than a hundred years we have had the opportunity to work out many of them. Frequently a solution has been found in an alloy with special characteristics, such as Avialite*, Tobin* Bronze, or Beryllium Copper. Our Research Department has produced and tested many special copper-base alloys, most of which are now in common use for special types of service. We will be glad to discuss with you war production metal problems which you may consider especially difficult.



And when the Red Metal gets the Green Light...

Copper, as you know, is off to the wars . . . every last, single, precious ounce of it. But despite every possible substitution, war demands for copper are greater than its vastly increased production. The properties which have made this metal and its alloys so essential for our tools of war—high electrical and thermal conductivity, resistance to corrosion, strength, workability and durability—are the same properties which make these metals indispensable to industry.

So when, with peace, Copper gets the green light, it will resume its role as the "metal of progress"—contributing its many desirable properties to the development and construction of countless improvements in the art of living, in the fields of science, engineering and manufacture.

*Trademark Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

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General Offices: Waterbury 88, Connecticut • Subsidiary of Anaconda Copper Mining Company

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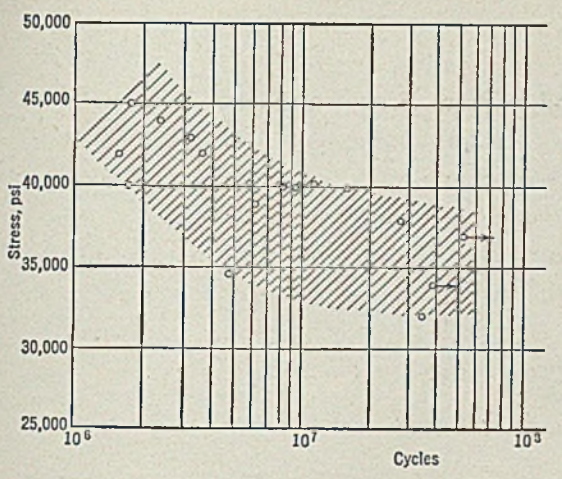
Anaconda Copper & Copper Alloys



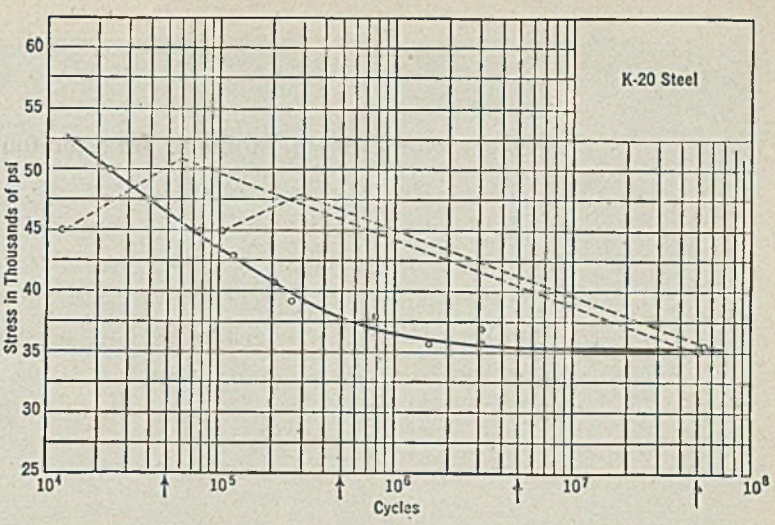


Fig. 23a (Left Above)—Wide scatter in specimens of one lot of Monel metal. Russell and Welcker[48]

Fig. 23b (Above)—Very small scatter among specimens of an unusually homogeneous steel

and nearly all engineering nonferrous metals have a considerable gap between yield and tensile strengths, a range of plastic action. This plastic action is utilized in cold-forming, it is not utilized in normal service of a completely finished part, save as possible insurance against shattering failure when an accident occurs. Ability to be cold-formed during installation, as in the bending of conduit tube is often required, and even some load-carrying members are given final dimensions by cold-forming, but after this forming has been done, actual service of the member seldom requires large ductility.

An airplane propeller blade, bent in landing, that can be hammered back so as to serve temporarily and after a fashion, has a useful attribute, and a very real advantage, as is discussed by Fisher,[33] but one only called upon in non-normal service. Perhaps even the straightening of an automobile fender might be classed as in the normal course of events. In these two cases, design may contemplate accident, but this is not true in the vast majority of cases. Straightening of a part at some stage of fabrication may be required, but in close-clearance parts and in load-carrying parts, plastic deformation in *finished* parts has to be avoided by design that restricts loading to that below the yield strength.

Tensile strength, and the range of plastic action between yield and fracture are therefore figures in which the engineer has some interest, but seldom can he use them directly in design.

Ductility Determinations

The ductility values, elongation and reduction of area, determined in the course of carrying the yield strength test clear to fracture, are not in lbs./sq. in., they are in per cent of the original length or area. The engineer does not and cannot use the figures in design. The fabricator does not and cannot use them directly to appraise ability for cold-forming. Both use them only in indirect fashion, for what they connote rather than what they state.

They do not directly measure toughness. The stress-strain diagram plotted from a tensile test gives two areas, one that of energy absorbed during elastic deformation, depending only on the modulus and the yield strength, and second, that of energy absorbed during plastic deformation.

This area is a quantitative measure, the elongation and reduction of area figures give only an inkling of the area. Even the area under the stress-strain diagram tells nothing about the "notch sensitivity" of the material, it defines "toughness" only in a qualitative sense. The ductility figures do give a rough idea of the reserve of plasticity available for insurance against shattering fracture in an accident.

Many specifications demand high values for elongation and reduction of area, though normal service could not endure one per cent of plastic deformation, and even when normal service demands a slight local ability for plastic adjustment, to distribute load in an imperfectly matched structure, as in a riveted bridge or in non-axial loading under tensile stress, this local adjustment will probably not exceed one per cent.[34]

We do demand ability to give a trifle in order to redistribute stresses, the fit of the threads of a bolt and nut is improved by screwing them together under load so that there is a trace of deformation. Under conditions of repeated stress we also want the ability to give just a trace locally, at the base of a notch, to redistribute stress. Ability to do this, so called "crackless plasticity" will be discussed under fatigue. The "ductility" required for the very local action involved in this redistribution of stresses calls for very little motion, no one knows just how much, for the needed deformation is on a scale too small to measure, but some experts again give rough figures ranging from one[35] to "a few" per cent elongation as adequate. One per cent is far smaller than the elongation shown in the tension test by any of the usual metallic materials of construction, outside of cast iron.

Sachs, Lubahn and Ebert[36] present data on the small degree of deformation required under eccentric tensile loading, to permit a notched tensile bar of steel to give, without cracking and thus to eliminate the eccentricity of loading before failure ensues. They say that "evaluation of a steel based on the very high values of contraction of area in regular tensile tests is entirely misleading; the 'notch ductility' represents the practically useful ductility". This "notch ductility" as they define it is not based on elongation, but on per cent contraction of area *at the root of the notch*. A strain of less than 2 per cent, thus measured, they consider sufficient almost to completely eliminate the effect of stress concentration on the fracture stress. However notch-base-contraction of less than 2 per cent can accompany a 50 per cent contraction on an unnotched tensile bar.

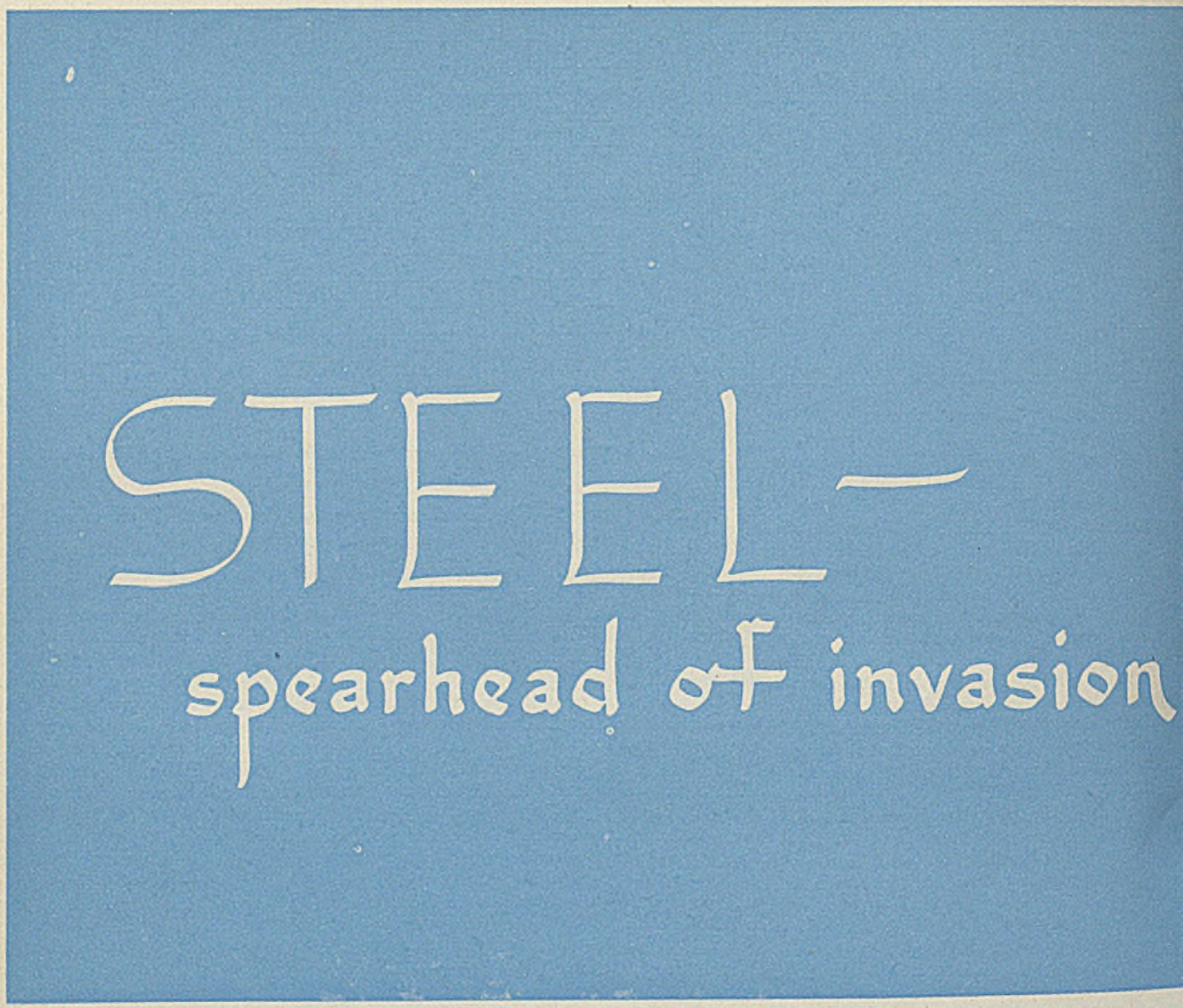
Behavior on Eccentric Loading

They propose testing by controlled eccentric tensile loading of a notched bar. Without taking space to discuss the test details or the meanings of the co-ordinates, one of their figures is shown as Fig. 14b, to bring out the wide difference between a steel with no notch-base-contraction, i.e., one that behaves brittle, and one with 1 per cent notch-base-contraction which behaves with almost the same toughness as does one with 10 per cent. Moreover, it is not possible to distinguish, after deformation has taken place in this test, between steels that, pulled without eccentricity, show 10 per cent or 30 per cent notch-base-contraction.

Quite the same sort of behavior has been found with magnesium alloys at very low temperatures, a surprisingly small amount of plastic flow, around 1 per cent, suffices to allow a tough, rather than a brittle fracture, under static tensile stress.

Jackman[37] remarks that many aircraft structural designers believe that 3 to

(*Please turn to Page* 152)



A knight in armor has for centuries been the symbol of a man well armed for war. Yet, for all his heavy gear, medieval smiths had to forge for him and his horse only 150 pounds of metal.

★ ★ ★

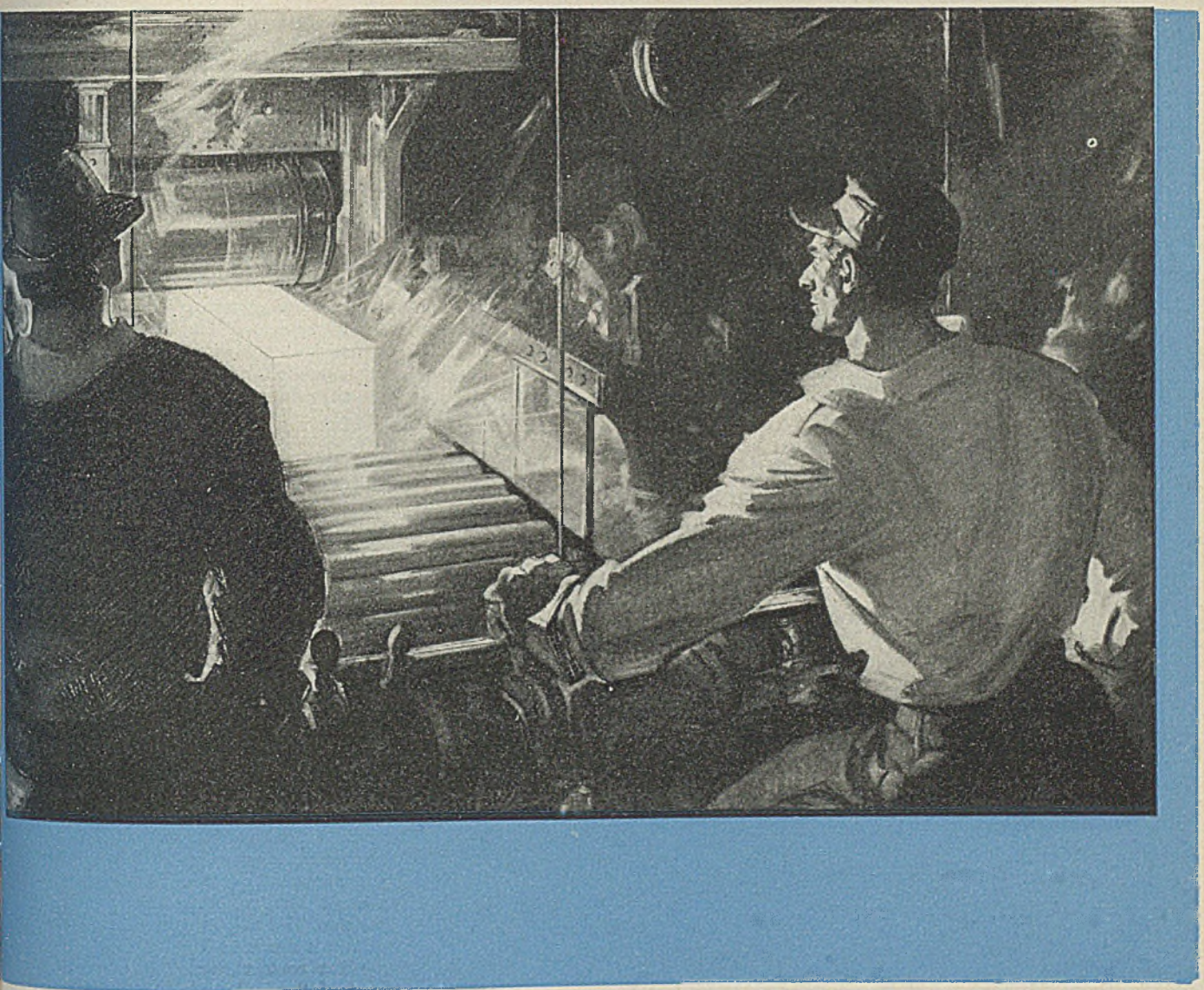
For every one of our modern knights now in this mechanized war . . . for each soldier, sailor, marine . . . the steel industry this year produced 18,000 pounds of steel. These 18,000 pounds of steel for each fighting man go to war with him as steel in ships, tanks, planes; steel in guns, shells, bombs; steel in protective armor, medical supplies and for the safe preservation and transportation of food. To land a single fighting man on an invasion front and support him there takes enough steel in a year to make automobiles and household appliances for a number of families . . . steel that all of us gladly do without so that every son and brother may be fully armed . . . and protected.

★ ★ ★

Such is the contrast between the wars of knights and this war of the world and between the worker in metal in the middle ages and the man of steel in this modern era.

★ ★ ★

Yet war . . . the waging of war . . . the making of the weapons to arm . . . invade . . . carry the battle to centers of enemy resistance by land, sea, and air . . . is still a man-for-man job . . . with



FROM AN ORIGINAL DRAWING BY ORISON MACPHERSON

the individual initiative, enterprise, and zeal of each fighter . . . each worker . . . joined to his fellows and coordinated to the common purpose and goal. So it is that free men work and fight.

★ ★ ★

So it is that hundreds of thousands of men of steel by their skill . . . experience . . . will to do . . . and with the means that far-sighted planning and organization provide . . . wrest the raw materials from the earth and convert them into the fighting steels that are the spearhead of invasion . . . the tools with which to forge the victory.

★ ★ ★

So it is that steel will be the spearhead of peace . . . when this strongest and most serviceable of our metals will be the means of rehabilitating and restoring civilization to a world that yearns to hear the bells of freedom ring again.

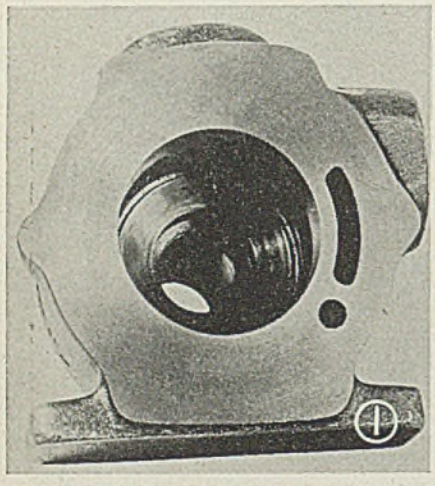
JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

J&L STEEL CONTROLLED QUALITY STEEL FOR WAR J&L STEEL

INGENIOUS CARBIDE TOOLING

. . . . attains high dimensional precision and surfaces equivalent to ground work



INGENIOUS tooling developed by Yale & Towne Mfg. Co., Stamford, Conn., not only holds dimensions of machined surfaces in aircraft parts to tolerances within a few ten-thousandths of an inch, but also helps obtain surface finishes having a smoothness equivalent to that obtained by grinding.

The part on which the process was first worked out was a body for a 3-inch inside diameter vacuum fuel pump in which a high dry vacuum had to be maintained, see Fig. 1. This necessitated extremely close tolerances since even a very small increase in running tolerance materially reduces the vacuum. Total running clearance actually must be held to 0.0010-inch maximum with the rotor running at 1750 revolutions per minute.

To produce the fine finish and close tolerances required, the entire sequence of boring and facing operations is carried out on a turret lathe employing mainly cemented carbide tools. The tooling layout is shown in Fig. 2. The first operation, rough boring the 3-inch diameter, is performed with a noncarbide tool. Next, the 1 5/16 and 1 7/16-inch diameters are bored with two carbide tools mounted on the same quill, to assure that these bores will be concentric within a maximum of a few "tenths".

Cuts 160 Feet Per Minute

A recess required in the 1 5/16-inch bore is next produced with a carbide tool, followed by reaming the same bore with a carbide reamer. The 3-inch diameter is then finish bored to within a few "tenths" as to size and concentricity with the 1 5/16-inch bore. In this operation it was found impossible to obtain the close tolerance by reaming due to the unequally cored parts.

The carbide tool now used cuts at around 200 revolutions per minute, equivalent to around 160 surface feet per minute. Feed is 0.012-inch with a stock removal of around 0.008-inch per side. The tool developed for this operation is shown in detail in Fig. 3. Note the flat contact surface on the ⅛-inch nose of the tool. Final operation with the turret tools is the "carbide reaming" of the 1 7/16-inch hole, concentrically with the other diameters.

Due to operating requirements, depth of the 3-inch bore must also be held to within a few ten-thousandths in relation to the face of the pump body, see Fig. 5. To achieve this, the face is first rough faced with a carbide tool mounted on the rear slide, while the tools for finish facing both faces simultaneously are mounted on the front slide.

The close relationship of the faces is obtained by mounting these two tools, see Fig. 4, in the front tool slide and

(Please turn to Page 146)

FIG. 2

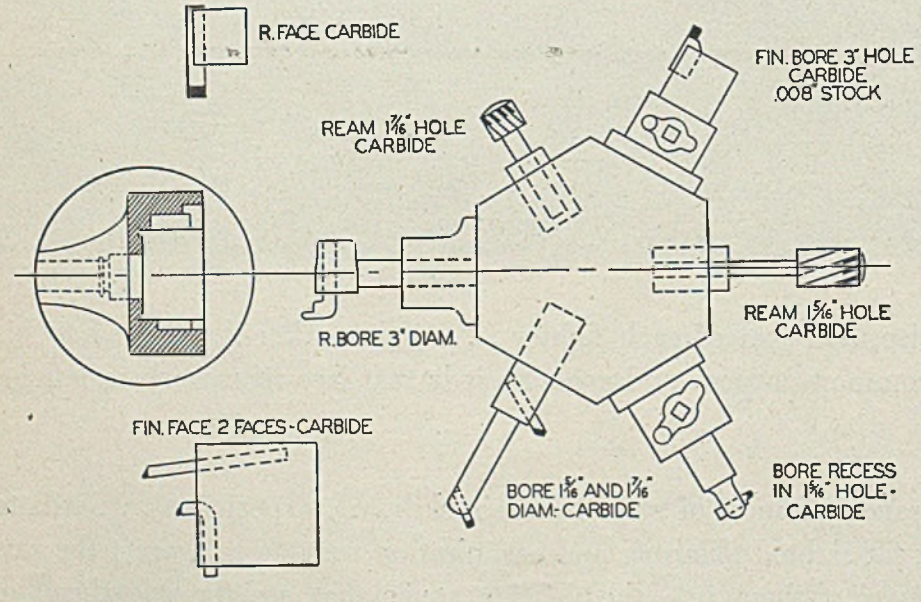


FIG. 3

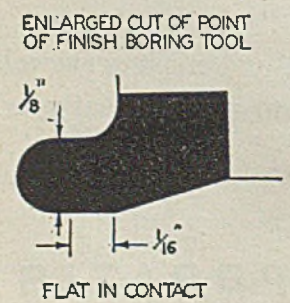
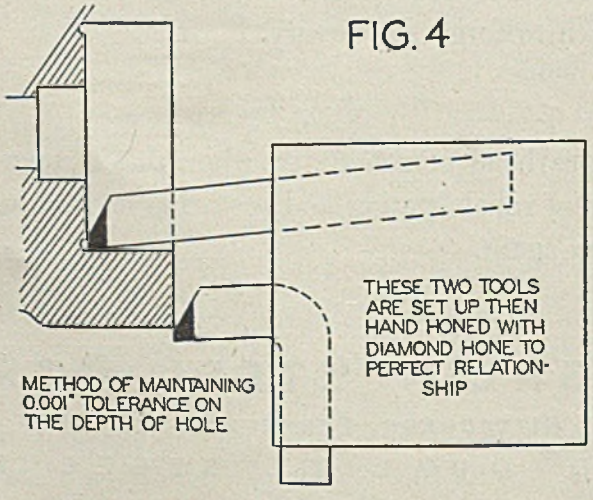
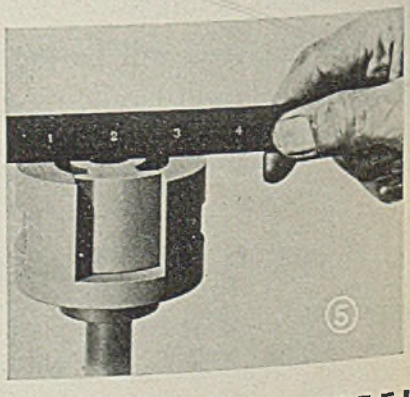


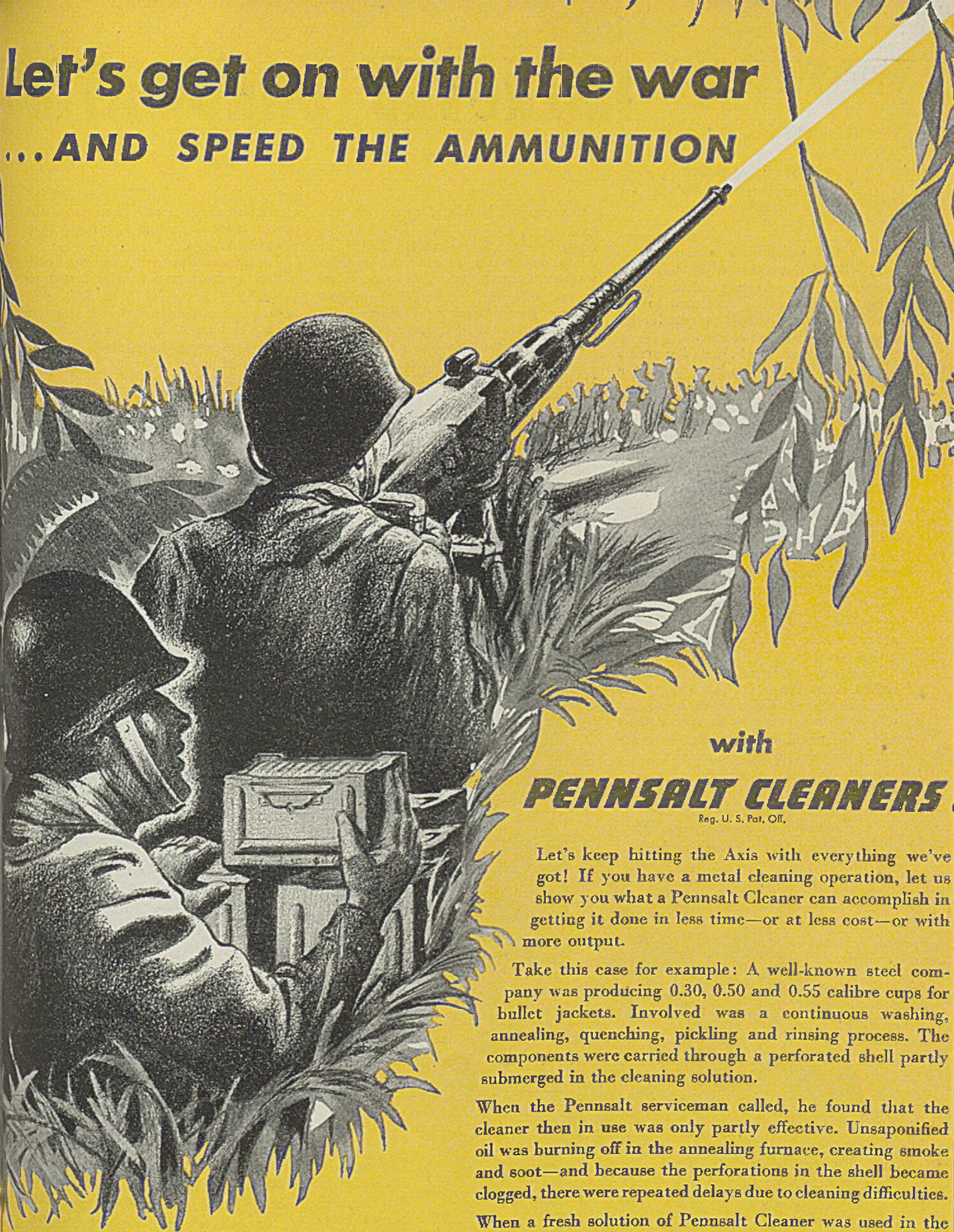
FIG. 4





Let's get on with the war

...AND SPEED THE AMMUNITION



with

PENNSALT CLEANERS

Reg. U. S. Pat. Off.

Let's keep hitting the Axis with everything we've got! If you have a metal cleaning operation, let us show you what a Pennsalt Cleaner can accomplish in getting it done in less time—or at less cost—or with more output.

Take this case for example: A well-known steel company was producing 0.30, 0.50 and 0.55 calibre cups for bullet jackets. Involved was a continuous washing, annealing, quenching, pickling and rinsing process. The components were carried through a perforated shell partly submerged in the cleaning solution.

When the Pennsalt serviceman called, he found that the cleaner then in use was only partly effective. Unsaponified oil was burning off in the annealing furnace, creating smoke and soot—and because the perforations in the shell became clogged, there were repeated delays due to cleaning difficulties.

When a fresh solution of Pennsalt Cleaner was used in the tank at one ounce per gallon concentration—*delays and cleaning difficulties stopped at once!*

Let our experienced technicians help you with *your* metal cleaning problems. Actually billions of cartridge cases, shell cases and bullet jackets—as well as great quantities of other ordnance and armament—have been most successfully cleaned with Pennsalt Cleaners.

Consultation involves no obligation. Write fully—Dept. S.

PENNSYLVANIA SALT
MANUFACTURING COMPANY
Chemicals

1000 WIDENER BUILDING, PHILADELPHIA 7, PA.

New York · Chicago

IMPROVED CHROMATING

By S. E. MAXON
The New Jersey Zinc Co.
New York

MUCH of the sucess which has been encountered in converting cartridge cases from brass to steel is attributed to the development of a simple process for inhibiting the corrosion of zinc.

Protection of steel cartridge cases against the elements has been one of the most difficult problems involved in converting from brass to steel. With most practices it has been found that the protective coatings cause the cartridge cases to stick in the guns upon continued rapid firing.

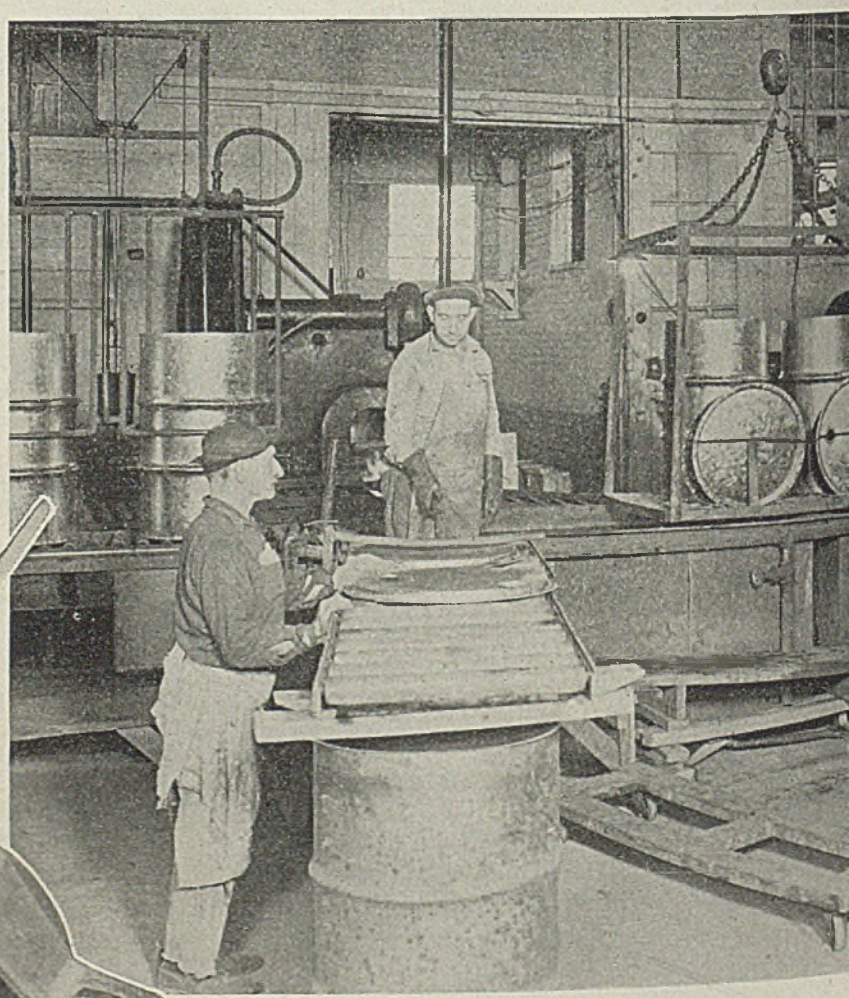
The objection has been overcome by plating the steel cases with zinc, and subsequently protecting the zinc coating by dipping in the inhibitor. The same treatment also is being used for many other ordnance items, including fuze parts and ammunition containers. Other items treated include carburetors, lock parts, gasoline drums, gasoline meters and numerous instrument and communication parts.

Zinc long has been known for its excellent resistance to corrosion in outside atmospheres, but under special conditions where stagnant water lies in contact with the metal a comparatively bulky film composed largely of zinc oxide will develop in a short time. This film appears on galvanized sheets stored in damp places and on zinc die castings where moisture becomes entrapped in recesses. It is objectionable for the reasons it may clog orifices or interfere with the operation of delicate mechanisms. Also, there is the appearance factor.

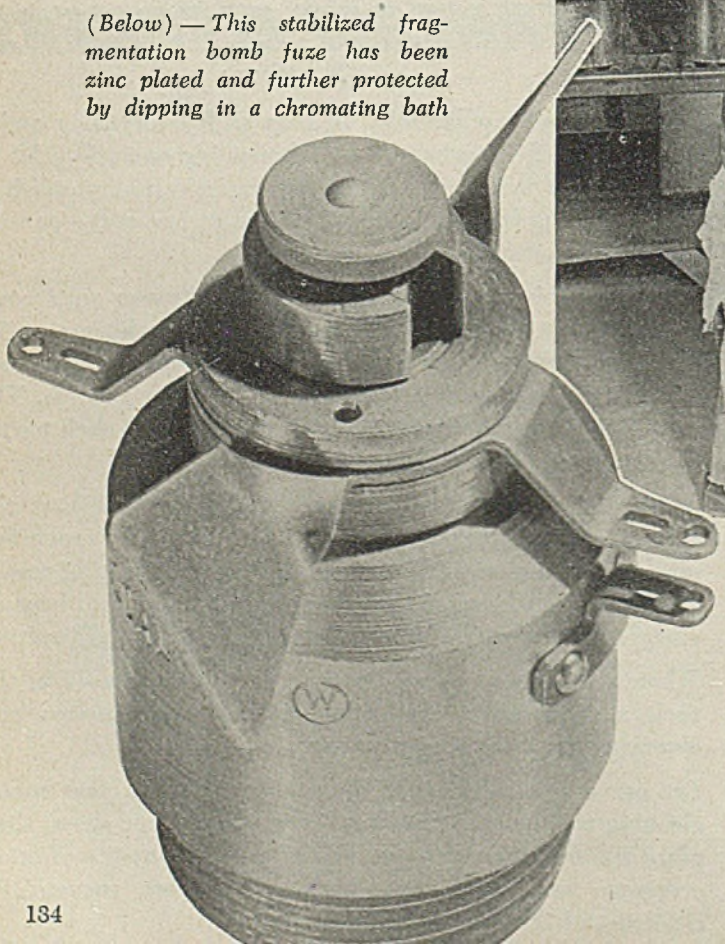
"Cronak", the chromating process developed and patented by The New Jersey Zinc Co., New York, recently has come into more extensive use with the wider application of zinc alloy die castings and electrodeposited zinc coatings. The process is equally suitable for hot-dip galvanized coatings.

The process involves immersing completely cleaned zinc or zinc-coated articles for a period of 5 to 20 seconds in a solution containing 200 grams of sodium dichromate and 6 to 9 cubic centimeters of concentrated sulphuric acid per liter of water at room temperature, followed by rinsing and drying.

Careful studies involving analytical, X-ray and electron diffraction methods lead to the conclusion that the film is a



(Above)—Hot galvanized steel aviation drums being chromated in Petroleum Iron Works Co. plant, Sharon, Pa. Drum shells, heads and bottoms are treated before assembly. At extreme right, drums have just been removed from chromating tank. Drums in center have been rinsed once, are ready for second rinse. Shells at left are being dried by compressed air from pipe rings, while the head and bottom in the foreground are being dried by air gun



(Below) — This stabilized fragmentation bomb fuze has been zinc plated and further protected by dipping in a chromating bath

PROCESS

. . . . inhibits development of oxide coatings on hot-dip and electrogalvanized steel and zinc die castings subjected to entrapped moisture—important in extending use of zinc-plated steel

basic chromium chromate of the general formula $Cr_2O_3.CrO_3.XH_2O$ or $Cr(OH)_3Cr(OH)CrO_4$. A typical film weighs only about 0.1-gram per square foot of surface and is around 0.00002-inch thick. Color generally is golden brown.

Numerous tests have been conducted to determine length of protection afforded under varying conditions. In one test, an untreated sample showed white products of corrosion in one day in atmosphere saturated with moisture at 203 degrees Fahr. compared with 12 days for the treated sample. Untreated samples in moisture-saturated atmospheres at 104 degrees Fahr. in both upright and horizontal positions also showed white corrosion products in 1 day, while treated samples in similar positions held up 182 and 365 days, respectively. In a salt spray test (20 per cent NaCl) at room temperature, untreated samples showed first white salts at the end of 8 hours, against 91 to 104 hours for treated pieces.

Exposure of zinc-coated samples to normal outdoor atmosphere proved conclusively that the chromate film does not extend the time to rusting by more than a few per cent. In other words, for normal outdoor use there is no substitute for an adequate coating of zinc.

The method by which the Cronak film is applied may be readily visualized by referring to the flow sheet but, in view of current interest, each step will be described in detail.

All parts to be treated must be completely free of grease, dirt, oxide or other contaminating elements. The film will form over a partially cleaned surface but adherence will be poor. Parts which have been in contact with machine oil require most careful cleaning and this may be accomplished through the use of a volatile solvent type of cleaner such as benzine, gasoline or trichlorethylene, which is followed by an alkaline detergent cleaner.

It must be emphasized that a solvent cleaner alone cannot accomplish complete removal of grease since the last traces of the solvent invariably leave a thin film of dissolved grease. This film may be removed by vapor rinsing, and if carefully done, subsequent electrolytic cleaning in an alkaline bath may be unnecessary.

However, cleaning by simple immersion usually is unsatisfactory and final processing in a hot alkaline solution in which the work becomes the cathode generally is advisable. A solution containing 6 ounces of trisodium phosphate per gallon of water or any suitable plater's cleaner may be used. Sufficient current is passed through at 6 volts to provide copious gassing. The cleaner tank should be welded from low carbon steel which serves as the anode.

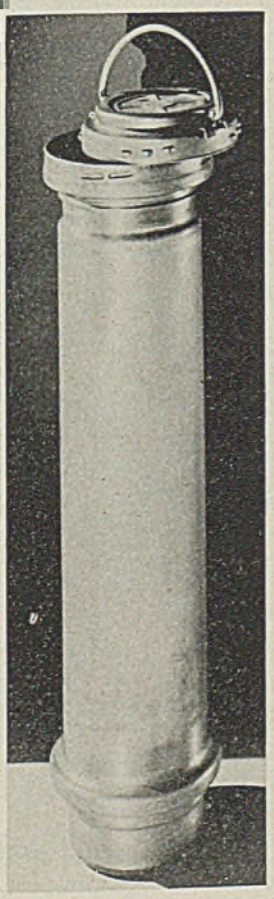
Change Rinse Water Often

The next step is rinsing in cold running water to avoid carrying alkaline cleaning salts into the acid solution. The rinse also serves to bring the material down to approximately room temperature and to apply a thin coating of water, which are requisites prior to dipping in the dichromate solution. Best practice seems to dictate a complete change of rinse water every ten minutes.

The quantity of sulphuric acid in the chromating bath is fairly critical and should be measured accurately. For each gallon of water, the additions should be 23 to 34 cubic centimeters of acid (94 per cent, specific gravity 1.84) and 26.6 ounces of sodium dichromate or, as previously expressed, 6 to 9 cubic centimeters of acid and 200 grams of sodium dichromate to 1000 cubic centimeters of water.

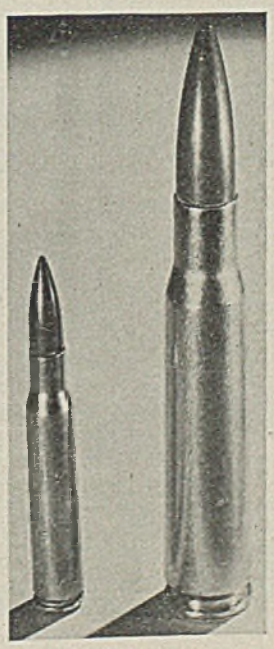
Where very thin zinc coatings are being treated, the lower range of acid concentration is preferable. During the treatment, the solution will remove about 0.00002-inch of zinc but this amount, of course, is too small to be of consequence except in the case of extremely thin zinc coatings.

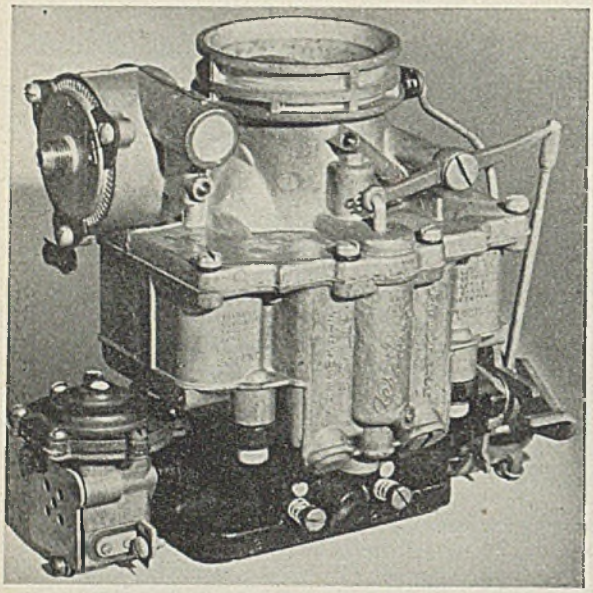
As the sulphuric acid content of the bath diminishes, the color of the film produced will become increasingly lighter. The solution may be brought up to proper strength so that the film again attains proper appearance through the addition of small quantities of acid, usually 1 to 3 cubic centimeters per liter. The sodium dichromate requires only infrequent replenishment. Normally, it is impossible to restore a solution to proper condition after two or three acid additions and it is advisable



(Right)—U. S. Navy ammunition container shown here is drawn from steel, zinc plated and chromated. The container is 6¾ inches in diameter and 31½ inches long

(Below) — These zinc-plated, chromated steel cartridge cases have a smooth, golden brown finish and are reported working well in service





If moisture becomes entrapped in this zinc die-cast carburetor no corrosion will result since it has been chromated. A treatment time of 10 seconds is sufficient for most die castings

to prepare a fresh chromating bath.

Temperature of the solution should be held close to 70 degrees Fahr. Temperatures higher than 80 degrees and lower than 60 degrees should be avoided. Higher temperatures accelerate the rate of reaction and the film produced tends to be chalky and poorly adherent. Lower temperatures retard the reaction.

Time of immersion has a definite effect on appearance, thickness and adherence of the film. Broadly speaking, the film becomes darker in color and thicker as immersion time is increased. Films produced by a 5-second immersion usually are so thin that they appear iridescent. As the film becomes thicker, this iridescence disappears and is replaced by a golden brown color which is characteristic of a coating of proper thickness.

Only unalloyed rolled zinc, die casting alloys and zinc coatings containing no copper acquire the golden brown color. Presence of copper in the alloys results in the production of a film of dark greenish tone but there is no change in the protective ability. For most applications, a treatment time of about 10 seconds has been found most suitable. Electrogalvanized products seem to require longer immersion times ranging from 10 to 30 seconds.

The tank may be glass, earthenware, stainless steel or ordinary low-carbon steel such as SAE-1010. Racking of the work in the tank is desirable but should take into consideration possible entrapment of the treating solution in recesses. Agitation of the work in the solution results in films that are less protective and produce a greater loss of zinc. Therefore, agitation should be limited.

All of the treating solutions must be removed before the work is dried and this cannot be accomplished in a single rinse tank. The recommended method is to employ a series of tanks or compartments in cascade arrangement. Water draining from the work after the last rinse must be free from yellow color. Rinse water temperature should be close to room temperature.

Drying of the work is one of the most important steps in the process, since the adherence of the coating depends upon the method used. The best system is rapid removal of visible water mechanically by blowing it from the surface with a blast of cool air. Material such as sheets, strip and wire may be passed through soft rubber squeegee rolls. Small parts may be whirled dry in a low velocity centrifuge.

Some success also has been encountered with drying in a tunnel or duct through which air is passed at the rate of 25 to 35 feet per second. Thinner films may be dried under tunnel or kiln conditions but the temperature should not exceed 150 degrees Fahr.

Coatings not completely dry are susceptible to removal by rubbing and reasonable care in handling should be used until the work has stood for several hours at room temperature or is dried by heating at temperatures not exceeding 150 degrees Fahr.

Increase Foreseen in Electrocoating of Strip

In 30 years, plant capacity for electrogalvanizing strip steel has increased to more than 420,000 amperes primarily because electrocoatings withstand forming, may be deposited to any desired thickness and are much more uniform, according to Ernest H. Lyons Jr., chemist, the Meaker Co., Chicago. He predicts the method will be applied even more extensively in the future.

As an indication of the difference between electrodeposited and hot dip coatings in behavior under forming operations, Mr. Lyons notes that on bending, hot dip coatings appear to depend largely on thickness of the brittle iron-zinc alloy next to the steel and that it is more a question of the ductility of the coating than of its adhesion to the steel. These alloy layers, essential to the success of the application, are absent in electrogalvanized coatings. Properly electrodeposited zinc is far more ductile than the steel base and cannot be separated or "peeled" from it.

Weight of electrogalvanized coating may be made any desired value, he states, whereas the hot dip process does not lend itself to applying light coatings. Often coatings as thin as 0.0001-inch are quite satisfactory and offer substantial savings. Electrogalvanized coatings on strip steel are perfectly uniform except at the edges, and this difference can only be ascertained by microscopic examination of polished edges. As to comparative corrosion resistance, Mr. Lyons says that, thickness for thickness, electrogalvanizing is at least not inferior to hot galvanizing.

Oil-Burning Furnace Code Effective Early in 1944

The commercial standard for manufacture of oil-burning floor furnaces equipped with vaporizing pot-type burners, identified as CS113-44, has been approved by the National Bureau of Standards and will be effective for new production from Feb. 17, 1944, according to an official announcement of the bureau. Purpose is to establish minimum specifications for manufacturers, distributors and users; to avoid delays and misunderstandings; and to provide a uniform basis for guaranteeing compliance through use of labels and certification.

The standard applies to equipment described above, with or without mechanical draft or forced circulation, and either manually or automatically controlled. It is broad in scope and contains 11 sections under these headings: General Requirements; Design and Construction; Performance; Laboratory Test Code; Publication of Furnace Ratings; Informative Labeling; Guarantees; General Installation Requirements; Sizing; Placement; and Venting. Detailed diagrams of construction features are included.

Section 14 on general requirements covers specifications for sheet steel gages from Nos. 20 to 28, with tolerance allowed for each gage.

Although the areas and conditions under which oil-burning floor furnaces may be manufactured or installed are limited by War Production Board orders L-79 and L-173, the bureau expects this standard to be followed for permitted installations, and that after limitation orders are lifted, it will be adhered to generally. Mimeographed copy, No. TS-3584, is now available.

—o—

A group of colored identification coatings for tracer wire applications has been announced by the Sterling Varnish Co., 172 Ohio River boulevard, Haysville, Pittsburgh. These S-184 identifiers are intended to expedite the winding of electrical equipment. The preparation can be applied by running the wire through the varnish or by dipping the entire coil of wire in it. It leaves a smooth finish and dries very fast.

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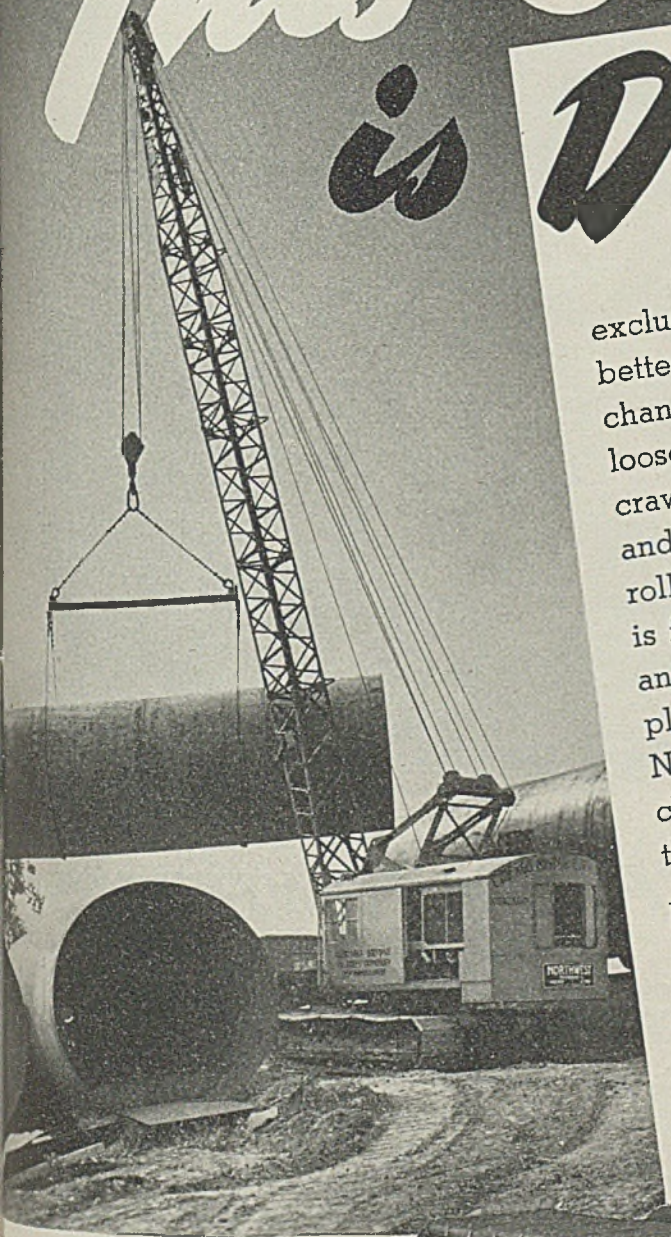

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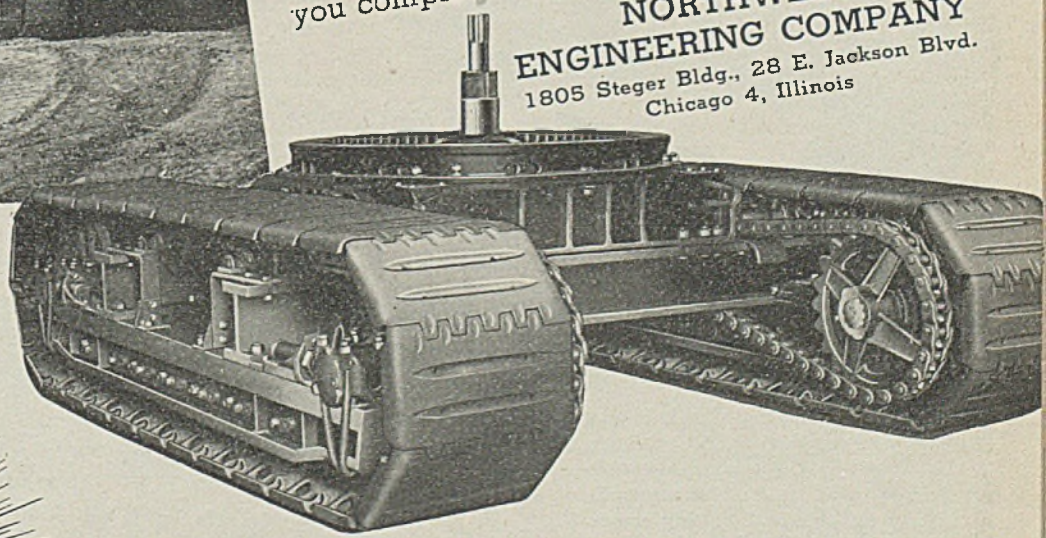

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CRANE VALVES

Evaluation of ELECTRIC ARC MELTING FURNACES

By W. HARVEY PAYNE
President
Hydro-Arc Furnace Corp.
LaGrange, Ill.

Furnace roof superstructure is picked up at four points hydraulically without imparting any stresses to roof refractories. Tilting is accomplished by a cylinder and piston rod operating in a shallow trench away from the furnace. Suggestion for handling electrodes for large furnaces involves preparation pits in close proximity to the furnace

(*Concluded from Last Week's Issue*)

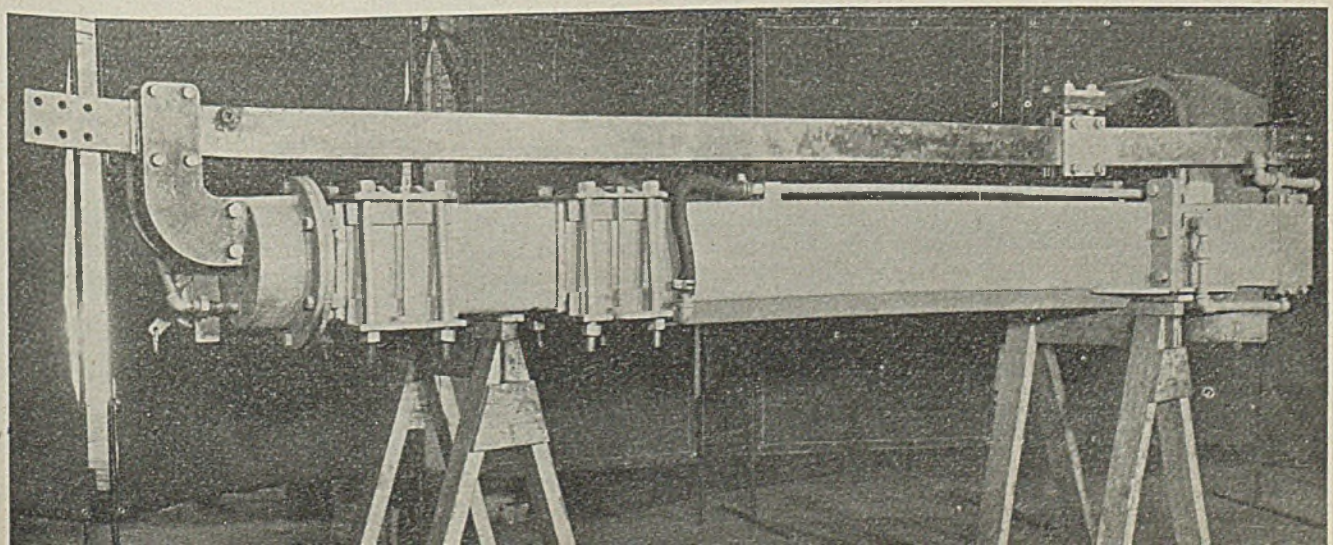
AMONG the troubles in some electric arc melting furnace designs is the horizontal side play between electrode clamps. This horizontal side play is not only related to good roller bearing adjustment, but is strongly controlled by the horizontal spread between these electrode arm guide rollers. For instance, with a small horizontal spread between sets of rollers guiding an electrode arm, there must be a necessary amount of roller clearance for lowest arm friction. This necessary clearance for easy arm operation will multiply into a certain amount of end play between the electrode clamps at the opposite end of the arm. These new electrode arm roller designs have substantially increased the spread of these guide roller bearings. This gives the lowest possible play between electrode clamps when the arm is set for easy operation. Good design at these important parts greatly assists the furnace operator.

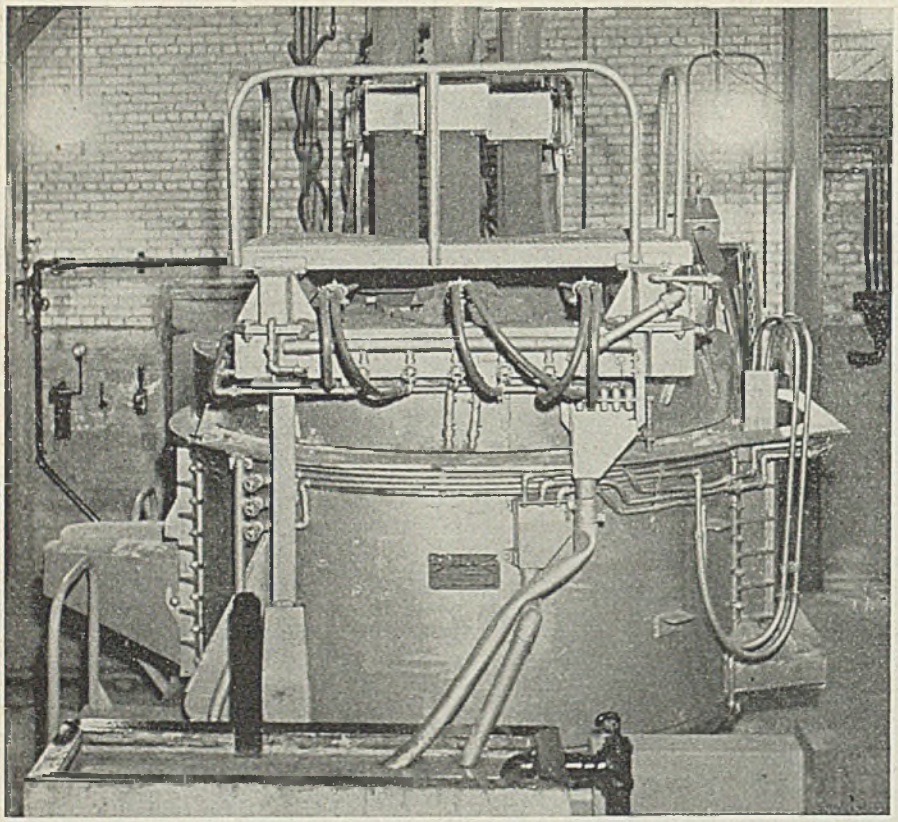
In general, these new hydraulic mechanical electrode operators control their electrode speed strictly in proportion to their co-operating electrode unit's desired power input. For this reason they are called power metering units, because they actually deliver hydraulic fluid in proportion to the electric arc change. This is an important point, because electrode speeds do not change with electrode arm weight variations. This will be discussed later.

European Hydraulic Design: Electric arc melting furnaces using European hydraulic operator equipment usually have a nonbalanced load piston valve operation. It is well known that a piston valve cycle for such an operation inherently has *port overlap* travel, *port registration* travel, and *valve closure* travel. Inasmuch as the rate of flow of liquid from a given pressure through an aperture is in proportion to the back pressure, it is easy to see that electrode speeds from such a system are controlled partially by the variable electrode weight and friction of the moving system. Since these European hydraulic designs have dampened, current controlled, equal settings for all three movements of the above cycle (overlap, registration and closure travel), they therefore have considerable time delay caused by the loss of time from dampened valve overlap travel and equally dampened closure travel, both of which permit no electrode movement. These points tend strongly to subtract from accurate positioning in such a system. The European piston valves are special and are operated by special torque motors and associated interlocks of hydraulic and electrical design. It is obvious that the electrical component of an electrode drive must be designed to work in complete harmony with its mechanical component in order to give the most accurate electrode positioning so desirable in electric melting furnaces.

Top Charge Equipment: That described in this article has been designed around the basis of simplicity and long life. The original design used a C-frame for picking up the roof superstructure hydraulically at three points and rolling it out over the pouring pit for the top charging, and then back again and lowering it in place. This design has the following advantages: It makes use of standard parts for the hydraulic equipment and picks up the roof at four points, thereby maintaining the existing stresses in the roof refractories. It uses an air motor to move the C-frame and roof load. An air motor has inherent overload stalling characteristics, which eliminate limit switches. The roof-lift, roll-out, top-

Shop assembly of power-operated electrode arm and clamp designed for an 11-foot inside diameter electric furnace shell





Side view of top-charged electric arc melting furnace with an inside shell diameter of 8 feet 9 inches. Electrodes are operated hydraulically

charge design, moving in a line parallel to the furnace side of the transformer room, is the only top charge design which requires no twisting of the secondary flexible cables.

Sidewall refractories may be severely damaged in top charged furnaces by spalling and abrasion, because of so much opening and closing of the roof. If the whole weight of the roof, electrode arms, operating mechanism, and so forth, in the top charged furnace is allowed to rest on the sidewall refractories, these usually expand away from the mechanical adjustment provided. Some designs use screws, jacks and wedges to allow the operator to keep the roof off the sidewall refractories, but no operator ever uses these things carefully. The net result is that the load is supported by the sidewall refractories. In the case of an 11-foot diameter shell, the load may be as much as 18,000 pounds or 9 tons. This load per unit area on the wall refractories as they become thinner increases until crushing occurs and emergency renewal becomes necessary. Refractory life thus is shortened and unexpected shutdowns result. Where the roof is supported from the furnace shell, these heavy top charged loads are at least distributed all over the sidewall refractories. Where the roof is supported separately from the furnace shell, the largest part of this heavy load is supported only on one side of the walls, causing the adverse results as mentioned. By maintaining a constant low oil pressure on the roof cylinder, however, at least 75 per cent of this load is supported at all times by the cylinder and not by the sidewall refractories.

Some "swing-a-side" roof designs must open 90 degrees for full top charging bucket clearance. It is important to make this swing angle as small as possible because it affects the life of the secondary flexible cables. On some small furnace designs, the roof swing mechanism consists of an accurately machined cam way in the lower part of the cylinder through which a heavy roller is projected from the fixed roof lift post. Larger furnaces use a piston-operated rack and gear for roof swing.

Furnace Shells: Furnaces described in this article use standard refractories. The heavy plate shell is made deeper than the old designs in order to hold a larger capacity of light melting scrap, and is rigidly reinforced wherever local overstressing might occur. Extra heavy steel castings, water-cooled where necessary, tie the shell plates together over the doors. Door frames are reinforced all around to oppose refractory expansion and buckling. Door guides are adjustable, well cooled and rigidly bolted to the shell. Door arches also are well cooled. Individual water circuits are as numerous as practical and the water piping is large, to accommodate bad water situations in some localities, and so arranged to be drained and cleaned easily.

Tilting: The furnace shell can be tilted by various arrangements, such as: full nose tilt, seminose tilt, or rocker tilt, to suit any particular installation. The seminose tilt is a compromise between the other two requiring only shallow pouring pits, no vertical or horizontal movement of the ladle while pouring the heat, and no additional overhead clearance. Rocker tilts require deeper pouring pits; though the pouring spout has practically a vertical travel, the ladle has to be lowered as the metal is poured. Pouring with arms in a low position, with this furnace, can be accomplished under comparatively low head room.

The standard medium size furnace may use a seminose tilt job. In this case a pivoted horizontal cylinder directly under the operator's floor is connected to a pull rod extending under the furnace to an inverted A-frame welded to the furnace. The furnace is tilted with this cylinder. This hydraulic arrangement, though simple, is more expensive; however, the added cost is more than justified when one considers the many advantages it offers. The tilting cylinder and piston rod are located away from the furnace in a shallow, well covered, accessible trench. Only the pull rod, which is connected to the piston rod, and the A-frame are under the furnace, and therefore, subject to damage from "cut throughs". They can be covered with refractory sleeves; but this is not necessary because both the rod and the frame are made of standard structural shapes and can be quickly repaired or even entirely replaced in almost anyone's shop, if necessary. Only a shallow, narrow trench is needed for this framework, thereby permitting draining of the slag pit into the pouring pit. The bottom of the entire foundation slopes downward into the standard pouring pit. Here, again, no limit switches are required because the cylinder stroke limits the travel of the furnace in either direction. Carelessness on the part of the operator cannot cause any damage. Whether a nose tilt or rocker tilt job is selected, layouts are carefully checked to place the center of gravity substantially behind the nose tilt axis or below the rocker center under any conditions.

Electrode Arms and Clamps: Another important part of a good electric melting furnace is the electrode arm and clamp structure from both an electrical as well as a mechanical point of view. The arms on these furnaces, as already explained, are insulated from and bolted to the top of the vertical extension. Because these arms sit across the top of the vertical extensions, they are easily insulated with heavy mica sheet far back from the flame and directly over the vertical extensions where the insulation is well protected from heat damage. This insulation is horizontal in all installations, has large creepage areas and is well protected from accumulating conductive dust. These electrode arms are adjusted easily by sliding them horizontally in their rear clamps when lining up a roof; they are free from bolt insulation.

The electrode arms consist essentially of a rectangular box structure for mechanical strength, over which is placed water-cooled electrical conductors arranged for lowest electrical loss. In the front of the box structure is a removable stainless steel, nonmagnetic yoke which goes around each electrode. This

(*Please turn to Page* 148)

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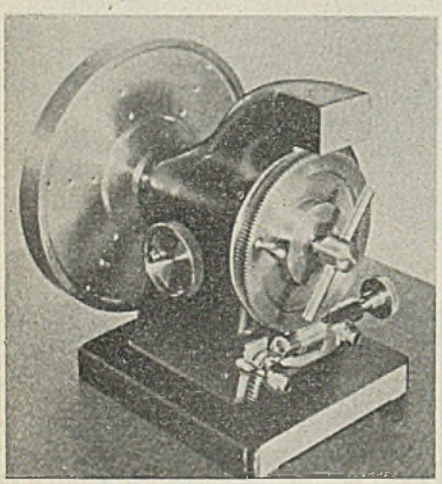
Angle Computer

A new Studler angle computer, model C, is now being manufactured by Angle Computer Co., 5720 Melrose avenue, Los Angeles 38. Specially designed for general shop use, it insures accurate survey of precision measurements and angles involving vertical, horizontal and related angles. The protractor and vernier on the unit are calibrated to show individual minutes, or 21,600 precise spacings.

This time-saving instrument affords two working positions at all times, either horizontal or vertical. From either of these positions the work can be rotated a complete revolution. If the job at hand must be laid out or checked in seconds, it is usually an easy matter to attach the sine bar to the job already set up. Where the third, or radial, angle is involved, Studler model A or B should



be used. Model A is available with either 5 or 1-minute calibrations; model B with 1-minute calibrations.

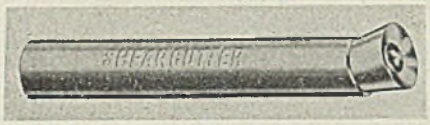
The face plate of the model C angle computer is 10 inches in diameter and 1 inch thick. An interchangeable surface plate is 5 x 10 x ⅝-inch. Fine grade cast-iron alloy, heat treated, is used in the body and machine steel is used for the spindle. Brake shoes are cast iron and fixed in place and machined at the same time as the main bearing is bored. This assures perfect alignment, so that when the brake is applied the work is not distorted or moved.

Boring Tool

A radically different type of boring tool which gets diamond boring machine results from an ordinary lathe has been developed by the Shearcut Tool Co., 19600 Sherman Way, Reseda, Calif. Known as the Shearcutter boring bit, this new tool has a circular cutting edge that lasts 10 to 30 times as long as a straight edge cutting tool before resharpening is necessary.

The shearing (instead of conventional prying) action of the boring bit leaves a curled chip and allows huge cuts to be taken without chatter. Chips sliding back over the cutting edge have a resharpening action. When an edge becomes dull, a new one is provided by simply turning the bit in its holder. No new setup is required.

Having cutting speeds up to 1000 feet



per minute, the new boring bit requires less power and generates less heat because of the shear cutting action. The mirror finish produced in one operation meets Navy specifications and usually eliminates any necessity for grinding, filing, reaming or polishing to remove tool marks. The boring bit works well with either a positive or negative rake and permits working to closer limits than normally possible.

Machine Tool Hone

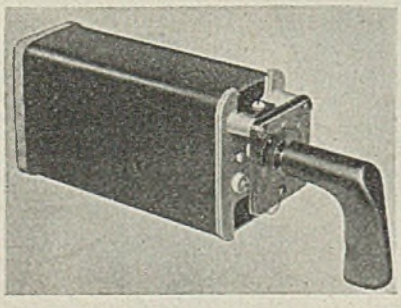
Carbide tools require less grinding if honed and kept highly polished with the new Tamaloy diamond hone, introduced by the Tungsten Alloy Mfg. Co., Newark, N. J. It is used easily either before each shift or while tools are in the machine.

In these hones a matrix of tungsten carbide holds the diamonds securely in place, resisting wear and preventing displacement of the diamonds when they contact a hard surface or edge, and lengthening life of the hone.

Three grades are available—100 grit (rough); 150 grit (medium); or 200 grit (fine). They are mounted on a convenient nonslip handle.

Master Control Switch

Although for use wherever repetitive operations of electrically operated devices run into many thousands per week, the new master control switch for heavy-duty service announced by General Electric Co., Schenectady, N. Y., is

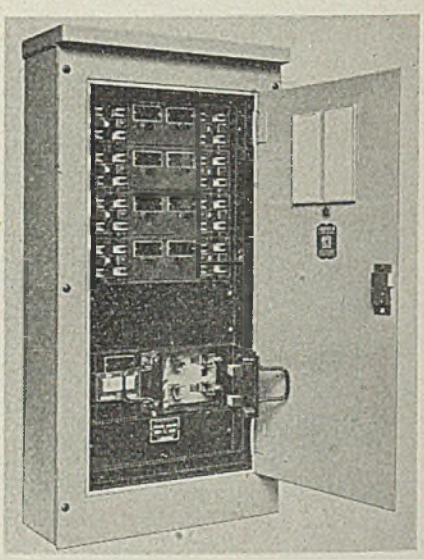


especially serviceable in steel mills for opening and closing control circuits from the control desk. Known as type SB-9, it can be mounted on panels varying in thickness from ⅛ to 2 inches.

The switch is rated at 600 volts, 20 amperes continuous, or 250 amperes for 3 seconds. Its interrupting rating is dependent upon the voltage and character of the circuit, and upon the number of contacts arranged in series.

Combination Power and Lighting Panels

Square D Co., 6060 Rivard street, Detroit 11, is now manufacturing combination power and lighting panels for marine use. They are made to meet either low or high shock specifications of the Navy. The panel illustrated was



built to meet low shock requirements and has eight 2-pole 30-ampere lighting circuits and two 2-pole 60-ampere power circuits. The box is drip-proof.

Milling Machine

Developed by Snyder Tool & Engineering Co., 3400 East Lafayette, Detroit 7, this machine is used in finish milling four cam slots in aircraft propeller cams.

It is equipped with four spindles to mill the four slots at one time. Spindles are mechanically interconnected (each having its own hydraulic cylinder) and go through rapid approach and feed into the work in small steps, while the work piece reciprocates and rotates in conformity to the master cam producing the cam contour. The master cam is integrated with the mechanical motion of the fixture and is designed with a rise-to-length ratio of one in five, resulting in very smooth operation of the cam follower mechanism.

Spindles are driven from electric motors through V-belts and worm wheel drive and are mounted on precision tapered roller bearings, allowing take-up for possible wear. The amount of infeed on the tools per reciprocation of the part is adjustable over a wide range of 0.010 to 0.150-inch. Infeed is hydraulic on automatic cycle operation but can be manually operated for setup purposes.

Fixture spindle and slide are hydraulically actuated and are equipped with

(All claims are those of the manufacturer of the equipment being described.)

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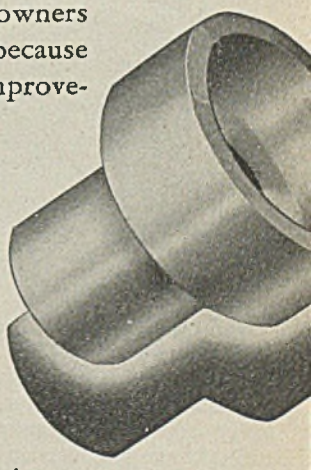

1. Upon request you will be given a statement in detail of the engineer's method of surveying your plant, and his credentials will be submitted.
2. The engineer will spend as much time as necessary in your plant, making detailed studies of operation without interrupting production or making demands upon the time of your organization.
3. A detailed written report will be made for you, with proposals for changes in method wherever opportunities for savings are found.

Proposals for improved method are by no means limited to cases where the savings can be made on Clevelands. In many studies made by Cleveland engineers new methods involving substantial savings have been found for the equipment already in use. In any event there is no charge.

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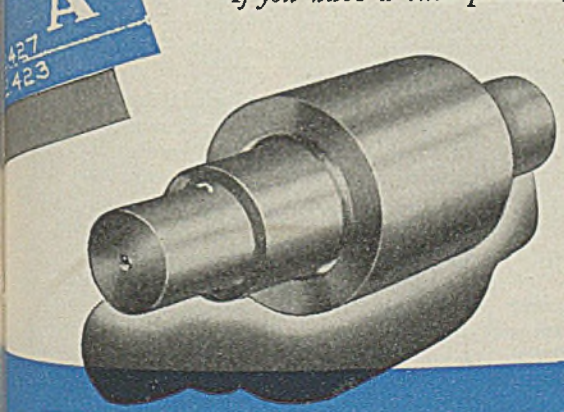

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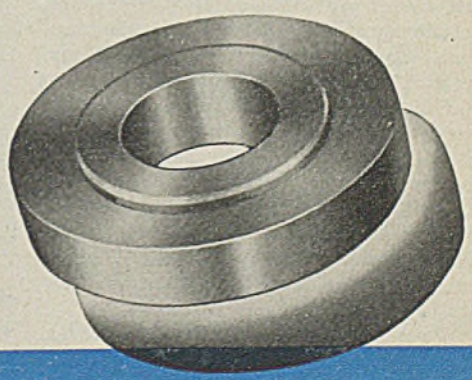

THE CLEVELAND AUTOMATIC MACHINE COMPANY

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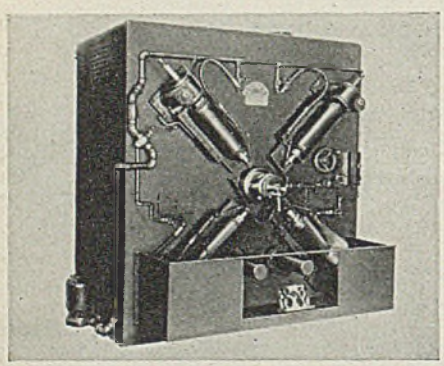
two feed rates—one for the cut through the shallow angle of the cam slot and a second, slower rate for the steeper portion of the slot. All hydraulic controls are adjustable and when once set are not disturbed until resetting is necessary.

Fixture spindle is mounted on preloaded, tapered roller bearings insuring rigid mounting and vibrationless operation of the machine. Provision is made for take-up on the preload. Fixture is designed for hydraulic clamping to insure uniform clamping pressure on the part.

The machine housing proper contains all motors except coolant motor, all hydraulic equipment, oil tank, etc. Coolant is contained in the forepart of the lower base. A chip trough is provided in front of the base.

Machine cycles for the finishing operation are approximately 7 minutes, or a production of seven parts an hour at 80 per cent efficiency. The spline mill



principle of feeding the cutters into the work step by step results in excellent finish and good tool life.

A similar machine developed for rough milling the slots eliminates the step-by-step infeed of the cutters and cuts the slots in one pass, leaving 1/16 to 1/8-inch of stock in the slots for finishing.

All-Position Electrodes

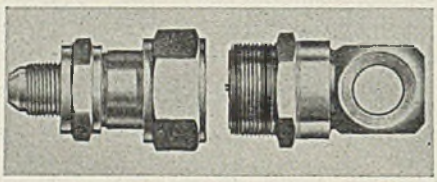
Raco type H-D 11 alternating-current electrodes are designed to produce all-position welds of highest quality and are particularly adapted for making X-ray perfect welds such as required in shipbuilding, pipeline construction, boiler work and so forth. The arc characteristics are excellent; the slag is easily controlled; and the weld metal is smooth, sound and superior to that produced by "old line" reverse polarity electrodes. No special training is required if operators are familiar with direct-current all-position welding.

Raco type H-D No. 11 electrodes may be used on direct current with excellent results and meet the requirements of the U. S. Navy Specifications 46E3, Grade III, Classes 1, 2, and 3; American Shipbuilding Specification H1G and B1G; AWS-ASTM Specification A233-42T, type E-6011; and ASME Boiler Code, Par. U-68.

The 14-inch lengths are available in 3/32, 1/8, 5/32, 3/16 and 7/32-inch diameters only; and the 18-inch lengths in 1/4 and 5/16-inch only. They are packed in cartons of 50 pounds. Color of the coating is light buff. These electrodes have been developed by Reid-Avery Co., Dundalk, Baltimore, Md.

Self-Sealing Coupling

A disconnecting self-sealing coupling which will withstand pressures of 2500 pounds per square inch after ordinary



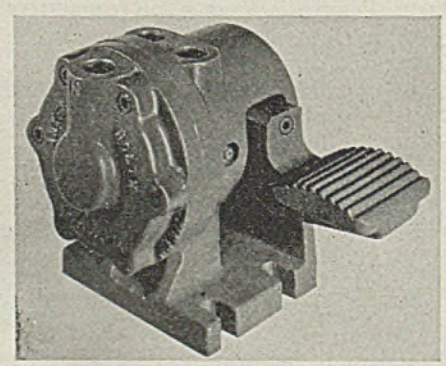
finger-tightening is the latest development reported by American Screw Products, 7000 Avalon boulevard, Los Angeles 3.

Tests under severe handling conditions show that the heavy construction of the aluminum alloy body prevents distortion and that jamming of the spring-loaded shut-off valve is prevented. Springs are of heat-treated steel. Lightweight cast phenolic poppets are positive sealing in action. The synthetic gasket provides leakproof connection when coupled for service. They are available with AAF or AN threads.

Foot Operating Valve

A new foot operating valve, designed for general use on all types of pneumatic equipment, is now offered by Anker-Holth Mfg. Co., 332 South Michigan avenue, Chicago 4. It is made in sizes from ¼ to ½-inch and is the disk type which assures economy in maintenance.

The pedal returns to neutral by means



of a spring. When the pedal is pushed down and the foot removed, it returns to neutral but the work is held until the pedal is again pushed down.

Straightening Press

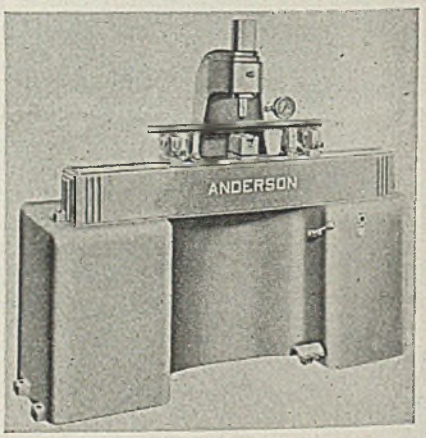
A sensitive, high-speed, hydraulic straightening press has recently been put into manufacture by Anderson Bros. Mfg. Co. as a supplement to its line of hand presses.

Capacity of the new machine is 10 tons; but a shaft may be bent as little as 0.001-inch. With this press, it is possible to apply the exact load required to correct shaft run-out.

The pressure gage, which indicates the ram loading, is mounted conveniently near the work at eye level to facilitate quantity production. Beneath the ram, at the point of maximum deflection of the work piece, is located an adjustable dial indicator. This indicator clearly shows the amount of shaft run-out in the preloaded, fully loaded and unloaded positions.

Use of the Barnes hydraulic system on this press provides four distinct advantages over conventional types:

First, a flexible, sensitive control of the press is made possible by means of a unique rotary control valve. This valve is operated from the front of the machine by a control lever which, when depressed, causes a corresponding increase in the load applied to the work. An infinite range of loading up to capacity is obtainable as the lever is moved



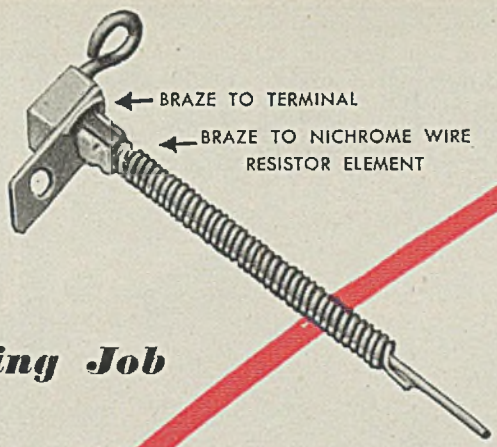
from zero to maximum displacement. Push button control of the hydraulic unit is provided for starting and stopping, although no load can be applied to the ram until the lever is depressed.

Second, safe operation is assured by use of the spring return mechanism of the control lever. Release of the lever reduces the load immediately and causes the ram to return rapidly.

Third, a high rate of production is attainable because of the rapid ram return speed; thus loading and unloading time between operations is cut to a minimum.

Fourth, ease of operation is assured since the operator has complete control of the press simply by use of the control lever. By depressing the lever until the desired load is attained and then releasing, the operator is able to complete the cycle.

The length of the work table of the press is 60 inches. Available table attachments include checking rolls, spring loaded centers and adjustable anvils. To further aid production speed, an adjustable stop collar is provided which may be used to limit the 6-inch maximum stroke of the ram. Hand operated control equipment is standard but extra provision can be made for foot operation.



A DIFFICULT *Brazing Job*

MADE EASY *by G-E Electronic Heaters*

YOUR difficult, localized heating jobs are made to order for electronic heaters.

Take this little overload-relay heater element, for example. Two brazes must be made within ¼ inch of one another. The copper contact strip is first brazed to the terminal; then the other end of the contact strip is brazed to the Nichrome wire resistor element. Because of production procedures, the two brazes cannot be made simultaneously.

With conventional heating methods the first braze loosened when the second one was made. Production was slow, and rejects were high!

G-E electronic heaters solved this problem completely. Because of their amazingly close control and their rapid heating, the heat is so localized that the first braze is not affected by the second. Production is increased, and the quality of the work is unusually high.

This is another of the many thousands of applications of inductive heating. With this versatile process you can heat practically any metal. You can harden, anneal, braze, or solder in a very short time and with great accuracy. And only one or two hours of training are required for an inexperienced worker to become an efficient operator.

It is very possible that electronic heating can speed up operations, improve quality, and reduce costs in *your* plant. It will pay you to investigate. For complete details, simply contact the nearest G-E office, or write to General Electric Company, Schenectady, N. Y.

G-E electronic heaters are manufactured in two standard sizes, with conservative output ratings of 5 kw and 15 kw. Larger sizes can be furnished to meet requirements.

NO. 4 IN A SERIES OF CASE STUDIES *on the accomplishments of G-E electronic heaters, a new and powerful tool that is speeding American war production. Like most new tools, it can easily be misapplied. The recommendations of G-E Industrial Heating Specialists are based on the experience gained with more than 200 installations of electronic heaters, plus a quarter century of experience in the development, manufacture, and application of electric heating equipment of all types.*

GENERAL ELECTRIC

ELECTRONIC HEATERS

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds

Carbide Tooling

(*Concluded from Page* 132)

then hand honing them with a diamond hone to perfect relationship.

The process has been so consistently successful that Yale & Towne has since applied the same principles to the machining of other precision parts. Contributing to the successful operation of course is that the long life of the carbide tools between grinds maintains the correct relationship over much longer periods.

On some iron and bronze parts on which tolerances of only 0.0002 to 0.0003-inch must be held, Yale & Towne is currently machining with carbide tools at speeds as high as 1300 feet per minute and 2500 feet per minute, respectively.

Six men were formerly required to "finish" some of these parts by filing. The inner faces of the rotor are finished with a fly-cutter which carries two standard cemented-carbide tools. Depth of cut is 0.007 to 0.010-inch per side with a table travel of 8¾ inches per minute.

One result of the application of carbide tools to such machining operations at Yale & Towne has been the ability to produce completely interchangeable parts without the necessity of "matching" rotors and pump bodies in sets—a highly important development in view of exacting service requirements in the field.

Industrial Lubrication And Use of Cutting Oils

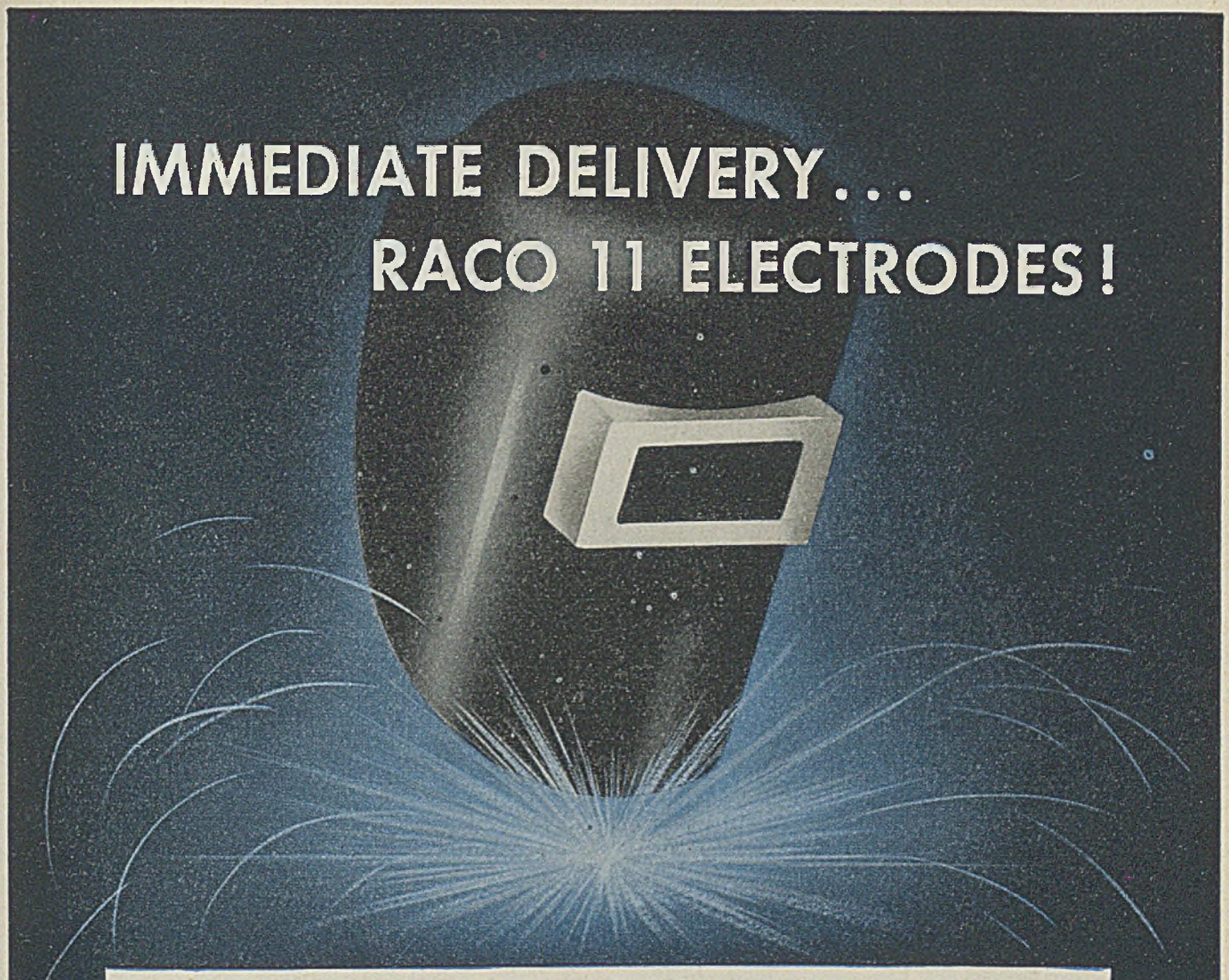
Lubrication of Industrial and Marine Machinery, by William G. Forbes; cloth, 319 pages 5½ x 8½ inches; published by John Wiley & Sons Inc., New York, for $3.50.

Lubricants and Cutting Oils for Machine Tools, by William G. Forbes; cloth, 90 pages, 5½ x 8½ inches; published by John Wiley & Sons Inc., New York. for $1.50.

These two volumes by the same author go deeply into the fundamentals of lubricants and their use. In the volume on lubrication the earlier chapters are devoted to distillation, cracking, refining and petroleum chemistry to help in understanding the main discussions that follow. Discussion of current lubricating practice includes practical material on a wide range of subjects, coving the more prevalent types of engines, machines and major industries, which may readily be applied to special equipment.

The volume on lubricants and cutting oils is designed to explain the fundamental principles of lubrication in relation to metal cutting and application of various types of cutting oils to machine tool operations. Discussion also covers the principles of machine tool lubrication from the viewpoint of practical maintenance. This volume has been adapted in part from the larger work to give practical information on problems arising in metal cutting, as a guide to machine shop practice.

IMMEDIATE DELIVERY...
RACO 11 ELECTRODES!



Yes, we mean it! You can now count on immediate delivery of RACO 11

...the electrode that the Welding Foreman of one of the largest shipyards calls "the best his crew has worked with...an electrode that assures the user X-Ray clean welds free from gas pockets and slag inclusion."

...the electrode that has proved to be the ideal utility electrode...that can be used on AC or DC...and give superior results on mild steel in all positions.

...the electrode that complies with the following specifications:

A.W.S.—A.S.T.M. Filler Metal Specifications A233-42T Classification E6011; Navy Bureau of Ships Specification 46E3, Grade III, Classes 1, 2, 3; American Bureau of Shipping Specifications HIG and BIG; A.S.M.E. Boiler Code, Paragraph U68.

All those features...plus immediate delivery! Write NOW for samples of RACO 11 ...and full information on RACO electrodes for every welding job.

The REID-AVERY COMPANY

DUNDALK BALTIMORE 22 MARYLAND

Electric Arc Furnaces

(*Continued from Page* 140)

yoke is water cooled and made of straight sections under tension from electrode clamping pressures. In the front corners of this yoke are two fixed copper contact blocks against which the electrode is clamped. The blocks are fastened conductively to the water-cooled conductors so that they can take a large overload without damage. Behind the electrode is a third, heavy, water-cooled, movable copper block called a pressure block. This has two sets of contact faces; thus, four current-carrying contact areas clamp against each electrode. These vertical contact areas are about evenly spaced around and so hold it to resist strongly magnetic repulsion in heavy melting surges. The pressure block is power operated and arranged in such a manner that the electrodes may be slipped from the floor.

Electrode Handling: The ideal method of handling electrodes on large furnaces would use an electrode preparation pit adjacent to the furnace. Electrodes would be assembled here at floor level, entirely eliminating the necessity of a man crawling up on the furnace. It has been shown in tests that medium and large diameter electrodes perform best if they are clamped with a foot-poundage substantially greater than the capacity of any one man. Therefore, external means for tightening large furnace electrodes can be conveniently, comfortably and safely made at floor level where joints can be properly cleaned and assembled at even temperatures. Several cases on record show that any operation performed above a hot flaming electric melting furnace is hazardous.

How Electrode Is Changed

Procedure followed in changing an electrode would be this: The short electrode about to be replaced already has a large bale screwed into its top thread during its assembly on the floor. The crane hood is maneuvered into this large bale and the pressure on the electrode is released from the floor. The crane lifts out the short electrode, places it on the floor, and picks up a longer one already assembled with another bale, and puts it where it is quickly power clamped in place.

With power-operated electrode clamps the electrodes are slipped and caught as they drop. In this way, the contacts are scoured clean, removing the nonconductive dirt off the electrode before it is reclamped. This not only prevents burning contacts, but saves time. Contrast this to the ordinary practice of getting on top of the hot furnace, prying a wedge loose, dropping the electrode on scrap or hot metal, leaving all the nonconductive dust on the electrode, and then "sledgehammering" the wedge in again, clamping the electrode against this nonconductive dust. This is not only a hazardous operation on top of the furnace, but it is uncomfortable, and

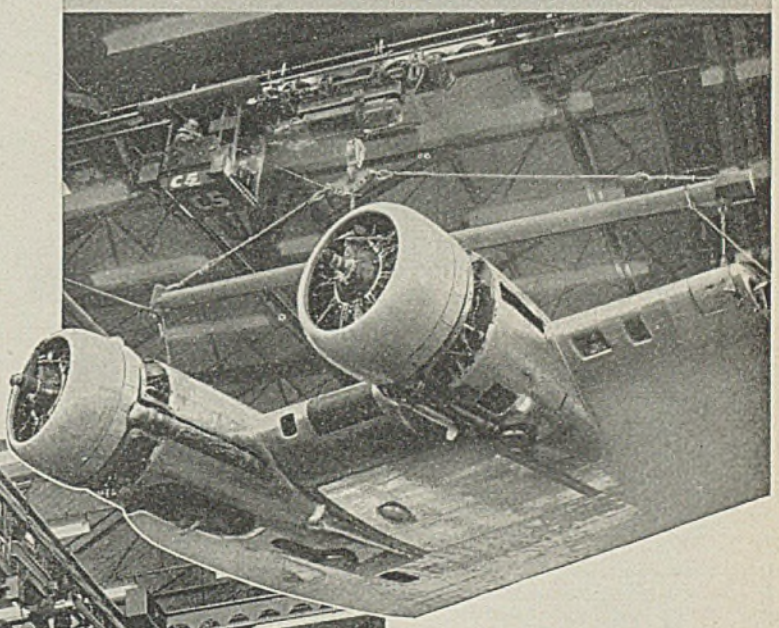
FIVE-RUNWAY CRANE HANDLES GIANT B-17 BOMBERS

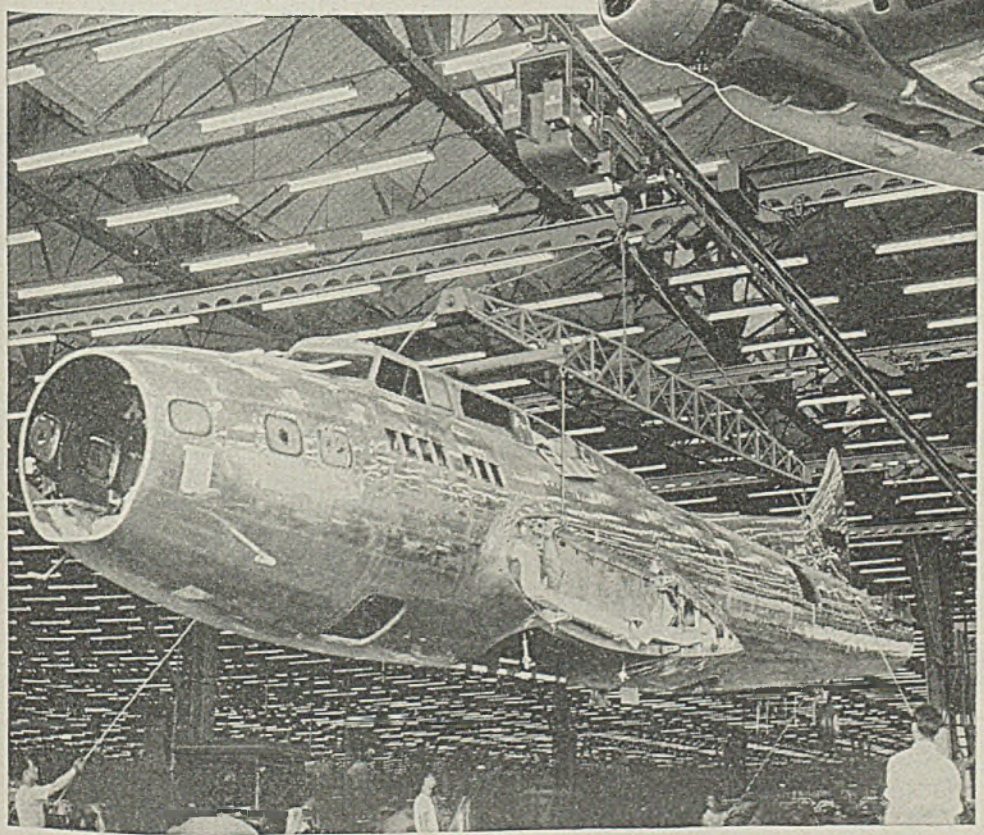
The mammoth B-17 bombers being built by the Vega Aircraft Corporation in California are moved down the assembly line by a Cleveland Tramrail five-runway power-driven transfer bridge. This bridge has a total length of 123 feet with runway centers of 30 feet. It is one of 12 transfer bridges of various spans. Interlocks make it possible to transfer loads from any bridge to any of the other bridges.

All motions of the transfer bridge hoist and carrier are controlled by the operator in the carrier cab.

The giant planes are picked up by means of a truss-type load bar which in turn is supported by three cables attached to a single hoist hook.

A large number of leading aircraft builders are speeding production with Cleveland Tramrail.





A B-17 inner wing section being transported to Final Assembly where it will be mated to the fuselage.

★

The photo shows one of the many four-engine monsters being moved down the assembly line by the Cleveland Tramrail overhead system. The completed fuselage "wins its wings" in the mating jig, next station on the line.

The Vega Aircraft Corporation is now in full mass production of B-17's for the U. S. Army Air Forces.

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BOOKLET No. 2008. Packed with valuable information. Profusely illustrated. Write for free copy.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1125 EAST 283RD ST. WICKLIFFE, OHIO.

CLEVELAND TRAMRAIL

OVERHEAD MATERIALS HANDLING EQUIPMENT

takes time, and then does not do the job right.

Most operators actually use only two separate voltage ranges in their standard melting process. A third voltage is used by some, and a fourth voltage used by others only as a holding input. In these designs and specifications, experience is of great value to the electric furnace user. To illustrate this point: on the one hand is the operator who is interested almost entirely on the full load electric arc lengths and control thereof; on the other hand is the transformer designer who almost always starts a design with no-load voltages. The first is primarily interested in arc length and stability under given load conditions, and the other is interested in no-load conditions. Therefore, an experienced organization is necessary to prepare the specifications for the electric furnace substation, electrical controls and mechanical parts which will fulfill the conditions required in a particular installation.

Resin Binder Conserves Mold and Core Sand

Since the war began, many foundries have greatly increased their use of mechanically-reclaimed silica sand going into cores and molds for casting armor steel by mixing it with a pulverized resin extracted from southern pine wood by Hercules Powder Co. In prewar practice, production of each ton of cast steel usually required half a ton of new sand; now aided by the resin binder known as Truline, one large foundry whose output is 5000 tons of castings per month has sliced its new sand requirements from 2500 tons per month to only 600 tons. Used principally as a core binder for railway and industrial steel casting production, the product is said to have shortened baking time considerably.

Patent Law Manual for Students and Engineers

Patent Law, by Chester H. Biesterfeld; fabrikoid, 225 pages, 5½ x 8¼ inches; published by John Wiley & Sons Inc., New York, for $2.75.

This volume is designed for use by chemists, engineers and students and is an outgrowth of a series of lectures on the substantive patent law. It is a compilation of these fifteen lectures, aimed to be helpful to students and also to others more or less regularly confronted with questions of patent law and practice in their daily research and miscellaneous technical work.

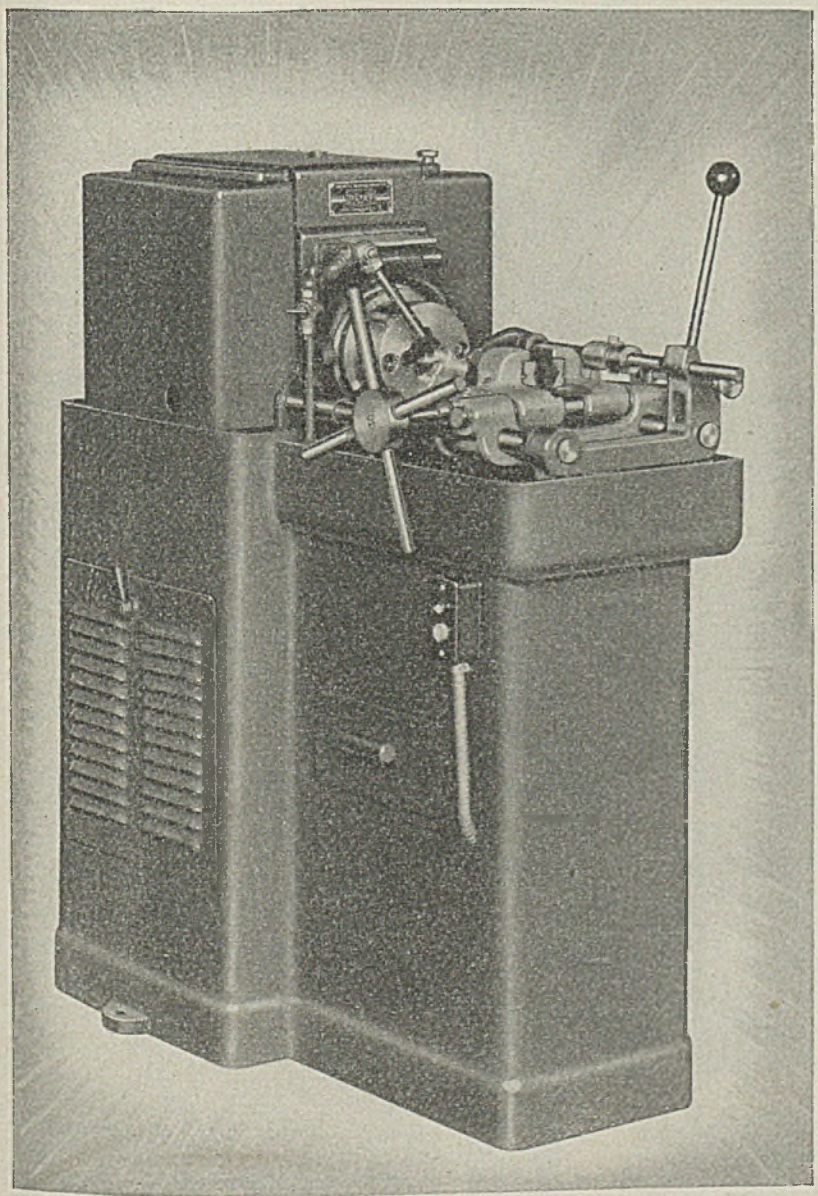
Especial attention has been given to recent court decisions bearing on the various subjects treated, to give the reader the benefit of current legal opinion. Older cases have been omitted where it appeared they would not assist in ascertaining present trends.

The main text is supplemented by a bibliography, a table of cases and a subject index.

17 FEATURES

Recommend the Oster "RAPIDUCTION JUNIOR"

for a wide Variety of Bolt and Pipe Threading Work



1 **DIE-HEAD**..rotary type..fully adjustable.

2 **DIES** . . . segmental type . . . *high speed steel* . . . one or more can be replaced without renewing entire set.

3 **DIE RELEASE** . . . automatic, with emergency hand trip . . . dies reset to size automatically.

4 **STOCK STOP** . . . adjustable . . . automatic in operation.

5 **VISE** . . . open type . . . with hardened steel gripping jaws . . . quick acting and powerful.

6 **VISE CARRIAGE** . . . lever fed . . . heavily constructed . . . and mounted on 1¼" solid steel studs rigidly supported at both ends to maintain perfect alignment.

7 **MOTOR** . . . 2 H. P., 1800 RPM . . . totally enclosed in base . . . protected from dirt and chips.

8 **DRIVE FROM MOTOR**..by V belts and motor and sheaves . . . eliminates noisy gears . . . prevents mechanical shock and sudden overload. V belts fully protected from oil and grease.

9 **WORM GEAR DRIVE** . . . hardened and ground steel worm running in BALL BEARINGS . . . bronze worm gear.

10 **MACHINE DRIVE SHAFT** . . . runs in BALL BEARINGS.

11 **SPINDLE** . . . hollow, for cutting threads of any length . . . semi-steel construction . . . runs in BALL BEARINGS.

12 **OIL PUMP** . . . easily accessible . . . insures full, uniform flow of cutting oil to dies . . . adjustable relief valve . . . pump shaft mounted in BALL BEARINGS.

13 **MOTOR CONTROL** . . . conveniently located . . . well protected.

14 **POSITIVE LUBRICATION** . . . oil level sight gauge makes it easy to keep oil at proper level to lubricate worm drive and all working parts which run in oil.

15 **BASE** . . . all steel . . . strongly braced for maximum rigidity . . . wide flaring pan prevents waste of cutting oil . . . keeps chips off floor.

16 **STEEL GUARDS** . . . easily, quickly removable for access to motor, pulleys, and oil pump.

17 **CHASER TRAY** . . . in base for convenient storage of spare chasers.

Oster "RAPIDUCTION JUNIOR" Threading Machines are made in one size: **No. 542** with regular bolt range: 3/16" to 1½" N.C. or Whitworth and 3/16" to 1¾" N.F. or B. S. F. Regular pipe or nipple range ⅛" to 1¼". **WRITE FOR CATALOG LIST No. 23.**

OSTER *for faster, better threading*

THE OSTER MANUFACTURING COMPANY, 2037 EAST 61st ST., CLEVELAND 3, OHIO, U. S. A.

Metallic Materials

(*Continued from Page* 129)

5 per cent tensile elongation in certain aluminum alloys is adequate for most design conditions. In an examination of conditions in the 24ST and Alclad 24ST skin and flanges of an actual wing, Koegeler and Schnitt[28] show that structural failure ensues from excessive permanent deformation that reflects less than 1½ per cent tensile elongation and then comment on the contrast between this figure and the 10 to 14 per cent elongation inherent in the material but "never attained" in service. Compare Fig. 14a.

Triaxial Loading

Some writers argue that because triaxial stresses tend to reduce the ability of a metal to undergo plastic flow, a large degree of tensile ductility should be present to allow more plastic action. The weakness of this argument lies in the fact that large tensile ductility does not insure against poor plastic behavior under triaxial loading. Copper, extremely high in tensile ductility, is nevertheless quite notch-sensitive. The rate at which a metal cold-works, becomes strengthened, and passes on the load so that the load becomes distributed over a larger volume, plays a considerable part in its behavior. So many factors, acting at the same time, control the behavior of a metal seeking a flow under triaxial stresses that such behavior of that metal is not adequately revealed in the ordinary tensile test.

Direct testing under the complex loading conditions of service on the actual part, in its actual size and contour, needs to be resorted to rather than to assume that a taffy-like behavior under a straight pull on a smooth, round bar, is necessary.

Some writers also are vastly impressed by small differences in reduction of area feeling that ability to flow locally is surely reflected by these values. The percentage reduction of area figures rather emphasize the actual deformation. At 25 per cent reduction of area a 0.505-inch diameter bar necks down to 0.437-inch, at 15 per cent to 0.465-inch. Even at 5 per cent, it necks down to 0.492-inch. Stainless steel, manganese bronze, and various other alloys do not neck much, the decrease in cross section results from general, rather than local, thinning down. Under the approach to triaxial stressing produced in a standard notched bar impact test, these materials act tougher than many that show great local necking in the ordinary tensile test.

Osgood[29] indeed, speaking of normal adjustment to tensile stress, as "accident insurance", remarks that it is the stretching *prior* to necking that counts and advocates noting the general elongation, exclusive of that in the necked portion.

In considering local plastic deformation in relation to formability, as in making a sharp bend, some authorities emphasize local elongation (in contrast to the point of view taken by Osgood in

respect to stress adjustment) and point out that in very strong materials whose elongation in a 2-inch gage length is very low, there may yet remain large ability for deformation over the very short length actually involved in bending, so that abilities for general and for local deformation do not necessarily go hand in hand. Hence engineering interpretation of elongation figures cannot be soundly made without differentiating between general and local ductilities.

A case of this sort occurs[40] in severely cold-worked low carbon steel with 1 per cent elongation over a 2-inch gage length, but with some 10 per cent over a gage length of 0.1 inch, and with good bending behavior. Similar cases occur in some precipitation-hardened aluminum alloys. Such materials can neither be dismissed as non-formable on the basis of low elongation in the "standard" tensile test, nor may they be assumed to be formable on reduction of area figures. Direct tests for formability are in order.

In *service*, as contrasted with a forming process, reduction of area and local elongation accompanying it, are not likely to come into play. By the time the applied stress has risen so high that local necking of the type measured in the conventional tensile test, starts, the change of overall dimensions through prior stretching will have become too great for the proper functioning of most parts in service, hence the reduction of area normally measured may be classed, along with excessive elongation, as unusable in ordinary service, and no certain indication of behavior under triaxial loading. Sachs' "notch ductility" may offer a better evaluation of the ability to redistribute stress through very local plastic flow.

Work-Hardening Traits Paramount

Riegel and Vaughn[41] cite a case of two steels of identical tensile and yield strengths, elongation and reduction of area, (45 per cent) which gave, in the approach to triaxial loading of the notched-bar impact test, 12 to 16 foot-pounds for one steel, 2 to 4 for the other, and comment that this indicates the futility of attempting to predict notch-toughness from the figures given by the ordinary tensile test or even from the area under the stress-strain curve.

That ductility itself is of minor engineering importance, in a finished structure; that the benefits ascribed to it come largely from the work-hardening accompanying severe deformation; and that tensile test methods might be elaborated to give information on work-hardening propensity—or other more direct tests used to evaluate it—are brought out in a discussion by O'Neill[42]. He emphasizes that there is "more promise in using quantities which embrace work-hardening properties than in searching for a single value which only represents one point on the deformation curve". Thus, even from the point of view of fabrication requiring plastic flow, the tensile ductility figures, elongation and reduction of area, are appraised as insufficient and incompetent to tell a complete and

true story. Work-hardenability may not be the same under polydimensional straining, as it is in tension.

That specifications call for high ductility is only rarely because the service requires the large ductility; it is usually because that large ductility has been an adventitious characteristic of the material that has been selected for its other properties, perhaps primarily for the best compromise between strength and machinability.

For one given material, wide variations in ductility indicate that something has been altered in the processing of the material. The absolute level of the ductility figures means nothing unless it is related to a certain material. For one grade of cast steel 24 per cent elongation may be characteristic; for steel in certain big guns, 17 per cent; for one heat-treated aluminum alloy, 12 per cent, for another, 7 per cent; for a spring steel, 4 per cent; for cold drawn bridge wire, 2 per cent; and for some zinc-base die-casting alloys, under 1 per cent. Each is a usable material and all right of its kind. We don't call for the same height and weight in a St. Bernard and a Scottie. Large deviations from the characteristic value, whether up or down, raise doubts as to the sample tested being a normal example of its kind, with dogs or with metals. Wide variation from the norm raises a presumption that other desirable properties, which we do not wish to go to the trouble of measuring, may also vary from their norm.

Transverse Tensile Tests Unpopular

The usual "property charts" for 4340 or any other alloy steel at 115,000 p.s.i. yield show 65 per cent reduction of area on a *longitudinal* section. It is well known to metallurgists, though seldom emphasized to designers, that different heats may all show 65 per cent reduction of area on a longitudinal specimen, but vary in transverse specimens from a figure only slightly under 65 per cent, down to half that figure.

It is difficult to take tensile specimens in the transverse direction from small sections so the properties in that direction are seldom determined. Sometimes taking transverse tests is rather deliberately avoided, for fear of getting low results and getting the user all worked up about them, when it is known that in spite of lower transverse than longitudinal ductility, the steel will serve its purpose. Under these conditions what the user doesn't know doesn't worry him, but it would be better if he did have the information on heats that have given adequate service in spite of existing, but unrecognized, lower transverse ductility than he assumes is present on the basis of longitudinal tests. The behavior of heats of 4340 with only 35 per cent transverse reduction of area is admittedly satisfactory in some types of service that anyone would class as "severe". That is, the transverse bar's reduction from 0.505-inch diameter to 0.406-inch is accompanied by as sufficient a degree of reliability as is the longitudinal one's

reduction from 0.505-inch to 0.298-inch.

It is only because ductility values are regularly secured as a by-product of the directly valuable yield strength determination and thus are available in quantity, that we tend to use them as indirect criteria of quality, when they do not at all measure the quality we need. This familiarity with the normal, usually far super-abundant, ductility of the material formerly used, in likely to influence our thinking in respect to a substitute, and to make us reject, without trial, adequate materials of lower ductility. When we free ourselves from these false limitations, we are more likely to think of such substitutions as the Ford cast crankshaft and the glass gage shown in Figs. 15 and 16. Zero ductility is acceptable in the actual service of both, and, when we stop to analyze the service, few services call for much ductility. Fabrication is, of course, another matter. These matters are discussed in more detail in Reference 18.

Splitting hairs in regard to a few per cent of alleged differences in reduction of area between SAE steel and an NE steel, is not a sensible procedure in the selection of materials, especially since the variations from heat to heat of either steel generally far overbalance the alleged differences between the two.

We need more searching and more direct tests than ductility tests, instead of relying so implicitly upon the hoped-for, but unproven and generally nonexistent, correlations between the ductility figures and some other unnamed and untested property.

Determination of Resistance to Repeated Stress

Of as much importance as the knowledge of yield strength, the load-carrying ability for one application of load, is the endurance limit, the load carrying ability for many applications of load.

Under repeated stress, failure may occur, in apparently brittle fashion, at stress levels well under the yield strength, and without measurable deformation. The nucleus of failure is usually at the surface, and the fracture shows oyster-shell markings. The mechanism of failure is, progressively, a damaging action, formation of a crack as a result of this action and speedy propagation of the crack.

The nucleus of failure is almost invariably some sort of a stress-raising notch, or poor fillet, whose avoidance comes within the field of the designer, or an accidental nick or a roughness of the surface from the type of machine shop finish used. Mere weakness of the surface, due to decarburization, often plays a part in steel.

Two opposing factors operate during repeated stress, one the damaging action that finally results in cracking, the other a cold-working action that strengthens the material. The strengthening effect is evident in a notched-fatigue test of annealed 18:8 stainless steel, which work hardens very readily. A notched bar of this material shows a higher endurance

limit than a polished, unnotched bar—contrary to the behavior of ordinary steels—because of the local work-hardening at the base of the notch. It has "crackless plasticity".

In general, endurance against repeated stress, on polished bars, rises as the tensile strength increases, though, as is particularly evident in the case of some aluminum alloys, it is not always true that the stronger the alloy the higher its polished-bar endurance.

In ordinary steel, however, there is a rather close relationship between tensile strength and polished-bar endurance, but in notched-endurance, the stronger steels are much more easily damaged, they have too little ability to be cold-worked.

"Cloud-burst hardening" or shot-blasting to peen the surface of springs, etc., or the cold-working of the surface of a shaft by rollers under pressure, the pressure-rounding of the lips of oil-holes by a suitable tool, and working the bases of the notches in threads, keyways, splines, etc., by special tools, are expedients that are proving highly effective in improving the surface resistance to fatigue. The surface is almost invariably the vulnerable location. But in all such expedients great care has to be taken not to over-cold-work and thus do more damage than good. Evaluation of just what constitutes excessive cold-work would be much worthwhile.

What Is Excessive Cold-Work?

Almen shows this in diagram form, Fig. 17, and has discussed[43] the whole problem in considerable detail. The important question is, how to reach the peak, i.e.,—when to stop?

There are methods for control of the shot-blasting operation, so that a like degree of cold-work can be applied day after day, but proof of just what degree is best, requires recourse to fatigue tests.

Strengthening of the surface, by case-hardening or nitriding, or by local flame- or induction-hardening are analogous means for combatting fatigue failures. These are cases where hardening and strengthening are obviously primary factors. In the case of shot-blasting, surface compression stresses are produced that may act in analogous fashion to the introduction of stress in auto-frettage of a gun, and discussion rages whether it is the hardening or the compressive stress that is the more potent. To the designer it is enough that the result is beneficial, whatever the theory involved.

At very high repeated stresses excessive local cold-working and the production of incipient cracks will occur in time, just as happens in ordinary cold-working processes where over-cold-working has to be avoided. At low stresses, the cold-working may be beneficial. The phenomenon of "strengthening by understressing", i.e., a raising of the endurance limit by running at repeated stresses slightly under the endurance limit, is very marked in most metals.

The stress level at which strengthening by under-stressing is so potent that the material will last for an indefinite number of cycles, is the endurance limit.

Steel has a real endurance limit; if never stressed above that level, it would last forever, as far as we can determine. In most nonferrous alloys there is no such sharp limit, at low stresses the strengthening effect predominates over the damaging effect of overstress but is not able to keep up this dominance indefinitely, ultimately the limit of the ability for local cold-working is reached and further repeated stressing produces damage. Hence, the endurance limit for steel can be satisfactorily established by running 5 or 10 million cycles, but in nonferrous alloys not less than 50 million, preferably 200 to 500 million, cycles are imposed in careful testing. The endurance stress figures for nonferrous alloys need to be accompanied by a statement as to the number of cycles to which testing was carried. See Figs. 18 and 19.

Endurance Data Shortcuts Out

Testing can be speeded up by running a steel for a couple of million cycles or a nonferrous alloy for 25 or 50 million, then raising the stress to a higher level which, by previous tests at that higher level, alone would break the specimen in, say, a quarter million cycles for steel or five million for nonferrous alloys, and observing whether the specimen lasts longer than that figure. If its life at the raised stress is appreciably longer, the evidence is good that, at the lower stress, the strengthening effect so predominated that a very much longer life would have been shown had the testing been continued at the lower stress.

Short cut methods for evaluating endurance have been suggested, but none of them have proved reliable. Special warning against accepting so-called "endurance data" obtained by the "rise-of-temperature" method, is in order, since some current publications on investigations relative to welding, still present data so obtained. Those who first suggested the method for trial now condemn it as failing to give reliable information. It was hoped that the damping power of metals, the ability to absorb energy, might be related to fatigue behavior and the ability to resist damage and the effect of notches. This hope was illusory, no direct connection could be shown. The notable high-damping materials are cast iron, which is relatively free from notch sensitivity in fatigue and magnesium alloys, which are highly notch sensitive. The damping that can be obtained by choice of materials is small compared with that from mechanical damping devices, hence damping tests of metals have almost no engineering application.

The curve of stress vs. number of cycles, obtained in a fatigue test, with each test run at one stress only, is called the "S-N" curve. Because of the large numbers of cycles, it is plotted on log-log, or semi-log coordinates. Testing at one selected high stress, and evaluating results on the basis of the life shown, has its uses, and far too little attention has been paid to the high stress end of the S-N curve, but scatter makes these data difficult to interpret. The position of the endurance limit or the stress for

500 million cycles is an important piece of engineering information that ought not to be omitted, even when chief interest centers on stresses for much shorter lives.

When the size of the stock permits, rotary beam testing of a circular specimen, unnotched or notched, so weighted that at each rotation each element of the test-length surface passes alternately through equal tension and compression stresses, completely reversed loading, is preferred for convenience. Tests under axial loading by pull-pull or push-pull cycles are also used, especially for sheet metal, or repeated bending deflection loading may be applied to sheet stock.

The data for most structural materials have been obtained by the rotary bending method. The Fatigue Research Committee of the American Society for Testing Materials has wisely chosen not to "standardize" fatigue testing methods, but instead, to discuss[46] the precautions necessary for reliable and reproducible results.

Polished-Bar Results Also Needed

Data are needed, in any fatigue study, on the best the material is capable of when not handicapped by stress-raisers, shown by the S-N curve for well-filleted, smoothly-polished specimens, and on what it will do under extreme handicap, shown by the S-N curve for severely notched specimens. Specimens with square notches, V-notched, with threads, or with a hole bored through, would serve for the latter. The reduced section specimen with two right angles offers two vulnerable regions instead of one in the V-notched specimen and may, therefore, be preferable. The specimens most commonly used in rotary beam polished-bar and notched-bar endurance testing are shown in Fig. 20. Much larger or much tinier specimens may be used in testing machines of suitable loading range.

Many engineering parts, subject to repeated stress, have to have threads, oil holes, etc., and others, either intentionally for production reasons, or, through oversight or accident, are not smooth, but have stress-raising small-radius fillets, notches, scratches, etc. The "polished endurance limit" figure sets up a par value for a material, which the engineer could utilize in toto if he were able to avoid stress-raisers, but which he may not be able to reach in practice.

The need for notched-fatigue testing, to supplement polished-bar fatigue data, could hardly be overemphasized, since the notched-fatigue limit is a vital, "pounds per square inch" value for the designer, and many materials and many conditions of heat-treatment that show superb polished-bar results fall down terribly in the notched conditions. Yet the polished-bar results are equally needed, especially to impress on the designer how much further he could go in raising fatigue life if he would avoid all stress-raisers.

The ability of a material to withstand the evil effect of stress-raising notches depends on the "notch sensitivity" of

the material (in steels, primarily related to their strength—see Fig. 21) and upon the severity of the notch.

By running the endurance test on a severely notched specimen and figuring the endurance limit in lbs./sq. in. on the area at the base of the notch, a "notch-fatigue limit" is obtained that represents about the worst possible condition of stress concentration.

The two "lbs./sq. in." values, polished-endurance limit and square-notched-fatigue limit provide figures as directly usable as is the yield strength. As in that case, the "sq. in." needs attention. Standard fatigue specimens are of small breaking section so that cheap machines will provide adequate load. In heat-treated steel the same old question of depth hardening, whether a tiny, fully hardened specimen correctly represents the large cross section of the actual part, comes in. There is also a question of the "size effect." As usual, the very large section does not have the full unit strength of the very small section. This has led to building equipment for fatigue-testing full sized railway axles.

Corrosion Test Takes Time

The fatigue phenomena are independent of speed within the ordinarily practical speeds of testing, so that fatigue tests may be speeded up enough to make them suitable for general use. When corrosion is involved simultaneously with stress, test methods have been worked out to appraise corrosion-fatigue resistance, but corrosion takes time, and such tests cannot be speeded up much.

Fig. 22 shows the behavior of steels of different strengths and hardness, tested in fatigue as polished bars, bars with notches, or polished bars with simultaneous corrosion. This brings out two important facts, first that when notches are present, very strong steels as a class are no better than moderately strong ones, second, there may be a high degree of scatter in fatigue results of different steels of the same static strength.

Data for one lot of Monel metal, Fig. 23a, show extremely wide scatter, though there is no inherent reason why Monel need show such variations. However, the fatigue curve for most lots of any metallic material is more likely to be a band than a line, though one lot of steel especially selected and processed for uniformity, gave the nice line of Fig. 23b.

In fatigue testing there is no analogy to the ductility measurements of the tensile test. Fatigue fractures may, and usually do, occur without any measurable permanent distortion of the piece. Such fractures may, and usually do, occur when no applied stress has ever been as high as the yield strength. In line with this is the fact that the ductility values determined in the tensile test, have no correlation with fatigue resistance. The gross phenomena of stretching and necking down have no opportunity to come into play. The same is true of the notched-bar impact test, whose results throw no light on fatigue problems.

That is, in fatigue, notch sensitivity is measurable only by the ratio between

the polished endurance limit and the notched endurance limit, there is no other criterion. The notched-fatigue limit has to be determined directly.

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(To Be Continued Next Week)