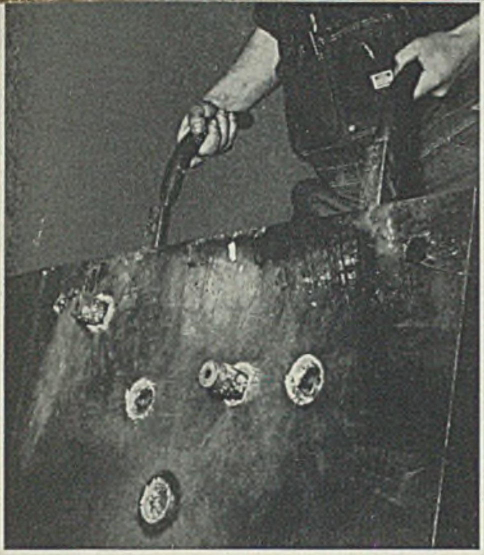

Critical alloys are being reduced in light armor steels for American fighting machines, p. 172

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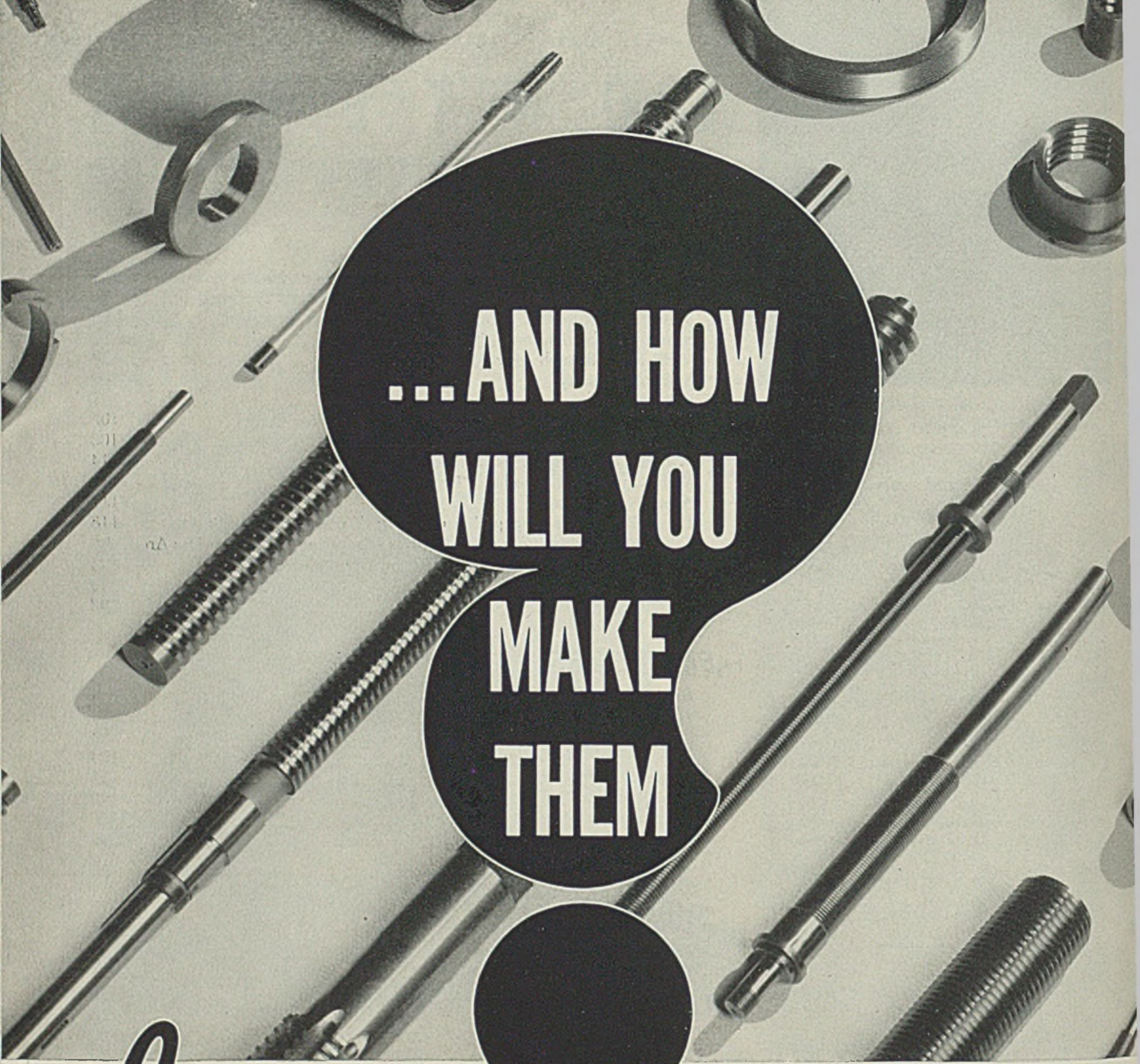

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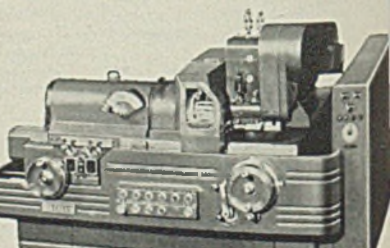

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HIGHLIGHTING

this issue of STEEL

METAL SHOW This year's National Metals Congress and Exposition, to be held in Cleveland, Oct. 12-16, is to be focused on producing for war. The discussions will break down into group meetings and papers (pp. 209-220) concerned with conservation, salvage, employe training, effective use of materials. Representatives of the armed forces will be present to acquaint industry more fully with the nature of the military requirements and the problems attendant upon production. The exhibits, too, will be in harmony with the wartime emergency (pp. 223-232). Those in the metals industries who can be spared from their work are urged to attend (p. 93).

SMALLER BUSINESS Donald M. Nelson last week recommended at a Senate committee hearing the creation of a War Liabilities Adjustment Board to facilitate use of productive plants during the war and to assure to small business enterprises the opportunity to re-enter the competitive economy after the war. The recommendation also would cover methods for keeping the financial position of smaller companies sound (p. 95). In the meantime the Smaller War Plants Division of the War Production Board reports some progress in providing war work for small plants (p. 294).

LEAN TIMES AHEAD An analysis of present trends supports Washington warnings that tough times lie ahead (p. 104). Manufacturers not producing something that is shot at the enemy will do well to examine the newly developing phase and plan accordingly. Ahead are shortages of manpower, food, textiles, wood and others still to be revealed.

TECHNICAL Paul G. McKimm concludes his discussion on the heterogeneity of steel ingots (p. 130) in the last of his series of articles on the manufacture of high-quality, low-cost steel.

Mass production methods developed by the Mccord Radiator & Mfg. Co. in manufacturing the new combat helmet are described (p. 122). Operations involved include stamping, forming, welding and painting.

Denys Val Baker describes British air raid protection methods and how air raids are prevented from seriously hampering production (p. 128).

Electric motor maintenance is a "must" today (p. 124). O. F. Vea describes methods. . .Tom Marney writes about crane protection methods (p. 135).

B. L. Wise describes some important applications of resistance welding in ordnance work (p. 184).

MATERIALS The Army Ordnance Department has helped to stretch out our supply of critical materials through methods of design, through substitutions and through manufacturing procedures. Prof. A. F. Macconochie tells details (p. 153). Prof. Macconochie also discusses our copper resources and what is being done by the Ordnance Department to conserve copper (p. 194). These are the first of a series of articles, the remainder to appear in future issues.

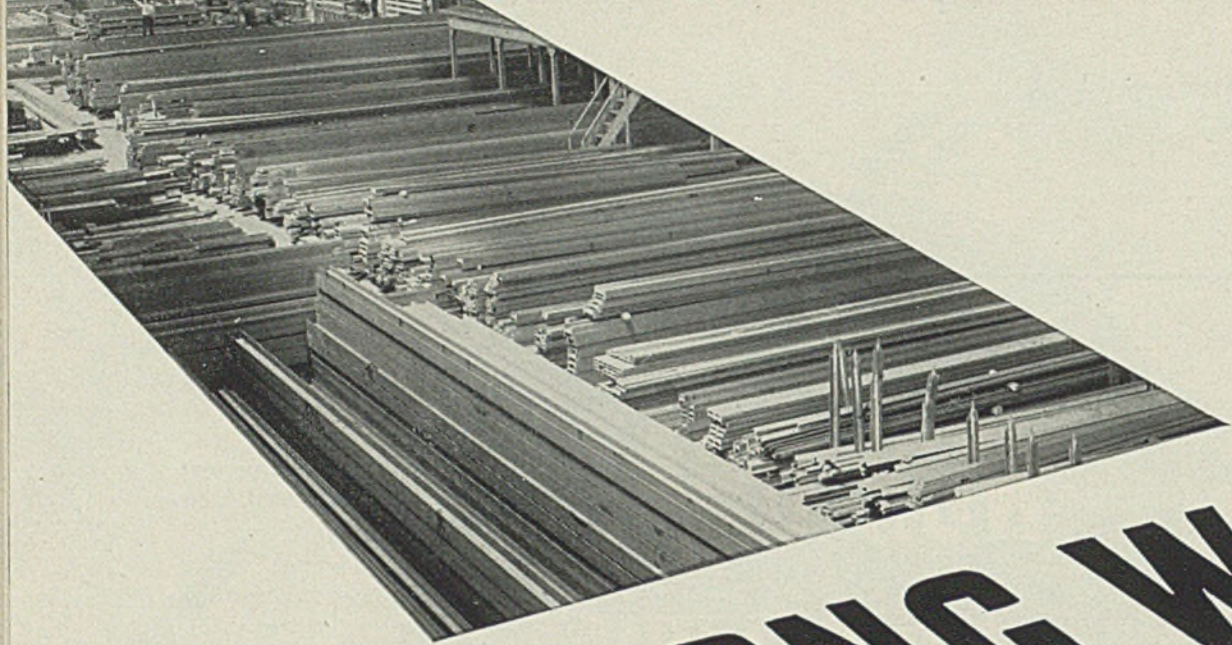
H. G. Batcheller explains workings of a new system of issuing steel production directives; it is leading to increased production (p. 108). Consumers will be asked to use less high-molybdenum tool steel. A further cut in use of tin will be ordered (p. 109). Control of copper exports has been clarified.

Because of the shortage of high-grade iron ore for open-hearth furnaces Canada's move to develop the Steel Rock deposit is important news (p. 286). Plan calls for a new ore dock at Port Arthur. Follansbee Steel Corp. is producing electric furnace quality alloy steels in open-hearth furnaces (p. 288). An Acid Open Hearth Research Association has been organized (p. 289). Control over Lake shipping will be more stringent (p. 295).

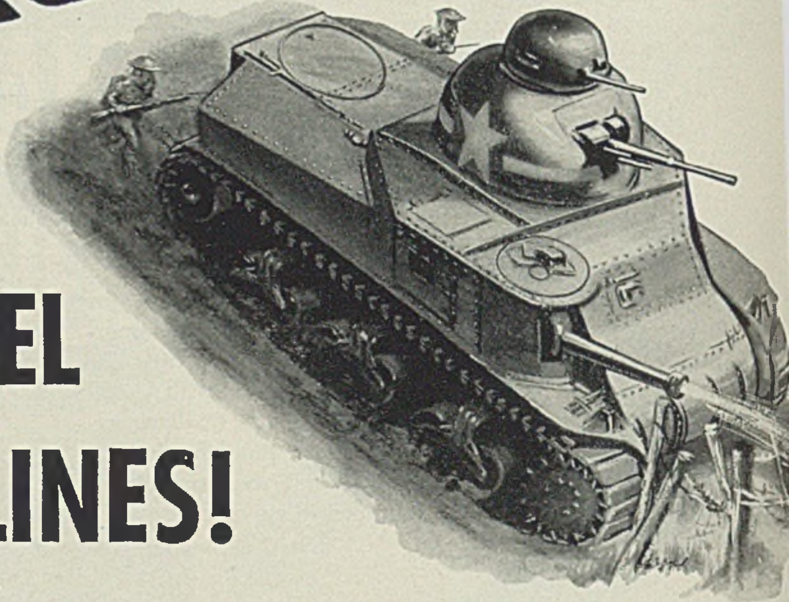
Results of the first few days of the national scrap drive have exceeded expectations (p. 94). Reclamation of idle mining machinery is complicated by the shortage of repair parts for mining machinery (p. 114).

A new vertical system of materials control is to supplement the present priority system. Production Requirements Plan will be used only to care for requirements of manufacturers of valves, bearings and other products which must be on shelves all over the country so that manufacturers of various end products can get them when needed. (p. 109).

Copper scrap, copper-base alloy scrap and ingots will be available to foundries only on A-1-a or higher priority ratings (p. 102).



IT'S A LONG WAY



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STEEL

October 5, 1942

Metals and the War

The Nov. 14, 1918, issue of Iron Trade Review, predecessor of STEEL, while devoted chiefly to the effect of the recently signed armistice upon American industry, also carried a brief item stating that the American Steel Treaters' Society had been formed to "promote the arts and sciences connected with the heat treatment of steel." A year later, this young organization, which meanwhile had established nine local chapters, held its first convention and exhibition in Chicago. Sixty-four manufacturers displayed their wares in the Seventh Regiment armory.

During the ensuing years this society, which was born in the crucible of World War I, changed its name, broadened the scope of its activities, increased its membership and greatly improved its service to industry. Today as the American Society for Metals, it is a vigorous organization wielding a powerful constructive influence in the important field of metals.

In Cleveland, Oct. 12-16, A.S.M. will hold its twenty-fourth annual National Metal Congress and War Production Edition of the National Metal Exposition. It will be the first the society has sponsored when the nation was at war. As usual the American Welding Society, American Institute of Mining and Metallurgical Engineers and the Wire Association will participate. More than 250 exhibitors will display metals, equipment, supplies and services.

This year the sole objective of the event is to increase production for war. Many technical sessions dealing with specific problems of production have been scheduled. Numerous government officials will participate with the leading technicians of the metals industries in discussing these problems.

Those who can spare time from the production front to attend the congress and show undoubtedly will be rewarded handsomely. They can obtain in a compact package ideas and information which could not be gained otherwise except at the expense of time-consuming travel and investigation.

E. L. Shaner

Editor-in-Chief

Industrial Campaign Under Way Throughout Nation

Seventy thousand plants asked to search for material; discarded metal from households, mixed with rubber, piled high on corner lots presents problem in collection

DETROIT

LAUNCHING of the nation-wide industrial "dormant" scrap drive over the next 90 days was announced here last Wednesday by Hamilton W. Wright, chief of the Industrial Salvage Section, Conservation Division, WPB, at a conference of 175 automotive salvage officials.

The campaign will include three successive letters addressed to presidents of 70,000 industrial plants, asking managements to inspect their plant properties thoroughly with a view to listing all dormant scrap items and making disposition against this list by Dec. 31.

These letters will be followed by visits to all the plants by the field organization of 140 of the industrial salvage section, with the assistance of 2000 volunteer assistants recruited from steel companies, the American Steel Warehouse Association and the National Federation of Sales Executives.

Dormant scrap is defined as obsolete machinery, tools, equipment, dies, jigs, fixtures, etc., which are incapable of current or future use in the war production effort because they are broken, worn out, unrepairable, dismantled, or in need of unavailable parts necessary to practical re-employment.

Field Men's Purpose

Function of field men and volunteer assistants making calls on industrial companies will be threefold—to help in doubtful cases in the prompt identification of dormant scrap items, to assist in facilitating the disposition of dormant scrap by using all available and pertinent plant manpower, and to obtain reports of approximate dormant scrap tonnage moved within any 30-day period.

Mr. Wright pointed out in his discussion of the drive that between July 1 and Dec. 31 America must collect and move to steel mills 17,000,000 tons of iron and steel scrap, this amount or more being necessary to support the monthly consumption rate of 2,250,000 tons and leave 7,000,000 tons as a balance for steel mill yards on Jan. 1, to carry production through the winter months.

Industrial leaders heading up the special dormant scrap drive include George Rose, secretary of the Salvage Committee of the American Iron and Steel Institute; Walter S. Doxsey, president, American Steel Warehouse Association; C. F. Winchester, executive secretary of Associated Equipment Distributors, and H. R. Doughty, director of field operations on salvage for the National Federation of Sales Executives.

Mr. Doxsey said the warehouse effort will be under leadership of J. J. Hill Jr., Hill-Chase Co., Philadelphia, who has been named chairman of a committee which will include C. E. S. Dickerson, Edgar T. Ward's Sons Co., Pittsburgh; L. R. Moise, Moise Steel Co., Milwaukee, and J. Frederick Rogers, Beals, McCarthy & Rogers Inc., Buffalo.

Meetings of warehouse salesmen in the 19 cities where there are association chapters will be held in co-operation with the regional chiefs of WPB's Industrial Salvage Section.

PHILADELPHIA

Results of the first few days of the popularized national scrap drive have exceeded general expectations, according to reports here late last week.

Scrap from every conceivable source—much of it collected by school children in a fervor of patriotism—is piled high in countless number of places, and its collection now has become a problem.

Here in Philadelphia in addition to a sharp increase in salvage from industrial plants, more than 7500 tons of household scrap was weighed within five days. By end of last week it was estimated 10,000 to 12,000 tons of household scrap would be accounted for. This special drive will continue two more weeks. Meanwhile, plans are being laid for a still more intensive search for industrial

HIGH above Broadway and Seventy-third street in New York, workmen last week were removing one of the cornices which has adorned the Ansonia hotel for many years. Reason is to obtain the copper it contains for use in the war effort. NEA photo scrap. Steel producers' district sales executives held an organization meeting last Thursday. They elected H. E. Richardson, Youngstown Sheet & Tube Co., chairman, and H. C. Husted, Bethlehem Steel Co., vice chairman. WPB representatives outlined objectives. Another meeting later in the week was to be attended by salesmen as well as executives, 80 in all scheduled to be present.

Details of procedure will be worked out, salesmen assigned to visit companies in an effort to develop a still greater amount of salvage material. District steel warehouse salesmen also are being organized. The area as now set up includes eastern Pennsylvania, Delaware, Maryland and Virginia.

The rapid accumulation of household scrap here and elsewhere is presenting a serious task for dealers in handling, processing and evaluating it. The scrap contains a vast assortment of items, and while the drive is primarily for ferrous material, accumulations include other metals and rubber and even rubbish.

The question of price must be settled quickly to expedite the movement to the yards. In some of the smaller communities price formulas have been worked out. For instance, in Reading, Pa., accumulations have been appraised by a disinterested expert, with price per ton set up on a basis of 96½ per cent ferrous scrap for which the dealers will pay a flat price of 50 cents per 100 pounds; 1½ per cent rubber, for which they will pay 1 cent per pound, and 2 per cent metal for which 2¼ cents per pound will be the price.

According to competent observers, accumulations of household ferrous metal here so far run about 90 per cent light scrap, which must be pressed, and galvanized material. This poses a problem at the moment for the yards, as in 20 in the city proper only eight have pressing equipment, 11 presses in all.

Moreover, all yards are short of men as they have lost heavily to the shipyards and other war industries which pay higher wages.

Incidentally, the surprising outpouring of scrap at this time causes some to speculate as to how much of it might have been available sooner if ceiling prices had been set at levels which would have encouraged collections. In other words, considerable scrap has laid dormant. There is little doubt but that a substantial portion of the scrap now being dumped on city lots by individuals would have been brought out earlier through normal routine channels if the venture had been made reasonably profitable to those in the business.

(For earlier news of the scrap drive, see pages 114 and 115).

War Liabilities Board Proposed by Nelson To Facilitate Use of Plants

CREATION of a War Liabilities Adjustment Board to facilitate the use of all productive plants during the war and to assure small business enterprises the opportunity to re-enter a competitive economy after the war ends was suggested last week by WPB Chairman Donald M. Nelson. The proposal was made to a special Senate committee to study the problems of small business.

The problem long has been a. tough one for the War Production Board—and a still tougher one for the small businesses. Numerous plans and efforts to ease the situation have been made by the WPB and other government agencies, through subcontracting programs and other devices, but none, it was said, has alleviated the difficulty.

Subcontracting efforts were satisfactory in many instances in increasing war production but bogged down in solving the problems of many small companies which were unable either to enter war production or to obtain materials to continue their normal lines of goods.

Result has been that small shops unable to convert to war production and plants that have been converted in a manner which did not permit full use of facilities are confronted with extinction or extreme difficulty when the war ends.

Mr. Nelson said he would like the Senate committee to develop possibilities along the following lines:

1. To help small business enterprises adversely affected by the war take care in an orderly fashion of overhanging liabilities which under normal circumstances they would have been able to discharge.
2. To provide effective mechanism for financing small business after the war.
3. To provide effective means for giving small business technical and other assistance at the end of the war.
4. To provide a mechanism for giving to small business enterprises broken up by the war a priority in the acquisition of machinery and equipment when the war is over.

Needs of the war program, Mr. Nelson reiterated, will force the country "to

Small business must be protected from the dislocations caused by the war, Donald M. Nelson, WPB chairman, warned members of a special Senate committee to study the problem of small business last week. Mr. Nelson emphasized that the national problem is two-fold: Getting out the most war materials in the shortest possible time; and preserving small businesses adversely affected by the war. NEA photo cut civilian production and civilian economy to the bone."

Before the war is over, he said, "we shall need to use in some way for essential purposes all the management ability we have, all the manpower we have, and all the materials we have."

For this reason, Mr. Nelson said, there should be no action by the government administrative agencies or by Congress that would tend to immobilize or freeze into a nonproductive state any of the elements of productive capacity—management, materials, labor, machinery, buildings or land.

Wherever possible, he said, war work will be taken to plants that now are in existence. He warned that in many cases it will be necessary to move both men and machinery to other places, but that in no case can useful equipment be allowed to remain idle until the war ends.

Machinery that cannot be put to use for essential purposes, he said, can be made a source for spare parts for machinery which is in use. Failing that, it will be used as scrap.

"The one thing we cannot do," Mr. Nelson told the Senate committee, "is to pack away permanently, in grease or in any other way, machinery and equipment against the end of the war."

"On the contrary, we must in some way know that every existing piece of machinery and equipment, regardless of whose hands it may be in, regardless of whether it is owned by a large corporation or a small shop, is available for use to win the war."

Need Government Help

Pointing out that it may not always be feasible to ask owners to care for machinery which is to be scrapped or dismantled, until such time as it is needed, Mr. Nelson said:

"We need, I believe, to begin setting up under the authority of the War Production Board an agency to buy and hold until needed machinery and equipment in the same way that we are now buying inventories of raw materials."

Making sure that full use is made of the nation's manpower is a joint responsibility of the War Production Board and the War Manpower Commission, Mr. Nelson said. It involves finding people, training or retraining both labor and management, and putting them in the right spots. For that reason, he said, he believed that the War Manpower Commission will institute a more intensive and extensive program for recruiting and retraining the proprietors and the workers of small business enterprises which cannot be employed in the war effort in their present concerns. Hence, he suggested, it may well prove desirable to use many of these smaller plants as training centers for practical production and management work.

Discussing his proposal for a War Liabilities Adjustment Board, Mr. Nelson said:

"As I see it, we are all vitally interested in providing for a sound economy when war is over. To me a sound economy calls for ample opportunity for small enterprises to enter particular fields and add their imagination, initiative and drive to the competitive struggle to provide more and better goods for all of us at continually lower prices. But to me this objective should not involve putting machinery or labor or management brains away in cold storage for the duration of the war."

Materials Requests Under PRP Cut Back To Match Supplies

PRODUCTION Requirements Plan will be modified in important respects for the first quarter of 1943 and completely revised for the second quarter, industries operating under the plan were advised last week. PRP will be retained only as a reporting system, to keep WPB advised of the movement of critical materials, it was said.

Authorizations to receive materials under PRP now are being returned to applicants, WPB Chairman Donald M. Nelson said last week. Original materials requests have been changed to conform with determinations of the WPB Requirements Committee.

PRP applications for the first quarter of 1943 have been approved and will be mailed out as soon as they are received in sufficient quantity from the printer. Schedule for the January-March quarter calls for receiving applications and returning the certificates to applicants before the beginning of the quarter.

Total raw material authorizations for military and nonmilitary production for the fourth quarter have been kept within the limits of estimated supply by the determinations of the Requirements Committee. This is the first time that such a balance has been accomplished in advance.

In adjusting requirements to match the available supply of materials it was necessary to cut back requests of companies under PRP from a moderate amount in the case of direct military items to a substantial amount in the case of less essential items.

All materials authorizations for the fourth quarter will be covered by preference ratings in the AA series. A new AA-5 rating has been established to be applied in certain instances.

All military items and many essential nonmilitary products already were covered by ratings of AA-1 through AA-4. Some of the nonmilitary items included among the quantity determinations of the Requirements Committee were not previously rated in the AA category. To uprate such items in the AA-4 category would place them in competition with military goods already in that class. To avoid this, the new AA-5 classification was established. It will include any remainder of the amounts on approved schedules to which the present PRP pattern ascribes a rating of lower than AA-4.

Average percentage of reductions or cutbacks in requests for authorizations cannot be reached because the factors in individual cases vary widely. Certain basic principles, however, were applied in all cutbacks. These included:

1. Total requests were kept within total supply.
2. End-use was considered so that items most urgently needed were provided for first, and received the least reduction.
3. Material inventory was considered so that reduction on requests was possible in cases where companies had sufficient stock in hand to permit such cuts.
4. Reductions in requests for other materials were considered in making final allocation of a particular material, so that each individual cut was as nearly as possible in proper proportion to the others.

Steel Requests Reduced

Carbon steel illustrates the problems encountered. When all requests were added, it was found that the needs of companies using this type of metal were estimated at 15,400,000 tons for the fourth quarter. This included the tonnage required by those under PRP and the amount set aside for use by consumers not under the system.

Estimated supply was only 11,100,000 tons. A reduction of 4,300,000 tons was necessary.

Requirements for all items made from carbon steel, therefore, were re-examined. Reductions were made first in items not intended for direct military use. Further reductions were made in co-operation with the armed services.

Structural Fabricators Shifted To War Work; 82% for Government

RESTRICTIONS on the use of steel for other than war purposes threaten to close down about one-half the fabricating structural steel capacity of the United States during the coming year. Many of the steel plants already have shifted over to the production of special products required by the Army and Navy.

This, in brief, was the report made to the twentieth annual convention of the American Institute of Steel Construction, Broadmoor hotel, Colorado Springs, Colo., Sept. 29-Oct. 2, by President Clyde G. Conley.

"All-out production for war must draft the brains and organization, as well as the equipment, of the shops fabricating structural steel," Mr. Conley said. "Prefabrication of structural parts has always speeded the construction of bridges and buildings. That technique has been widely extended to meet the needs of war. But the ability to produce, according to special plan and specification, anything made of iron or steel structural shapes and plates has proved of unique value in the war effort. This genius is available to develop new implements, make real the many new and startling ideas that the intense war effort requires and is constantly inventing.

"The same ability to fabricate steel to a plan and a specification is now being applied to a new job—to fabricate steel to a multiple of war uses, to supplement the production line to make "bits and pieces" that our arsenals and our factories may turn out more of everything. That is the job to which this industry is dedicated in the year ahead."

Mr. Conley pointed out that many new materials have been developed and substitute methods have been resorted to. These, he added, will not quietly withdraw at the end of the war and leave the markets to the older industries which formerly dominated them.

Smaller Tolerances Required

"Fabricators have been asked to make strange parts, often to a degree of accuracy that many of them had never attempted before. Government specifications demand small tolerances that may seem impossible of achievement. Plants have been forced to face the technical problem of tooling up, training new operators and retaining their old operatives. Government arsenals had, in the past, maintained some skeleton crews that were available to direct training programs in selected areas and some few fabricators had seemingly had the good fortune to have subcontracted a few articles with the arsenals. But the magnitude of war production was not foreseen and new production processes had to be worked out by industry itself.

"Shifts in structure of the economy during this war period will leave their mark. Whether the country will go into a great period of readjustment, rebuilding and expansion following the war, or into a long period of exhaustion and depression, we cannot tell, but we can be sure that the seeds of the future are now being broadcast.

"In no earlier war was the effort so great in the direction of building up production facilities; in no other war was the sheer magnitude of the expansion even thought of. The productive capacity of the steel industry alone has reached a point where the output can easily double the highest annual prewar consumption. In this war, it would seem, all industrial advances are being made during the years of the armed conflict. It was just the reverse during the previous World War. The advances in industrial productivity of that age came after the declaration of peace.

"In 1917-18 plant expansion was undertaken largely by private capital. For this war, plant expansion has been undertaken very largely by public capital. There is a strong possibility that private management may be compelled, in the years ahead, to share the management of industry, just as the government has already stepped in to share in the management of credit with the private banking system.

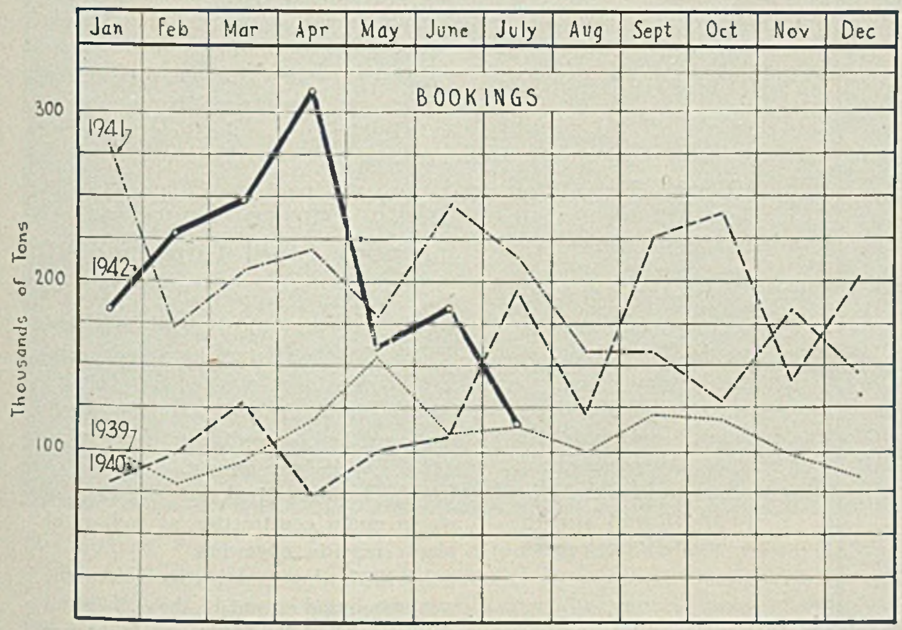
Must Develop Post-War Markets

"The war demands have induced an unprecedented economic change in our steel industry. By stimulating the demand for all steel products, it has brought about an expansion in the productive capacity beyond anything we would have otherwise contemplated. Fabricators and other consumers of steel will therefore find themselves pressed to develop post-war markets. These markets will be mostly domestic, for the war has also encouraged the building up of steel industries in countries never producing steel or which never produced steel in any appreciable quantity. Those previously backward producers will no longer be backward, and consequently we will be driven more and more to increase our own domestic consumption. . . .

"It will be a new world into which we will enter once this war is over, and in this new world we will have industrial problems which only industry can solve co-operatively."

Difficulties which the institute staff has encountered in attempting to obtain new war work for the industry were described by Robert T. Brooks, executive vice president. An impression prevails in government procurement agencies that the structural steel fabricating industry is specialized and concerned only with the building of structures. The impres-

(*Please turn to Page* 308)



Structural steel bookings have declined sharply this year since reaching a peak in April. August bookings of 73,541 *tons, however, compare favorably with those of December,* 1918, *when war-time restrictions first went into effect*

Steel Branch May Add "Labor" Man

WPB Chairman Donald M. Nelson last week said there is a "possibility of a labor man being appointed in the Steel Branch", as part of the overall program for giving labor greater representation in the functioning of the board.

A WPB labor-management committee is being lined up with one more man to pick, he said. Announcement of membership is expected soon.

Discussing the future of the Army-Navy Munitions Board, Mr. Nelson stated representatives of the services were moving into the branch to work with it on the steel program. He said ANMB will continue in existence because a certain amount of adjustments must be made between the services in directing the flow of materials.

War Bureau Heads Recommend Higher Wages in Metal Mines

Concern over the rapidly developing manpower shortage last week led representatives of the War Production Board, the War Manpower Commission and the Army, Navy and Maritime Commission to testify before the War Labor Board in favor of increased wages for copper, lead and zinc miners of the West as one way to guarantee continued production of these critical metals.

Their testimony was placed before the board as it considered whether to grant a $1-a-day increase to the 90,000 men of the industry, recommended by a majority of a mediation panel in an effort to attract back to the mines men who have migrated to better-paying jobs. The Mine, Mill and Smelter Workers union, CIO, acknowledged that wage increases since Jan. 1 have already boosted pay scales over 15 per cent, but William H. Davis, WLB chairman, asserted his board "is not going to tie its hands behind its back" by promising to freeze increases at the 15 per cent level.

$450,000,000 Higher Payroll Seen in Rail Unions' Demand

Railroad brotherhoods representing about 900,000 non-operating employes of the nation's 120 Class 1 railroads last week set Oct. 25 as the deadline for carriers to meet their demand for a closed shop, wage increases of 20 cents an hour and a 70-cents-per-hour minimum wage. Management heads estimated the increases would add $450,000,000 to payrolls and prepared to reject the demands.

The ultimatum, first concerted attempt by the unions to obtain such action since the Railway Labor Act was passed in 1926, ignored the national wage agreement signed last December by both operating and non-operating brotherhoods and the fact that it does not expire until Dec. 31. A 10-cent wage raise granted at that time averted a strike.

WLB Raises Wage Scales of 2000 in Refractory Industry

Wage increases of 3 to 5.5 cents an hour were ordered by the War Labor Board for 2000 employes of ten refractory plants and clay mines of three companies. Increases were held to be necessary by the board partly to remove reported wage inequalities with the steel industry and within the plants themselves and in part to bring wages since January, 1941 up to the 15 per cent advance in living costs.

Companies affected by the order were the Harbison-Walker Refractories Co., and its plants at East Chicago, Ind., and Olive Hill and Brinegar, Ky.; the North American Refractories Co., and its plants at Ashland and Hayward, Ky., Strasburg, O., and Curwensville and Lumber City, Pa.; and Kentucky Firebrick Co., and two of its plants near Haldeman, Ky.

Vast Post-War Consumer Demand Shown by Survey

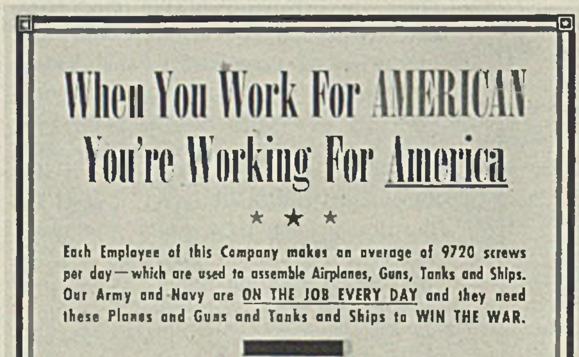
Nation-wide survey of family needs within six months after war ends has been completed by the Chamber of Commerce of the United States and a vast consumer demand is expected to develop. Survey shows that there will be need for 1,500,000 mechanical refrigerators, 1,200,000 washing machines, 1,200,000 radios and 600,000 sewing machines. Demand for automobiles is estimated at 2,100,000, and for electric irons, at 900,000. More than 1,200,000 families will want to buy furniture and rugs, while about 3.4 out of every ten home owners will make repairs. Six out of every ten farmers who own their farms are expected to repair outbuildings or erect new ones.

British Empire Countries Increase Steel Capacity

An estimated capacity of 6,000,000 tons of pig iron and ferroalloys and 6,500,000 tons of steel ingots and castings is soon to be attained by plants in Canada, India, Australia, and South Africa combined, according to a report received by the government.

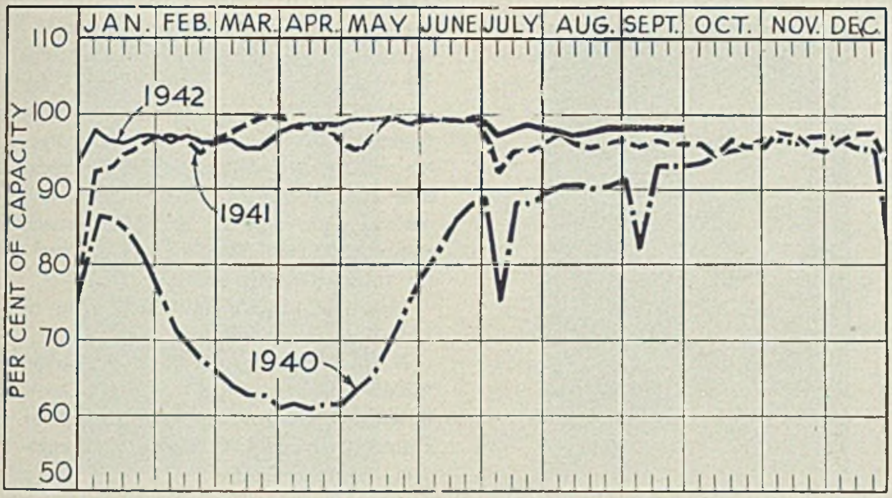
This estimate includes capacity of plants under construction as well as of plants now in operation.

In 1937, the record year before the war, combined output of these countries amounted to 3,800,000 tons of pig iron and 3,600,000 tons of steel. The increased capacity is a result of expansion projects in the major Empire countries.



SHAMES 'EM

ABSENTEEISM was reduced 50 per cent in American Screw Co. plant at Providence, R. I., as result of a poster campaign listing the number of absent workers and the loss of production caused by their absence. Average absenteeism before the campaign started was almost 10 per cent



District Steel Rates

Percentage of Ingot Capacity Engaged in Leading Districts

	Week ended Oct. 3	Change	Same week 1941	Same week 1940
Pittsburgh	96.5	+ 0.5	98	87.5
Chicago	102.5	None	101.5	97.5
Eastern Pa.	96	None	94	92
Youngstown	95	None	98	85
Wheeling	.85	+ 4.5	94	97
Cleveland	92.5	— 1	97.5	88
Buffalo	90.5	None	90.5	90.5
Birmingham	95	None	95	97
New England	100	None	83	88
Cincinnati	88	— 4	81*	90
St. Louis	91	— 1	83	82.5
Detroit	93	— 2	89	94
Average	98	None	*96	*93.5

*Computed on basis of steelmaking capacity as of those dates.

STEEL . . . . STEADY

PRODUCTION of open-hearth, bessemer and electric furnace ingots last week continued at 98 per cent for the sixth week. Two districts made gains, four declined and six were unchanged. A year ago the rate was 96 per cent; two years ago it was 93½ per cent, both computed on capacity as of those dates.

Pittsburgh—Advanced ½-point to 96½ per cent as scrap supply became easier.

Wheeling — Increased production 4½ points to 85 per cent.

St. Louis—One consumer dropped an open hearth for lack of scrap and another added a furnace after repairs, the net result being a decrease of 1 point to 91 per cent.

Chicago—Unchanged at 102½ per cent for the third week, scrap being sufficient to maintain all serviceable furnaces.

Cincinnati—Necessity for open-hearth repairs caused the rate to drop 4 points to 88 per cent.

Buffalo—Four open hearths were down for repairs again last week, the rate remaining at 90½ per cent.

Cleveland—Receded 1 point to 92½ per cent as one interest took off an open hearth for repair, which was not compensated fully by a slight advance by another producer.

Youngstown, O.—Three bessemers and 75 open hearths were in operation, holding the rate at 95 per cent for the third week. Carnegie-Illinois Steel Corp. has blown out a stack at its Ohio Works and Youngstown Sheet & Tube Co. has lighted a stack at Campbell Works.

Detroit—Down 2 points to 93 per cent.

Central eastern seaboard—On steady supply of scrap steel production held steady at 96 per cent.

Birmingham, Ala. — With 23 open hearths in production the rate was unchanged at 95 per cent.

New England—Held at 100 per cent for the third week, recent furnace repairs keeping all open hearths in service.

U. S. STEEL SUBSIDIARY BLOWS IN A BLAST FURNACE

PITTSBURGH: Pretty Jean Rodgers aims a glowing hot rod into the tuyere and a U. S. Steel blast furnace returns to operation at Carnegie-Illinois Steel Corp.'s Clairton Works. The blowing-in ceremony came after rehabilitation of the giant furnace was achieved 21 days ahead of schedule. Miss Rodgers is a granddaughter of William Stewart, veteran blast furnace superintendent at Clairton. Others shown are H. W. Seyler, assistant general superintendent, center, and William Painter, hot blast man. U. S. Steel Corp. subsidiary photo

Fast Time in Building Furnaces for Naval Base

Rust Engineering Co., Pittsburgh, recently constructed several industrial furnaces for an overseas naval base in the unusual time of 47 days, saving 13 days of the 60 allowed by the order.

The order was received the fourth day of a month. By the tenth electrical equipment had been ordered; by the 12th control items; by the 13th all structural steel had been ordered; on the 20th drawings had been completed and all critical materials ordered.

MEN of INDUSTRY

GEORGE W. ROONEY, comptroller, United States Steel Corp., has been elected vice president, comptroller, and a member of the board of directors and executive committee, United States Steel Corp. of Delaware, Pittsburgh. He was appointed comptroller of the corporation, Oct. 1, 1940, advancing from the position of comptroller of National Tube Co., another subsidiary. Mr. Rooney has been associated with U. S. Steel since 1930.

George W. Rooney

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Theodore C. Baer, counsel, Keystone Steel & Wire Co., Peoria, Ill., has been elected a director succeeding **A. G. Heidrich.** Re-elected for three-year terms are **W. H. Sommer**, president, and **D. P. Sommer**, vice president and general superintendent; **A. H. Sommer**, superintendent of the steel mills, has been made a director to fill the unexpired one-year term of the late **Charles W. La Porte.**

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Charles C. Chamberlain has been named general sales manager of Jenkins Bros., New York. He was appointed advertising manager in 1932 and advanced to publicity manager in 1940.

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Roger Stuart Brown now represents Ajax Electric Co. Inc., division of Ajax Metal Co., New York, in the New York metropolitan area, including northern New Jersey and eastern New York state. His offices are at 136 Liberty street, New York city.

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Howard D. Grant has been elected president, and **Stevens H. Hammond**, executive vice president, Whiting Corp., Harvey, Ill., manufacturer of cranes, rotary shears, foundry equipment and other heavy machinery. Mr. Hammond will also serve as chief of the executive staff, other members of which are Mr. Grant and **D. Polderman Jr.**, formerly in charge of the New York office. **R. Elliott Maxwell** has been named vice president in charge of sales in the eastern half of the country. His headquarters will be in New York City. Until recently, Mr. Maxwell was associated with U. S. Steel Corp. as special representative for railroad sales.

Stevens H. Hammond

Howard D. Grant

R. Elliott Maxwell

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Society of Automotive Engineers Inc., New York, has announced new officers for 1943 as follows:

Mac Short, vice president of engineering, Vega Aircraft Corp., as president; **David Beecroft**, products division, Bendix Aviation Corp., as treasurer. Vice presidents elected include **John G. Lee**, assistant director of research, United Aircraft Corp., for aircraft; **S. K. Hoffman**, chief engineer, Lycoming Division, The Aviation Corp., for aircraft-engine; **Grover C. Wilson**, Research and Development Laboratories, Universal Oil Products Co., for diesel-engine; **W. M. Holaday**, automotive research engineer, Socony-Vacuum Oil Co. Inc., for fuels and lubricants; **R. E. Cole**, vice president of engineering, Studebaker Corp., for passenger-car; **G. J. Monfort**, Body Division, Chrysler Corp., for passenger-car-body; **Arnold Lenz**, assistant manufacturing manager, Chevrolet Motor Division, General Motors Corp., for production; **C. G. Krieger**, agricultural engineer, Ethyl Gasoline Corp., for tractor and industrial; **A. M. Wolf**, automotive consultant, for transportation and maintenance; and **E. W. Allen**, coach engineer, General Motors Truck & Coach, for truck and bus section.

Members of SAE Council, term of 1943-44, are as follows:

N. P. Petersen, president, Canadian Acme Screw & Gear Ltd.; **C. G. A. Rosen**, director of research, Caterpillar Tractor Co.; and **J. C. Zeder**, chief engineer, Chrysler Corp.

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C. E. Werner, sales representative, SKF Bearings Inc., Milwaukee, has resigned to become chief engineer, J. W. Hewitt Machinery Co., Neenah, Wis. He was formerly sales engineer for the Galland-Henning Co., Milwaukee.

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Desmond Sprague, mechanical engineer, Sprague Specialties Co., North Adams, Mass., has joined the engineering staff of Curtiss-Wright Corp., Propeller Division, Caldwell, N. J.

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Nelson M. Jenkins has been appointed production superintendent at the Birmingham, Ala., plant, Rheem Mfg. Co. He had previously been associated with Tennessee Coal, Iron & Railroad Co. as assistant superintendent in the tinplate mill.

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W. H. Bowden, a former official of Abrasive Co., Philadelphia, has been named president, Waltham Grinding Wheel Co., Waltham, Mass. Other new officers are **E. Paul Floyd**, formerly with Simonds Saw & Steel Co., Fitchburg, Mass.; **H. A. Johnson**, previously, with the Bonbright Co., New York, treasurer; and **R. L. Lyons**, who has been associated with the Waltham Co., general manager.

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Lawrence E. Riddle, general superintendent, Isabella furnaces, and superintendent of blast furnaces, Duquesne Works, Carnegie-Illinois Steel Corp., completed 50 years of association with the Steel Corp., Oct. 1. He was born in Cincinnati, Dec. 16, 1876, and on Oct. 1, 1892 went to work as sample boy in the laboratory of the Isabella furnaces, Carnegie Steel Co. Ltd., Etna, Pa. He was appointed assistant chemist at the furnaces Nov. 16, 1893. On Jan. 1, 1913, Mr. Riddle became superintend-

Lawrence E. Riddle

ent, Isabella and Lucy furnaces at Etna, and one year later, general superintendent, City Blast Furnace Plants of the Carnegie Co., including the Isabella, Lucy, Edith and Neville stacks. He was promoted Oct. 1, 1935 to general superintendent of City Blast Furnace Plants, Duquesne Works.

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Robert P. Breese, formerly of the Bendix Products Division of Bendix Aviation Corp., has joined General Bronze Corp., Long Island City, N. Y., as industrial development engineer.

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Ralph Bradford, secretary, Chamber of Commerce of the United States, Washington, has been appointed general manager, a new post recently created by the board of directors. For a number of years before becoming secretary, Mr. Bradford was manager of the Commercial Organization Department.

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Charles H. McCrea, vice president and director, National Malleable & Steel Castings Co., Cleveland, has been elected president of the company succeeding the late C. C. Gibbs. He began his career in the engineering department of the Pennsylvania railroad, after graduation from Purdue University. He joined National Malleable in 1913 at its Toledo, O. works, rising through the ranks to the vice presidency in May, 1942.

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W. Louis Bunting and **William S. Jasinsky** have been promoted to superintendent, and assistant superintendent, respectively, of the plate mills, Lukens Steel Co., Coatesville, Pa. Mr. Bunting has been with the company since 1909, Mr. Jasinsky since 1917.

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M. B. Sheik has been appointed project manager for Columbia Steel Co.'s $150,-000,000 Geneva Works in Utah, authorized by the Defense Plant Corp. **E. M. Barber**, vice president, is in charge of the project. **R. C. Talbott**, temporarily in

Charles H. McCrea

charge at Geneva, resumes his position as resident engineer.

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D. L. (Doc) Immel has been promoted to assistant plant superintendent at Copperweld Steel Co.'s Warren, O. plant.

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Fred C. Tanner, vice president ana former manager of sales and engineering, Federal Products Corp., Providence, R. I., has been advanced to general manager of the measuring instruments concern. He was at one time associated with Western Electric Co. as development engineer and with General Electric Co., as chief inspector of manufacturing.

OBITUARIES . . .

John Henry Towne, 73, chairman, Yale & Towne Mfg. Co., Stamford, Conn., died Sept. 29 at Mt. Kisco, N. Y. He was the son of Henry Robinson Towne, a founder of the company. Mr. Towne began work in the Yale & Towne plant following graduation from Massachusetts Institute of Technology in 1890. He was transferred to general offices in New York in 1894, was elected a director in 1898, secretary in 1904, and chairman in 1938.

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George B. Garrett, 49, sales manager of the iron and steel division, Arthur G. McKee & Co., Cleveland, was killed Sept. 24 in a train wreck near Dickerson, Md. He was on his way to Washington where he had an appointment with a war priorities board. Mr. Garrett became associated with the McKee company, builders of blast furnaces and steel plants, soon after his graduation from Case School of Applied Science in 1915.

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Frank Low, 84, vice president and sales manager, Ludlow-Saylor Wire Co., St. Louis, died recently in that city. He had been a member of the concern for more than half a century.

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Herbert L. McKinnon, 72, vice president, C. O. Bartlett & Snow Co., Cleveland, died Sept. 26 in that city. Widely known as a specialist in foundry equipment, Mr. McKinnon was responsible for his company's venture into the field of industrial machinery.

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Wilbur L. Gourley, president, Lehmann Machine Co., St. Louis, Mo., died Sept. 19.

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Harry L. Woodruff, 58, president, Atlas Copper & Brass Mfg. Co., Chicago, died Sept. 21 following injury in an automobile accident in Pontiac, Ill.

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Peter K. Vergot, 58, superintendent, Columbia Scale Co., Chicago, died Sept. 22 in Waukegan, Ill.

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Edward A. Hurley, vice president and eastern manager, Foundation Co., New York, died recently in Quincy, Mass. He was largely responsible for the design of the Bethlehem-Hingham Shipyard and new Fore River Yards ways and wet slip.

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John Gordon, 82, builder of lake coal cranes, died Sept. 26 in Cleveland. A mechanical engineer for Pittsburgh Coal Co. 37 years ago, Mr. Gordon supervised construction of small coal cranes to fill cargo holds of lake vessels. Until his retirement seven years ago, he had charge of construction of the larger car dumpers that line the shores of lake ports.

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Samuel A. Williams, 65, assistant manager, Atlas Car & Mfg. Co., Cleveland, died Sept. 23 in Cleveland.

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James Turner Gibson Sr., 75, superintendent of blast furnaces at Ensley Works of Tennessee Coal, Iron & Railroad Co., died Sept. 17 at his home in Birmingham, Ala.

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Col. Henry C. Nutt, 79, retired president of the Monongahela railroad, died Sept. 26 at his home in Boston. He became president of the railroad following his return from overseas service in the first World War, retiring in 1933.

Bureau of Priorities Control Established by War Board

ORGANIZATION of a Bureau of Priorities Control was announced last week by J. A. Krug, deputy director general for priorities control.

The office will include a deputy director, four divisions and a total of 15 operating branches, an appeals board and a clearance committee.

Edward Falck will serve under Mr. Krug as assistant deputy director general for priorities control.

Top staff members of the bureau, in addition to Mr. Krug and Mr. Falck, are: Dr. A. N. Holcombe, chairman, appeals board; Donald Uthus, chairman, clearance committee; Henry P. Nelson, chief, system planning; Herman Director, assistant chief, system planning; John H. Martin, chief, program liaison; Dr. Samuel S. Stratton, director, priorities review division; Joseph Tucker, director, Canadian priorities; John H. Ward, director, compliance division; C. E. Rhetts, director foreign division, and a director, yet to be appointed, of the materials control division.

Chiefs of the branches within the four divisions are:

Materials control division: PRP Branch, C. M. Schoenlaub, chief; emergency rating branch, D. C. Gallagher, chief; distributors' branch, L. C. White, chief; materials scheduling branch, to be appointed; materials records branch, to be appointed.

Priorities review division: Routing and issuance branch, C. C. Crossland, chief; review branch, W. G. W. Glos, chief; appeals branch, H. T. Bourne, chief; field contact branch, J. J. Burnett, chief.

Compliance division: Survey and analysis branch, H. J. Dowd, chief; business contact branch, Mason Manghum, chief.

Foreign division: Reports and control branch, J. D. Coppock, chief; foreign priorities branch, E. C. Garwood, chief; Russian supply branch, British Empire supply branch, Latin American supply branch, Middle and Far East supply branch, to be appointed.

Steelmakers Get Maintenance Supplies Over PRP Limits

Iron and steel producers will be permitted to accept deliveries of maintenance, repair, and operating supplies in excess of the amounts authorized under the Production Requirements Plan when necessary for essential operations, Ernest Kanzler, Director General for Operations, has announced.

Manufacturers have been notified of this permission by telegram, which makes it clear that the action taken is on a trial basis.

It was pointed out that it is essential to maintain steel mill production and that uncontrollable factors make it difficult to estimate in advance operating and maintenance needs for this industry.

A-1-a Rating Required for Copper Scrap and Ingot

Copper scrap, copper-base alloy scrap and ingot will be available to foundries only when their orders bear preference ratings of A-1-a or higher, the Director General for Operations announced in a letter to the industry.

Essential orders bearing ratings as low as A-1-j heretofore have been receiving some of this metal, but because the need grows constantly more urgent for copper, copper scrap, copper-base alloy ingot and scrap, only special authorization by the Director General for Operations will now enable the metal to be shipped on ratings lower than A-1-a. Primary copper has been available for only A-1-a and higher orders for several months. The new order puts scrap and ingot in the same position as primary copper.

Foundries apply for their requirements each month on Form PD-59 and PD-123, pursuant to Order M-9-b. Authorizations to use metal requested on these forms, beginning with the month of October, will be granted only to requests for metal to fill orders bearing preference ratings of A-1-a or higher. Applications for Form PD-59 are required to be filed with WPB on or before the 5th of the month preceding the month in which delivery is sought.

Industrial-Size Coal To Be Sold at Run-of-Mine Prices

To speed production of industrial-size bituminous coal, mine operators, under certain conditions, will be allowed by OPA to sell crushed coal at run-of-mine prices.

Previously industrial coal (fine sizes) generally sold at prices below those for

RCA WAR RALLY ATTRACTS 60,000

THIRD phase of RCA Mfg. Co.'s "beat the promise" campaign was opened recently with a gigantic rally and war show which attracted more than 60,000 war workers and their families at Garden State Park near Camden, N. J. The crowd, part of which is pictured above, heard speeches by war production leaders, cheered war heroes, laughed at comic impersonations of Axis leaders, thrilled to a program of martial music

PRIORITIES-ALLOCATIONS-PRICES

Weekly summary of orders and regulations issued by WPB and OPA, supplementary to Priorities-Allocations-Prices Guide as published in Section II of STEEL, July 6, 1942

M ORDERS

M-104 (Amendment): **Closures for Glass Containers,** effective Sept. 28. Makes black plate rejects subject to quota restrictions of the order.

M-148 (Amendment): **Exports of Critical Material,** effective Sept. 28. Provides that an order from the holder of an export license issued by the Board of Economic Warfare shall be filled in accordance with the preference rating assigned by BEW. Removes restrictions contained in WPB limitation orders, in so far as they might apply to inventory or use in foreign countries of materials rated by BEW. Holders of outstanding export licenses issued by BEW to which the M-148 allocation stamp has been affixed will rerate the authorization to AA-2X.

M-199 (Amendment): **Silver,** effective Sept. 29. Extends to Nov. 15 period for processing foreign silver, if in process before Oct. 1, 1942. Permits delivery to manufacturers, including laboratory, plating or repair operations. Prohibits sale of foreign silver, semi-processed materials, or scrap except to suppliers or to Metals Reserve Co. Places ban on use of foreign silver in production of all jewelry.

M-227 (Amendment): **Copper Chemicals,** effective Sept. 24. Permits farmers to obtain copper chemicals for soil treatment, insecticides and fungicides without filing PD-600 forms.

P ORDERS

P-118 (Amendment): **Dairy Machinery,** effective Sept. 29. Extends order for 90 days to Dec. 31 by which preference ratings of A-1-j are assigned for maintenance and repairs and A-3 for operating and replacement needs.

L ORDERS

L-64 (Amendment): **Burial Equipment,** effective Sept. 24. Limits use of iron and steel from Sept. 24 to Dec. 23 in joining hardware to 6 lb. per casket and to 4 lb. if casket contains handle hardware assemblies fabricated prior to March 28. Weight of joining, hardware limited to 4 lb. per casket after Dec. 23. Bans use of iron and steel in handle hardware Sept. 24, except fabricated assemblies in inventory prior to that date. Restricts amount of iron and steel in each liner to 50 lb., not exceeding 26 standard gage thickness, except thicker material in inventory prior to March 28. Permits use of lead in liners for caskets and for soldering. Limits use of iron or steel in joining hardware for shipping cases or burial vaults to 2 lb. per unit and for handle hardware to 3½ lb. per unit for shipping cases. Bronze and other metallic finishing materials in inventory on March 28 may be used.

L-104 (Amendment): **Metal Hairpins and Bob Pins,** effective Sept. 25. Restricts production to 25 per cent of 1941 rate, prohibits bulk sales and provides that no more than 100 pins may be included in one package. Ban against purchase of high-carbon steel wire used in manufacture of bob pins is removed.

L-148 (Amendment): **Wire Communication Equipment,** effective Sept. 25. Permits delivery of equipment for telephone and telegraph companies, if it was 90 per cent or more completed by Sept. 8.

L-196 (Amendment): **Used Construction Equipment,** effective Sept. 29. Extends time for owners to register equipment with WPB regional offices to Oct. 31. All owners of the type of machinery listed must file Form 1159.

PRICE REGULATIONS

General Maximum Price Regulation (Amendment): **Silicomanganese,** effective Oct. 3. Authorizes increases of $7 a gross ton in maximum prices for all grades of silicomanganese to basis of $135 per gross ton on the 1½ per cent grade.

General Maximum Price Regulation (Amendment): **Silver Salts,** effective Sept. 22. Permits producers to add to their maximum prices amount per unit by which cost of production is increased as a result of higher silver bullion or silver compound cost.

No. 49 (Amendment): **Iron and Steel Products at Resale,** effective Oct. 1. After Oct. 1, sales of distress or standard iron and steel products destined for export become subject to price regulation No. 204 (Idle or Frozen Materials Sold Under Priorities Regulation No. 13). All other interests engaged in reselling domestically must dispose of idle or frozen items under Price Order No. 49.

No. 230—**Reusable Iron and Steel Pipe,** effective Oct. 3. Establishes maximum prices for pipe other than oil country tubular goods in terms of percentage of jobbers' resale prices on new pipe at 70 per cent of list price of lowest grade of new pipe having the same diameter and weight per foot. Prices for reusable oil country tubular goods are 75 per cent. Provides premiums for segregation and thorough reconditioning.

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run-of-mine. The OPA action, taken in amendment to Price Regulation 10, will permit mine operators to crush lump, double-screened and run-of-mine coal and sell it at run-of-mine prices.

Demand for industrial-size coal, OPA explained, has outrun normal production since Pearl Harbor, and operators naturally have been reluctant to crush higher-price coal to be sold at industrial-size prices.

Scientists To Determine Scope of Office of Technical Development

Appointment of a committee of engineers and scientists to determine the manner in which a projected Office of Technical Development should be set up within the WPB, and to define the scope, functions and method of operations which the office should have, was announced last week by Chairman Donald M. Nelson.

Chairman of the new committee is Webster N. Jones, director of the college of engineering, Carnegie Institute of Technology, Pittsburgh. Other members:

Dr. Lawrence W. Bass, director of research, New England Industrial Research Foundation, Boston.

Dr. Oliver E. Buckley, president, Bell Telephone Laboratories, New York.

S. D. Kirkpatrick, editor, *Chemical and Metallurgical Engineering,* New York.

Col. Clarence E. Davies, Ordnance Department, United States Army, Washington.

Dr. Ray P. Dinsmore, manager, development department, Goodyear Tire & Rubber Co., Akron, O.

Admiral J. A. Furer, United States Navy, Washington.

Dr. Jerome C. Hunsaker, head of the departments of mechanical and aeronautical engineering, Massachusetts Institute of Technology, Cambridge, Mass.

H. W. Graham, director of metallurgy and research, Jones & Laughlin Steel Corp., Pittsburgh.

Additional Advisory Committees Appointed

Additional advisory committees were appointed last week by T. Spencer Shore, chief of the WPB Division of Industry Advisory Committees.

Abrasives

Arthur Batts, Carborundum Co., Niagara Falls, N. Y.; J. H. Byers, Abrasive Products Co., Lansdowne, Pa.; R. R. Cole, Monsanto Chemical Co., St. Louis; A. T. Dalton, Chicago Wheel & Mfg. Co., Chicago; E. B. Gallaher, Clover Mfg. Co., Norwalk, Conn.; W. A. Harty, Exolon Co., Blasdell, N. Y.; C. N. Jeppson, Norton Co., Worcester, Mass.; H. D. Williams, Washington Mills Abrasive Co., North Grafton, Mass.; J. Kuzmick, Manhattan Rubber Mfg. Division of Raybestos Manhattan Inc., Passaic, N. J.; S. B. Leishman, Gardner Machine Co., Beloit, Wis.; T. J. McIntyre, Macklin Co., Jackson, Mich.; W. L. McKnight, Minnesota Mining & Mfg. Co., St. Paul, Minn.; J. W. McLean, Abrasive Co., Philadelphia; A. V. Parker, General Abrasive Co., Niagara Falls, N. Y.; P. R. Shuttleworth, Allison Co., Bridgeport, Conn.

Antifriction Bearings

J. J. Donovan, chief, Replacement Parts Section, Automotive Branch, is the government presiding officer.

Committee members: E. H. Austin, Timken Roller Bearing Co., Canton, O.; V. A. Dupy, United Motors Service Inc., Detroit; L. R. Murphy, Roller Bearing Co. of America, Trenton, N. J.; J. H. Thorsell, Marlin Rockwell Co., Jamestown, N. Y.

Material Requirements Subcommittee, Automotive Replacement Parts

J. J. Donovan, chief, Replacement Parts Section, Automotive Branch, is the government presiding officer.

Committee members: K. J. Ammerman, Borg-Warner Corp., Chicago; B. B. Bachman, Autocar Co., Ardmore, Pa.; F. C. Bahr, Chrysler Corp. Parts Division, Detroit; V. E. Doonan, Ford Motor Co., Dearborn, Mich.; M. D. Douglas, Chevrolet Motor Co., Detroit; A. L. Johnson, Warner Machine Products Co., Muncie, Ind.

Hairpin, Bobpin Manufacture Limited to 25% of 1941 Output

To reduce the amount of steel use in the production of hairpins and bobpins, Order L-104 has been amended to restrict manufacture to a rate equal to 25 per cent of 1941 production. The original order, issued April 25, had already cut production by 50 per cent.

Compared with 1941 consumption, approximately 5700 tons of steel will be saved as a result of the curtailment. In 1941 over 7600 tons of steel were used in the industry.

WINDOWS of WASHINGTON

United States entering era of shortages—of materials, manpower, food, clothing and all civilian goods. Controls over available supplies to become more strict and rationing more widespread

FOR months past responsible authorities in Washington have warned that tough times lie ahead for everybody in this country. Anybody who regards these warnings as cries of "wolf" is making the mistake of a lifetime.

At the risk of further reiteration and repetition, it seems advisable to analyze the prospects—since failure on the part of individual citizens and businessmen to plan wisely for the immediate future may prove embarrassing and costly. It generally is realized that tough times lie ahead, but very few people anticipate just how tough they are going to be.

In girding our strength to fight the war, there first was all-out emphasis on planning, constructing and tooling-up. Then the emphasis was shifted to "conversion" from peacetime to wartime production. Our latest problem has been a lack of materials needed to keep all war plants in full operation.

When this latest phase of the war program became a problem it was not unexpected. There originally was no experience on which to base estimates of capacity to produce machines of war. Contracts were placed right and left for all manner of ordnance, either needed or believed to be needed—and the contractors were urged to get going just as soon as possible and produce as much of every item as they possibly could.

Now it turns out that the productive capacity in the war plants is in many cases far greater than had been anticipated. It may be explained that this result, while presenting new difficulties, has its highly gratifying side. That is, it is easier to slow down production of items that are ahead of schedule than it is to bring them up to schedule.

A manufacturer holding an important production responsibility here illustrates the present condition of unbalance by telling about an incident that occurred at his plant a number of years ago.

Stocks Unbalanced

"During the depression," he says, "we kept our inventories at minimum in order to keep overhead down. One day we had to stop the assembly line because we were all out of bolts of certain needed sizes. I checked into the reason for this shortage and found that three carloads of wire had been delivered to be converted into bolts in our cold heading department. It turned out that all this wire had been manufactured into bolts of three sizes. There we were with enough bolts in three sizes to last for three or four years, whereas we needed 27 other sizes.

"As a result of that lesson we organized a scheduling system of a most comprehensive character and we never again had to shut down the assembly line for lack of needed parts. That is where we are today on the nation's war assembly line. We now are working up the necessary scheduling system."

The thinking as to how this scheduling is to be accomplished already has reached an advanced stage. A workable system is in sight. While it is too early to discuss details, it may be described as aimed at stretching out our materials for maximum possible production, rather than merely trying to fit production to available materials. It calls for planning far in advance, just as private industry in normal times formulates its plans far in advance of their execution. Fortunately the scheduling system is being formulated with the aid of men long successful in production scheduling on a large scale.

Some of the new scheduling already is in effect and it is possible that the problem as a whole will have been disposed of by the end of the year.

The next big problem on the immediate horizon is that of labor supply. Officials concerned with this problem point out that it will be even more difficult to solve than the problem of materials. Many difficulties will have to be overcome in order to mobilize our manpower on the scale that is necessary.

They are pretty well agreed that they cannot do the job unless Congress legislates a draft labor bill under which each individual can be put at the work the country wants him to do. Efforts so far made under the voluntary system have proved unsatisfactory. Men can

Newly organized Production Executive Committee, members of which are shown above at the committee's first meeting, will keep a constant check on the flow of materials into war materials. Left to right: Rear Admiral Howard L. Vickery, vice chairman, Maritime Commission; Lieut. Gen. Brehon B. Somervell, United States Army Services of Supply; C. E. Wilson, chairman; Vice Admiral Samuel M. Robinson, United States Navy procurement; Maj. Gen. Oliver P. Echols, Army Air Force. NEA photo find many reasons for refusing to act on requests that they accept a switch in employment. It is hard, for example, to dissuade miners from going out and engaging in work that pays more, but it will have to be done in order to get out metallics in adequate quantities for the war effort.

Need Labor "Czar"

The job of manpower mobilization involves many possibilities, most of which still remain to be decided. For example, serious thought is being given to closing gold mines in order that the miners may be shifted over to production of more essential ores. No spectacular aspects of manpower mobilization are expected to take form until such time as the War Manpower Commission or some manpower or labor "czar" is clothed with the necessary authority. But manpower needs very shortly will bite deeply, not only because of the vast numbers of men to be siphoned off by the armed forces but also because of the increase in the number of workers to be needed in the production program as now envisioned.

We are producing war goods in 1942 valued at around 45 billions of dollars. President Roosevelt originally asked that this figure be increased to 60 billions in 1943. Recently the Army and Navy raised the 1943 figure to 85 billions—and the officials in charge of production declare that this figure must and will be reached. The latter figure compares with our entire national 1942 income—98 billions!

That figure of 85 billions should be a stopper to every manufacturer who has the least doubt as to whether products he now is making will be subject to limitation orders still to be issued. It is the opinion among responsible leaders in Washington that businessmen have not yet reflected the degree of imagination that is necessary in planning realistically for what may come in future months.

For example, silverware manufacturers recently complained about the order forbidding use of silver in the manufacture of ornaments. Certain senators tried to get alleviation for them but without success, since silver now is a critical metal. It is true that if Congress were to authorize the Treasury to make all its silver available for industrial use, the manufacture of silver ornaments could be continued for a time to come. However, such a move would provide only temporary relief since silver is needed increasingly in the war production program. There is the other question as to how long workers would continue to be allowed to produce ornamental silver, or how long producers of silver ornaments could continue to get electric current and obtain other necessary services and supplies.

What is said about the present status of the ornamental silverware manufacturers applies also to many other manufacturers of products that may in the future come to be ruled out as unessential. Those responsible for production planning repeatedly have made it clear that there is to be no pampering to bolster morale by diverting materials to nonessential production and that the less essential industries, therefore, are going to fare badly.

Each sickness in this war has brought a cure that in turn created another sickness. The critical condition of the supply of materials, together with the coming critical labor shortage, are going to bring new shortages.

One shortage that cannot be avoided, in the opinion of planners, is a food shortage. This will result from a shortage of agricultural workers, a shortage of repair parts for agricultural implements as well as for food processing equipment, together with huge shipments of food to foreign destinations. Transportation also may become a bottleneck. In fact, the trend toward a food shortage already has gained some momentum; fruit crops were left to rot on a substantial scale this summer because pickers were unavailable in required numbers.

The food problem also, it is expected, will require some reorganization since too many experts in one department or another now have something to say about food control. The recent experience with reference to rubber and gasoline taught a badly needed lesson here, that unless responsibility is definitely assigned there can be no effective controls. Hence a food control seems in sight for the near future.

A shortage of clothing very definitely is seen ahead. This also will result from the labor shortage and from the scarcity of repair parts for textile mills. Incidentally, the matter of scarcity of spare parts is getting to be very difficult even in keeping essential industries going. For example, trouble has been encountered in keeping mining machinery going because of lack of repair parts.

Spare Parts Scarce

Something will have to be done about this problem of spare parts, and it will be done under the new system of scheduling now being worked out. However, it is certain that no more than minimum consideration will be given to providing spare parts for machinery such as used in the textile mills. The term "minimum" in the foregoing statement has reference to textile requirements for the armed forces, with minimum quantities for civilians.

Not long ago it was generally believed that the woodworking industry was on safe ground, particularly because wood can be used in so many applications as a substitute for metals. Recently, however, most lumber has been placed under strict priority and use control. Now a general shortage of wood is ahead. The number of lumberjacks getting out the timber has been reduced and will become further reduced. Less labor is available for operating woodworking plants. It will become more difficult to get repair parts for machinery for timbering and woodworking.

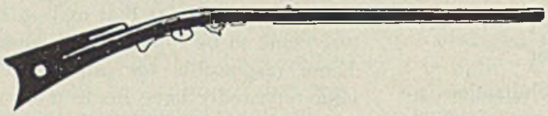
An acute housing situation is expected to appear when it becomes necessary to draft and reassign workers on a large scale. Shortages of labor and of materials necessary to provide housing on the needed scale are expected to combine to form a real problem.

Business from this time forth can expect to see the establishment of one control after another. All of these will be aimed at overcoming some shortage or other, either of labor, materials, transportation or other shortages some of which are not yet foreseen. Many controls will be accompanied by rationing. Rationing of sugar, rubber and fuel oil,

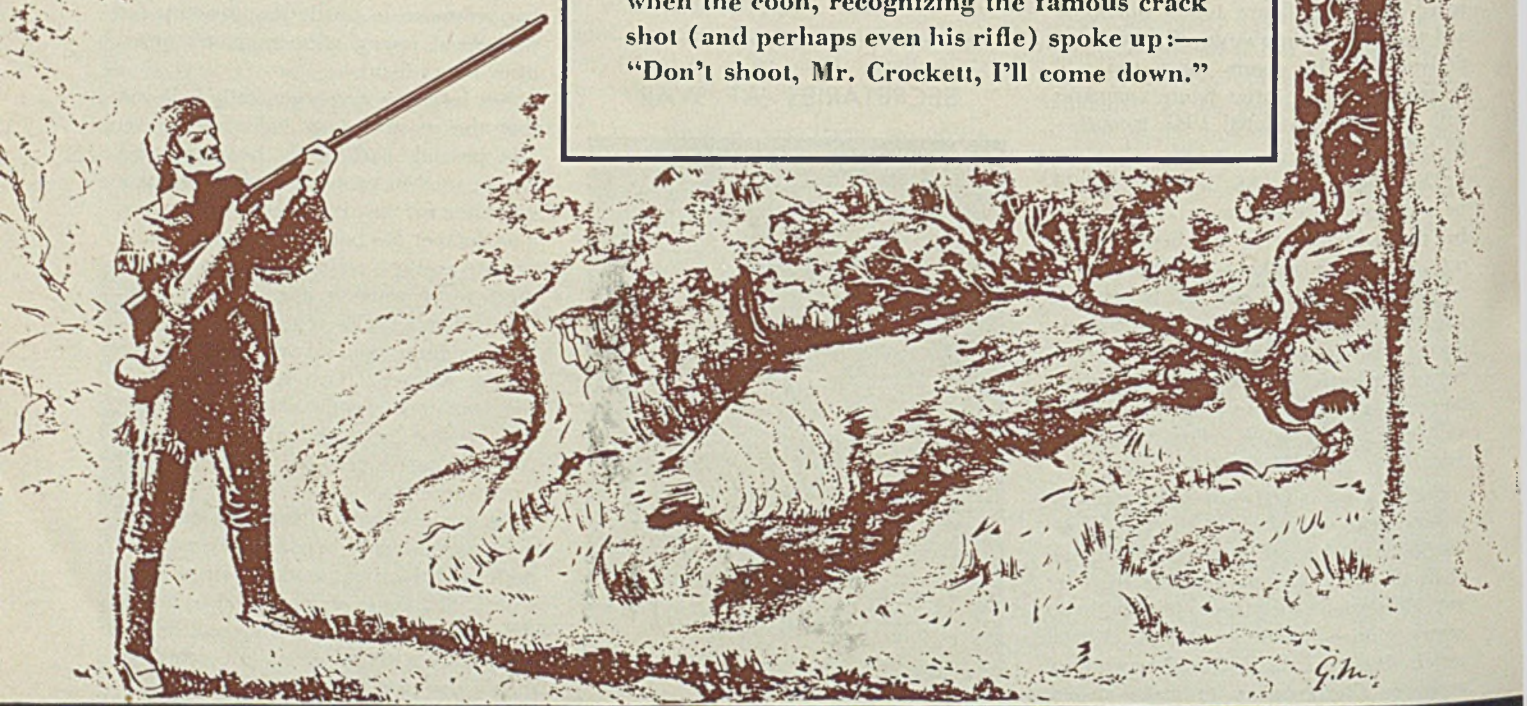
SECRETARIES AT WAR

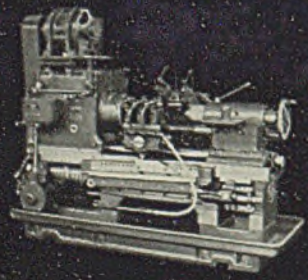
INTO big baskets like the one above, 150 secretaries at Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., dumped 3250 pounds of unnecessary mail and material from files in a 30-day drive. They saved 2610 hours of time, prompted officials to extend the drive to other divisions, "streamlining" office work to aid war work

"Don't shoot, Mr. Crockett"



This country was explored, staked out, settled and defended by men with firearms in their hands. By the time of Texas independence gunsmithing had developed from the trade of the armorer into a much more specialized and refined skill. First to make guns of a degree of precision permitting the interchange of parts were the gunsmiths of the old National Hydraulic Company from which Jones & Lamson traces its industrial ancestry. These superior rifles were in great demand on the frontier and many were supplied to the "Lone Star Republic." A favorite Vermont story of the times deals with the famous frontiersman and patriot, Davy Crockett. One day, armed with his rifle, Crockett had drawn a bead on a treed coon when the coon, recognizing the famous crack shot (and perhaps even his rifle) spoke up:— "Don't shoot, Mr. Crockett, I'll come down."





FAY AUTOMATIC LATHES

AUTOMATIC THREAD GRINDERS

OPTICAL COMPARATORS

AUTOMATIC OPENING DIE HEADS

. . . I'll come down"

HERE in this community the ancient craft of shaping metal first developed modern precision. Because the times demanded better firearms this skill was promptly and earnestly applied to the rifle . . . the one indispensable tool of the pioneer.

But more was accomplished than the making of better guns . . . more was brought down than Davy Crockett's coon. This improved technique literally began the career of the modern high-grade machinist and toolmaker. And from the skill gained in making weapons of destruction came the civilizing force of modern machine tool production.

Today this skill and ingenuity plus all that science and the years can teach are devoted, not only to meeting the needs of industry in time of war, but to anticipating the country's wants in the years ahead . . . when the forces of destruction shall be made to serve the needs of peace.

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and the nation-wide rationing of gasoline, represent only a starter. The current outlook is that before very long most consumer goods will be rationed. Much more could be said about the "tough" situation that lies ahead. The foregoing, however, should suffice to show that it is going to be plenty tough.

Control of Carbon, Alloy-Type Tool Steels To Be Consolidated

New order supplementary to M-21 now is being drafted by the WPB Iron and Steel Branch to "wrap up in one package" control of both carbon and alloy types of tool steels. It will replace and extend the restrictions now applying under Orders M-14, M-21 and M-21-a.

Under the new order, users of tool steels will be asked to use less of the high-molybdenum types (averaging 8.5 per cent moly) and more of the high-speed (18-4-1 or 14-4-2) or middle-group molybdenum types averaging 4.5 per cent molybdenum and 5.5 per cent tungsten.

New regulations will save some molybdenum at the expense of tungsten, it is pointed out, but this will work no further hardship since supplies of the latter are relatively freer than some time ago.

Steps already have been taken to make the provisions of the new order effective through directives which have been sent both to producers of tool steels and makers of metal cutting tools.

Steel producers were instructed to schedule the melting of high-speed Grade II and Grade III, Class A steels on Form PD-440 for October in quantities not more than 70 per cent of average monthly melt during the second quarter of 1942, for November at not more than 50 per cent of such average and for December and subsequent months at not more than 30 per cent. Grade II is high-molybdenum, low-tungsten type, and Grade III high-molybdenum-vanadium type.

Steel producers also were told to diliver in fourth quarter not more than 75 per cent of the combined amounts of Grade II and Grade III, Class A high-speed steels delivered in second quarter of this year, except that the restrictions do not apply to flat-rolled sheets. At the same time, they were told to schedule for melting a sufficient amount of Grade I, Class A molybdenum high-speed steel (so-called 6-S type) to make up for the deficiencies in Grade II and Grade III.

A directive also was sent to producers of metal cutting tools by the Industrial Specialties Branch of WPB advising them to revise requests for delivery in fourth quarter in accordance with these regulations.

Production Directives Stabilize Steel Production, Employment

System of issuing steel and production directives, inaugurated by the WPB Iron and Steel Branch about two months ago, is proving successful in directing the production of the most urgently needed steel products and strengthening controls over output, according to Hiland G. Batcheller, chief of the branch.

A committee of the branch, known as the production directive committee, meets with representatives of each steel producer to plan monthly output by products. The committee investigates all pertinent facts, such as the company's producing facilities, unfilled orders, relative priority ratings, etc., and then formulates a production directive indicating the product distribution for the company on a monthly basis.

This directive reflects the basic determinations of the WPB Requirements Committee. For instance, if the Requirements Committee has determined that 1,100,000 net tons of plates should be made in a particular month (this is the present figure), the total of all directives issued will equal this figure. The part of the total tonnage to be made by each producer is determined by the Production Directive Committee.

Within the limits of each Production Directive, companies must schedule their orders on a priority basis. That is, if a company is directed to produce 5000 tons of bars per month, it then schedules the 5000 tons of bar orders on its books which have the highest priority ratings, and which are to be delivered in the specified month.

In respect to nonintegrated steel companies (those who purchase steel for further conversion) the Production Directives are issued on a slightly different basis. The committee schedules the rate of operations of the producer on a basis comparable to integrated steel companies manufacturing the same product. The directive is then supported by an allocation of the necessary steel from specified integral companies to the non-integrated producer. In this manner, the nonintegrated producer can plan his operations on the same basis as the integrated producer.

The committee has issued 84 production directives, 46 to integrated producers and 38 to nonintegrated producers. Practically all of the integrated producers have been covered but a large number of the nonintegrated companies are yet to be directed. Full coverage of the industry in 30 to 60 days is expected.

Mr. Batcheller said that the production directives are increasing output because of their stabilizing effect. They are also creating steadier employment for labor and providing the means of making changes in the steel product distribution in the best interests of the war effort.

The directives are signed by the Director General for Operations. They remain in effect until changed and are constantly reviewed, and if necessary, revised by the branch.

August Munitions Production Increases 8 Per Cent

Munitions production in August was 8 per cent higher than in July but was 14 per cent below the goal for the month, WPB Chairman Donald M. Nelson reported last week.

Total value of munitions produced and war construction during August was $4,700,000,000.

Mr. Nelson said aircraft output increased 6 per cent; ordnance, 3 per cent; naval ship construction, 7 per cent; merchant shipbuilding, 6 per cent; and other munitions, 14 per cent.

The WPB munitions index, covering all implements of war, shows production now is more than 3½ times as large as in the month preceding Pearl Harbor.

Admitting the increases are impressive by themselves, Mr. Nelson reminded that they still fall far short of the goal and that greater effort must be exerted during the last quarter of the year.

More encouraging was this assurance: "Available information indicates this year our total output of munitions at the least will equal that of German-dominated Europe, including France, Italy and the Balkan states.

"Studies indicate our rate of production already has caught up and passed that of the countries on the European Continent."

Vertical System of Materials Control To Be Instituted by WPB

New vertical system of materials control largely will supplant the present horizontal setup as soon as the machinery can be placed in motion to effect the changeover.

As reported in STEEL last week, the priorities system will be virtually abandoned and replaced with a complete and detailed scheduling plan affecting practically every manufacturer.

The horizontal system wherein materials are allocated or distributed through priority ratings to manufacturers without regard to the quantity of end-products produced works well when materials are only relatively scarce.

The horizontal system, however, fails when extreme scarcities develop in many items. For example, there is extremely competitive demand for the available supply of many types of steel going into ships, tanks, planes and the like. All these outlets merit equally high priority ratings, yet the decision must be made as to which actually should get the steel first.

Under the vertical system, it is first determined what end-products are required in relation to the total amount of material available. The actual job of laying out schedules for these end-products is up to the armed services, the Maritime Commission, and other war agencies, which tell WPB their exact needs. WPB then translates this information into plant production schedules to balance with the material supply. Where necessary, WPB will go back to the services and ask them to revise requirements of finished products. For instance, a number of units might be clipped off the schedule. With the experience of many months behind them the services now are reported to have a relatively clear picture of what is needed.

A number of standard items like bolts and nuts, bearings, fasteners and Mazda lamps accounting for approximately 20 per cent of the total production program must be treated on a horizontal basis, however, since it can be fairly accurately determined what will be needed but not exactly who will take them.

Industry now is nominally operating under the Production Requirements Plan through which some 27,000 concerns have indicated to WPB on Form PD-25-a their material needs for fourth quarter. These forms have not been returned but are due back soon. In the meantime, industry may operate under Priorities Regulation No. 11 which permits receipt of 70 per cent of the material requested under PRP.

PRP cannot be dropped flatly but is the foundation on which an improved scheduling system can be based. The priorities rating system also cannot be dropped entirely. Even under close scheduling on a monthly basis, relative standings on materials must be determined to keep them flowing evenly during the period. For instance, it must be decided whether copper shall be shipped to a user at the beginning of the month or part of it held up until the fifteenth.

Nonessential Use of Tin To Be Further Restricted by War Board

Further drastic reduction in the consumption of tin for nonvital purposes made necessary by a substantial rise in military needs will be effected through a complete rewriting of WPB orders M-43 and M-43-a. At the same time, a 50 per cent reduction in tin plate quotas for fourth quarter as compared with the average for second and third quarters will effect an immediate cut in the amount of tin used during the remainder of the year.

While the lower tin plate quotas now being worked out for the final quarter of this year partially reflect the off-season period in the canning trade, it is believed that the reduction will be continued into 1943.

While details of the new tin control are not yet available, it is likely to require further changeover to lead-base bearing alloys in place of tin-base; substitution of tin-lead alloy for tin in coating copper wire; further reduction in use of tin in solders; use of more low-tin or tin-free bronzes and more complete control over tin plate for use in containers.

The canning industry will be required to use electrolytic tin plate for an extensive list of applications, including sanitary cans. Practice in making electrolytic tin plate has been so improved that it may be used for many purposes for which canmakers previously deemed it inadvisable.

Coatings on hot-dip plate already are being held down to a maximum of 1.25 pounds per base box but makers of electrolytic plate will be required to shoot for a top of 0.5-pound per box. Even when the new electrolytic units now being constructed go into production, a maximum of 0.7-pound has been set until a definite practice has been established. One unit will be in by the end of the year and four others are expected in by April 1.

It is indicated that hot-dip plate will be used only for a limited number of applications. In fact, tin plate may no longer constitute the principal outlet for tin.

No fear is expressed in Washington that insufficient supplies will be available for military uses. Although the Axis has cut off the source of principal supplies prior to the war, production has been greatly stimulated in other quarters, including the Belgian Congo, Nigeria and Bolivia. Output of the Texas City, Tex., smelter with an annual capacity of 52,000 tons also is increasing satisfactorily.

Exports Made Subject To Preference Ratings

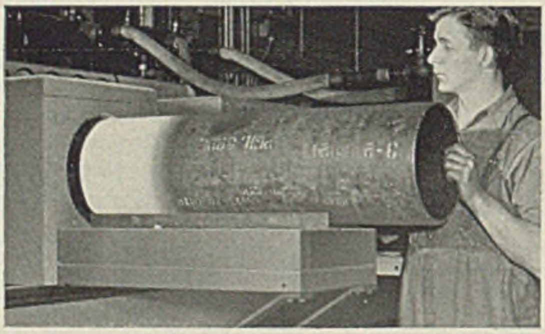
As a part of current moves to centralize control of materials distribution in the WPB, deliveries for export under General Exports Order M-148 have been made subject to the assignment of preference ratings.

The General Exports Order as amended provides that an order from the holder of an export license issued by the Board of Economic Warfare shall be filled in accordance with the preference rating assigned to the order by BEW. Specific authority to assign such ratings for definite amounts of materials will be delegated to BEW by the Director General for Operations. Previously, orders from the holders of export licenses were in certain cases given preference over all others.

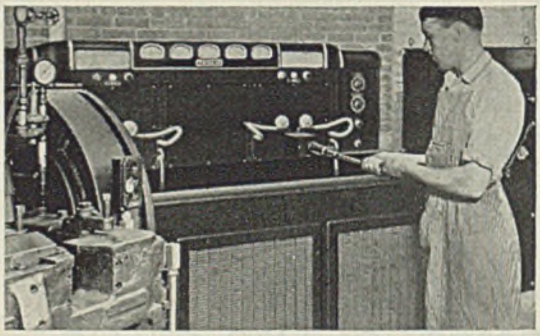
Quotas of material for export to foreign countries will continue to be assigned as before by the Requirements Committee and export licenses and preference ratings covering the materials in these quotas will be issued by the Board of Economic Warfare. BEW will continue to be responsible for determining the amounts which will go to individual countries and individual purchasers within the assigned quotas.

1 This one-inch diameter stock is TOCCO-heated to 2000° F. in 8 seconds for upsetting. Almost instantaneous heating by electrical induction practically eliminates scale, increasing die life and making possible closer tolerances and improved finishes.

How TOCCO prolongs life of forging dies . . . increases working efficiency



2 A 10″ section of 10¾″ pipe (⅜″ wall thickness) heated to 1800° F. in 75 seconds. TOCCO Jr. inductor coil makes possible uniform, localized heating for accurate forming of that section.



3 This TOCCO Jr. is located handy to related forming equipment. Cool, clean and compact, it provides good working conditions for efficient production. Doesn't require skilled labor.

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World's Fastest, Most Accurate Heat-Treating Process

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Engineers perfect metal-saving methods for manufacture of armament. . . Intensified scrap policy enunciated. Will mean disposal of additional quantities of tools, dies, fixtures

DETROIT

FOR a good many years, the No. 1 job of design and process engineers of the motor companies has been a constant vigil over manufacturing methods to see that maximum utility of materials and equipment was being realized. Under the stern whiplash of costs, they explored every avenue of substitution, conservation, simplification. Their efforts made the motor car what it is today, and if occasionally they fell behind, the competitive "hot-foot" soon stirred them into action again.

Today it is all different. The cost and competitive incentives have been suspended and the pressure is entirely on getting out the stuff ahead of time. However, another factor, conservation of critical materials, is of paramount importance in war production, so engineers still are being spurred on to developing materials and equipment in the interests of conservation. It is work with which they are all familiar, even though the incentive goes under a new name.

As the largest unit in the motor industry, General Motors Corp. has had many engineers and production experts concentrating on the problem of conservation. Their work has been slowed somewhat by the difficulty of "selling" the armed services specifications changes, but this obstacle is not nearly as serious as it was even a year ago.

A number of case histories can be cited to show important savings in critical materials which automotive engineers have achieved in war products, savings which C. E. Wilson, GM president, says "can be regarded as typical of what the automotive industry, and industry generally, is doing. They are the dividends which the government is collecting from our investment over the years in engineering production know-how. As time goes on, there will be many more such developments as our engineers and production men become more familiar with the new products they have been called upon to produce."

Here are brief details of a few case histories involving materials conservation:

1. Until recently one part of an antiaircraft gun had to be "chewed" down from a 56-pound solid steel forging to a 6-pound hollow slotted cylinder. Pontiac engineers suggested the forging be replaced by steel tubing welded to a forged base. Result—a saving of 42 pounds of alloy steel scrap per part.

2. Guide Lamp Division perfected a method of drawing army truck headlamp reflectors from steel instead of brass. The new method uses 78,000 pounds of steel and 5 pounds of aluminum per 100,000 vehicles, while the old system required 65,000 pounds of copper, 32,000 pounds of zinc, 275 pounds of nickel and 160 pounds of silver for the same number of headlamps. Estimates indicate the following monthly savings realized by changes in lighting equipment: 21,000 pounds of copper, 12,000 pounds of zinc, 6000 pounds of rubber, 2300 pounds of chrome steel, 240 pounds of aluminum and 135 pounds of nickel.

3. Chevrolet found it possible to reduce the thickness of the copper rotating band on shells without affecting performance, sought and obtained approval from Ordnance on the change, and effected a saving in copper amounting to 65,000 pounds per million shells.

In the case of trucks, Chevrolet estimates alternate materials have saved, for every 100,000 units produced, a total of 5,000,000 pounds of crude rubber, 1,200,000 pounds of nickel, 500,000 pounds of copper, 200,000 pounds of chromium, 125,000 pounds of latex and 70,000 pounds of tin.

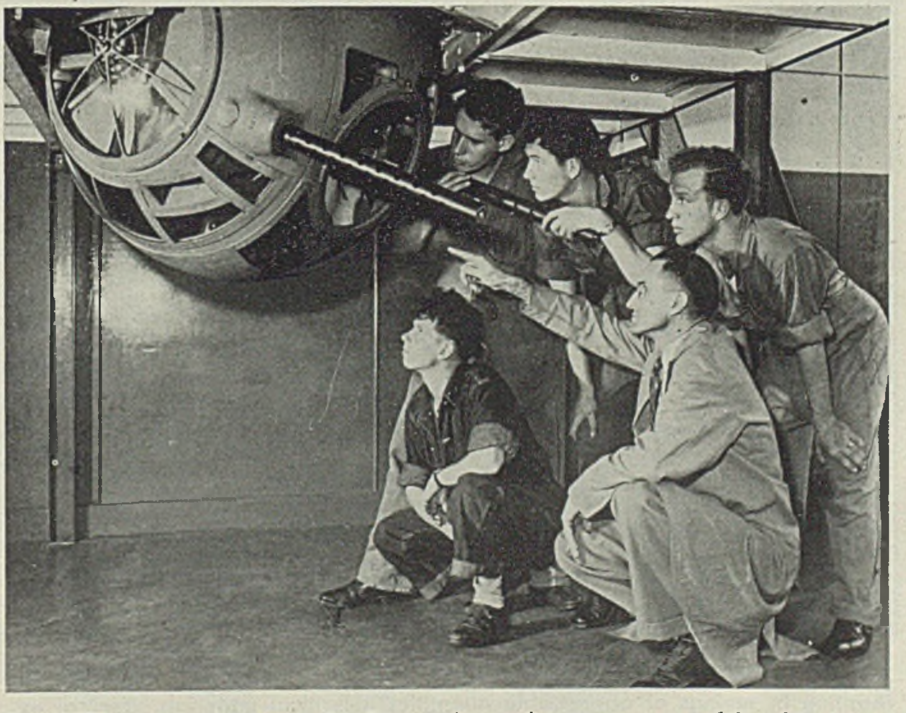
4. Delco-Remy Division has substituted battery cases of asphalt and cotton linters in place of hard rubber, and has redesigned battery grids so that only 7 per cent antimony is used in the lead instead of the former 11½ per cent.

5. Delco Products Division is saving 100,000 pounds of bronze yearly by eliminating two bronze bushings in shock absorber castings for trucks. The castings now are bored to finished bearing size. Another saving of 3½ pounds of aluminum per motor has been achieved by redesigning the rotor, using copper bars for conductors and making fans of cast iron.

6. A difficult war assignment was the production of rotator vanes for superchargers on aircraft engines. Cadillac designed special machines for the job, changed it from more or less hand machining to mass production and, in addition to important time savings, cut down on steel forging requirements to the extent of 496,000 pounds a year.

7. Engineers of AC Spark Plug Division asked why it would not be more sensible to start with a thin steel plate

SOLDIERS STUDY TURRET MAKE-UP AT PLANT SCHOOL



ENLISTED men in the Army Air Forces dismantle a new type of bomber turret in the turret maintenance school operated by Briggs Mfg. Co., Detroit, where several hundred men are being given technical training, the first class graduating Sept. 19. Briggs has erected a new blackout plant for construction of these turrets and production is now well under way and build up the thick end of a machine gun side plate by upset forging. Conventional method has been to start with a thick plate and shave half the thickness off except for a bump at one end. The Ordnance Department finally approved the suggestion which brought a saving of 9 pounds of steel per gun, as well as many hours in time required for machining.

8. Need for conserving copper prompted engineers of the Harrison Radiator Division to redesign heat exchangers or radiators for aircraft engines. In the case of one aircraft radiator, aluminum construction was substituted, not only saving 84 pounds of copper per unit, but saving production time and adding 52 pounds to the airplane's load-carrying capacity.

9. Several GM divisions are saving on high-alloy tool steel by making tools of carbon steel except for a thin strip of tool steel welded on the cutting edge. In one case, only 0.7-pound of high-speed steel now is used per tool, instead of the former 10.3 pounds.

10. Buick engineers found that changing from steam hammer to upset forging would save 19 pounds of steel on each propeller shaft forging being made for aircraft engines. Also, a change from steam hammer to forging press saved 7 pounds of steel on every fixed reduction gear for these engines.

GM plants, incidentally, have reached an employment level well above any peacetime peak ever recorded, during the week ending Sept. 13 figures showing total employment in the U. S. of close to 313,000, compared with 291,808 in June, 1941, highest previoius record. Of the new high total, 254,000 are hourly rated and 59,000 salaried, and in the former group approximately 12 per cent are women. Employment continues to gain at a rate of around 4000 a week.

Hours worked per week also are at a new high level, for the week ending Sept. 13 being 46, compared with 38.8 hours in the corresponding week a year ago, or an increase of nearly 19 per cent.

Deliveries of war materials from GM plants in the U. S. and Canada for August totaled $205,667,029, increase of 31 per cent over July and bringing total deliveries this year just short of a billion dollars. This is two and a half times the deliveries of war products in 1941.

Salvage representatives of the motor industry met at dinner last week to review results of intensified industrial scrap collection efforts since June 1, to listen to comment by Bureau of Industrial Conservation officials from Washington, and to lay the groundwork for a still further concentrated program in the weeks ahead.

In the scrap drive which began in June, a three-month survey reveals a total return of 337,000 tons of metal scrap from motor industry plants, this being exclusive of metal used in furnaces and foundries operated by the plants themselves. Motor vehicle, body, parts and tool and die companies collected and shipped 297,000 tons of production scrap in the June-August period, in addition to 40,000 tons of dormant scrap obtained from obsolete buildings, machines and tools. Of the total haul, 319,000 tons were iron and steel, 18,000 tons nonferrous metals. In addition, reporting companies released for scrap more than 5500 tons of material held by their vendors.

In a new statement of scrap and salvage policy the industry has pledged the scrapping of all tools, dies and fixtures used in production of replacement parts where demand indicates such tools, dies and fixtures are no longer necessary for maintenance of essential transportation facilities. This is another step beyond the policy enunciated in June, and will result in more production equipment going to the scrap pile. It is manifestly unfair to narrow down retention of tools and dies by the date of a model year, because of variation in manufacturing policy between companies.

This much can be said about scrapping of equipment in the auto industry: The industry realizes perhaps even better than government salvage officials do the need for scrap. It also knows, or at least is in a position to know, the utility of tools, dies and equipment in inventory. There is no person or group in better position to weigh these two factors than the industry itself. Rest assured iron and steel will be consigned to scrap the moment its utility has been disproved.

Public collection of scrap in the Detroit area a week ago resulted in one of the motliest collections of junk imaginable, but still totaling in excess of 10,000 tons. The collection was adjudged an overwhelming success, but it might be pointed out that even if all the material were suitable for open-hearth furnace charging—and certainly not over 90 per cent of it was—the available tonnage would be sufficient to fill the needs of one local steel mill for only four or five days.

REPLACE FORGING WITH TUBING TO CONSERVE STEEL

ADAPTATION of automotive production methods to armament manufacture is resulting in savings of appreciable quantities of critical materials. Typical example is this part for an antiaircraft gun, formerly machined from a 56-pound solid steel forging, resulting in 50 pounds of scrap steel. Engineers replaced the forging with a 14-pound piece of steel tubing, welded to a forged base, with the result only 8 pounds of scrap. The two piles of scrap turnings show the difference between the old and new methods

"Ghost Towns" Hold Many Tons of Scrap

Old mining equipment in Colorado now only accessible by truck; Will government help?

BELIEVING there is a larger tonnage of steelmaking scrap in the Colorado mountains, Colorado Fuel & Iron Corp., Denver, sent out "a scrap prospector" with camera on a searching expedition.

That the belief was well founded is proved by the pictures he obtained, a few of which are presented on this and following page. "The scrap is there, and the steel company's furnaces need it badly," it is reported. The chief difficulty in obtaining it is the heavy cost of reclaiming and transporting, far over ceiling prices which may be paid by the melter.

The area covered in the reconnaissance formerly was the site of many mining camps, long since abandoned. It includes the Central City, Black Hawk, Russell Gulch and Idaho Springs districts. The equipment, mainly heavy steel machinery, was shipped in by railroad, which were built to carry out gold and silver. After the mines ceased to operate, the tracks were removed and the only access at present is by motor highways.

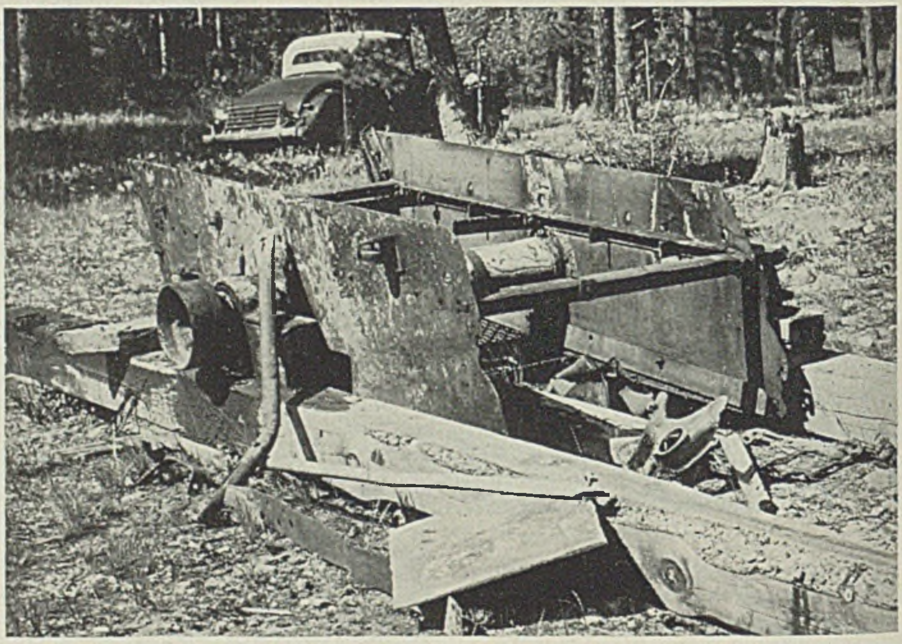
Recovery Cost High

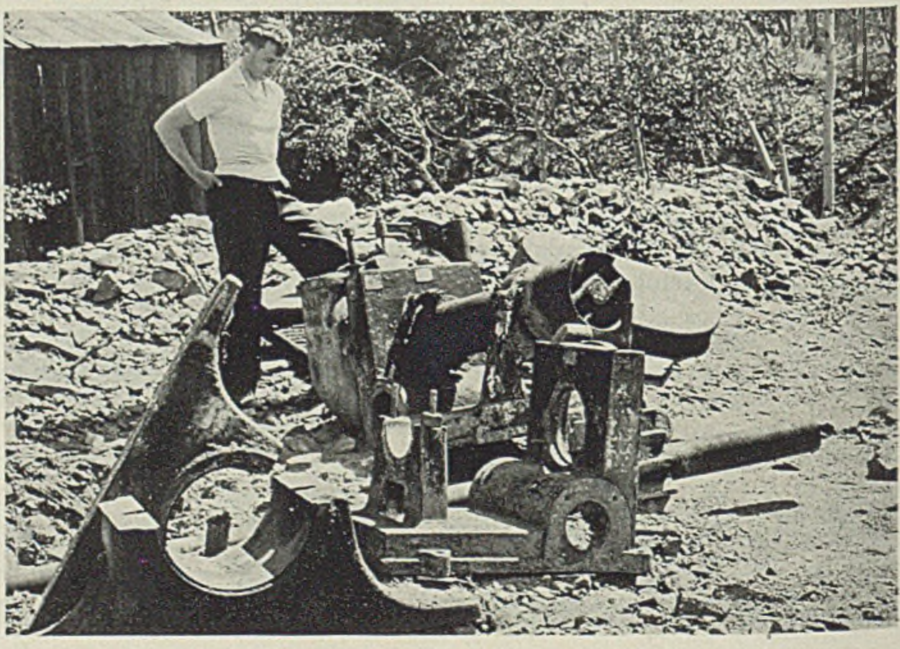
This complicates the problem of removing the scrap. It must be broken or cut to sizes that can be transported by motor truck, carried 50 miles or more to the nearest points of preparation, there graded, loaded and shipped by rail to the steel mills at Minnequa, Colo. The overall cost is estimated to equal, and usually to exceed, ceiling prices of the grades it will make. Examination of the photographs indicates the resulting scrap would be of the highest grade and forms a most tempting source of material.

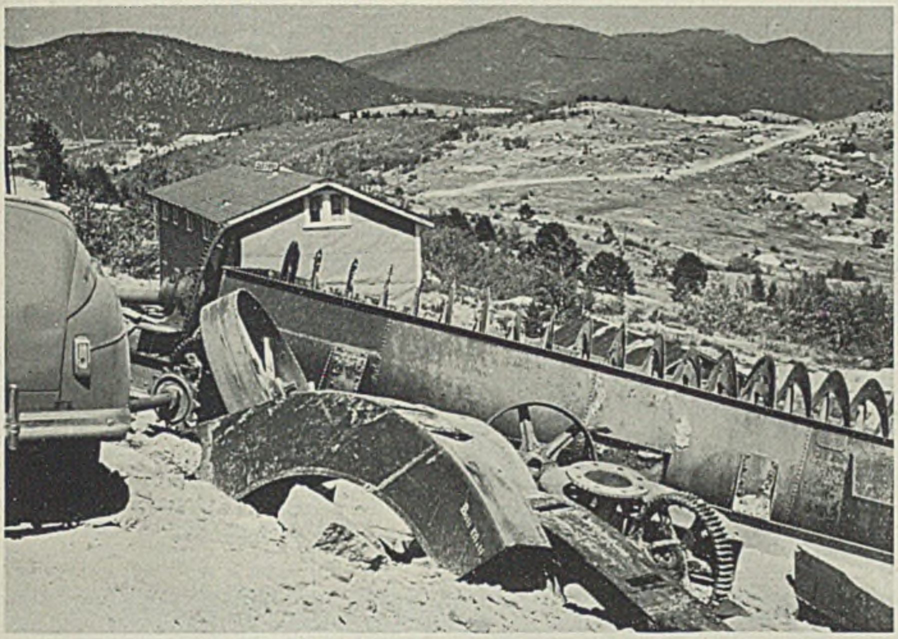
The company has sent a report to Washington, illustrated with many photographs, and is seeking assistance in moving the material to enable it to buy at ceiling prices.

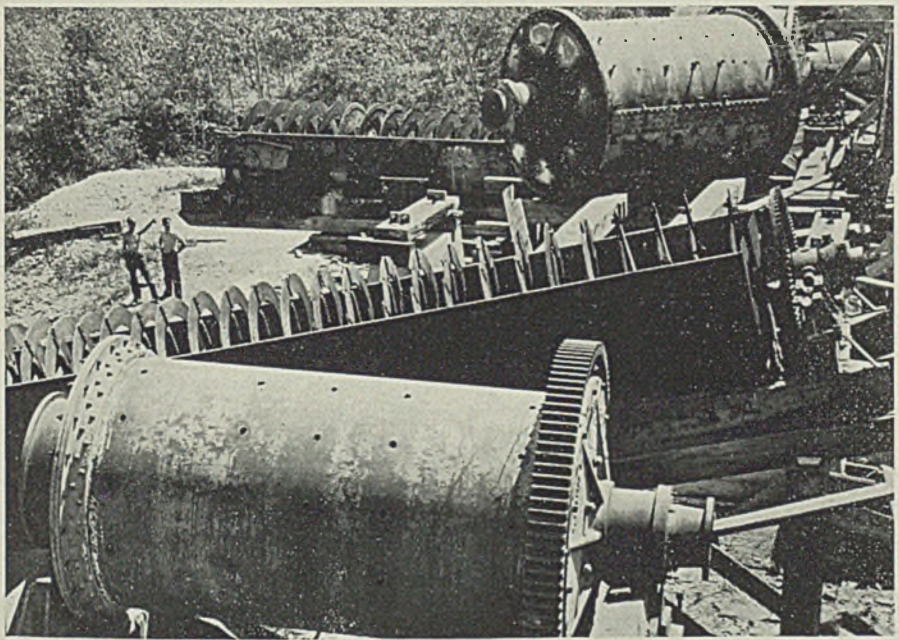
The company has a surplus of slightly more than one month's supply of scrap. It is striving to accumulate a stock of 100,000 tons by Nov. 1 to insure uninterrupted operation through the winter. Current receipts are insufficient to support present schedules.

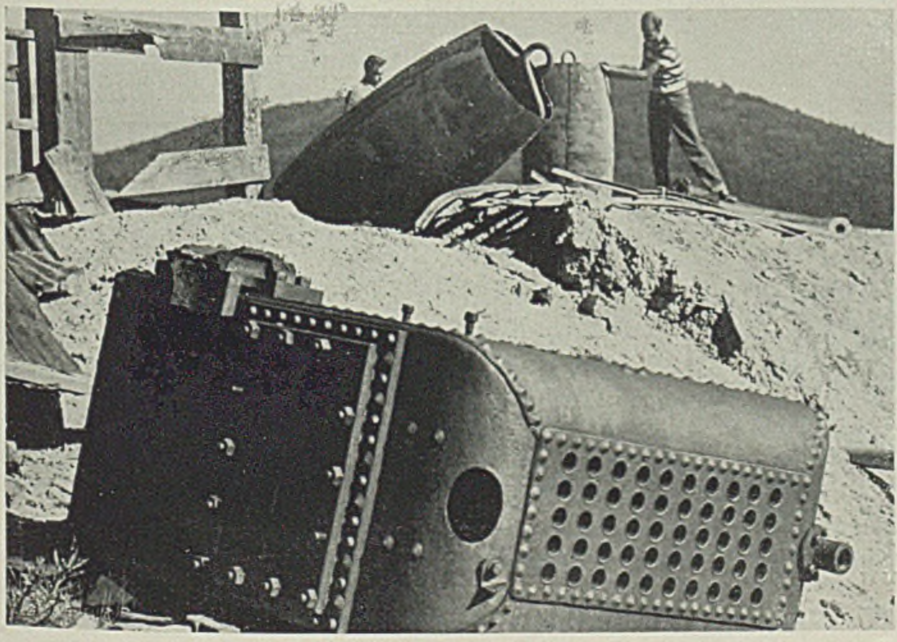
The problem is to provide dealers with methods of removing the remote scrap at a price below the ceilings, with a combination truck and rail haul, double











Thousands of tons of good scrap were found by the Colorado Fuel & Iron Corp.'s "prospector" recently, but the problem is how to get it out, since railroad tracks were removed when mining towns were abandoned. The photos—from a collection of a score or more—were made within 50 miles of accessible reclamation points. A considerable portion of the old equipment will have to be cut up before moving by truck

—o—

handling and in many instances preparation at both the point of origin and prior to freight car loading. The only solution in sight, under the ceiling price plan, the company states, seems to be financial assistance by War Materials Inc., organized recently to absorb excess cost in salvaging essential material.

In Washington it was learned by STEEL, that the problem is considered to be complicated by "pressing need for full-time mine operations in order to make available maximum quantities of metallics for the war production effort." Recently there has been difficulty in getting repair parts for mining machinery and equipment. Hence, it is the prevailing thought that no mining equipment should be scrapped unless it has been inspected by a United States Bureau of Mines engineer and approved for conversion to scrap. It is hoped that much of the idle mining equipment will serve as a reservoir for procurement of repair parts.

Weir Calls for Still Broader Scrap Drive

PITTSBURGH

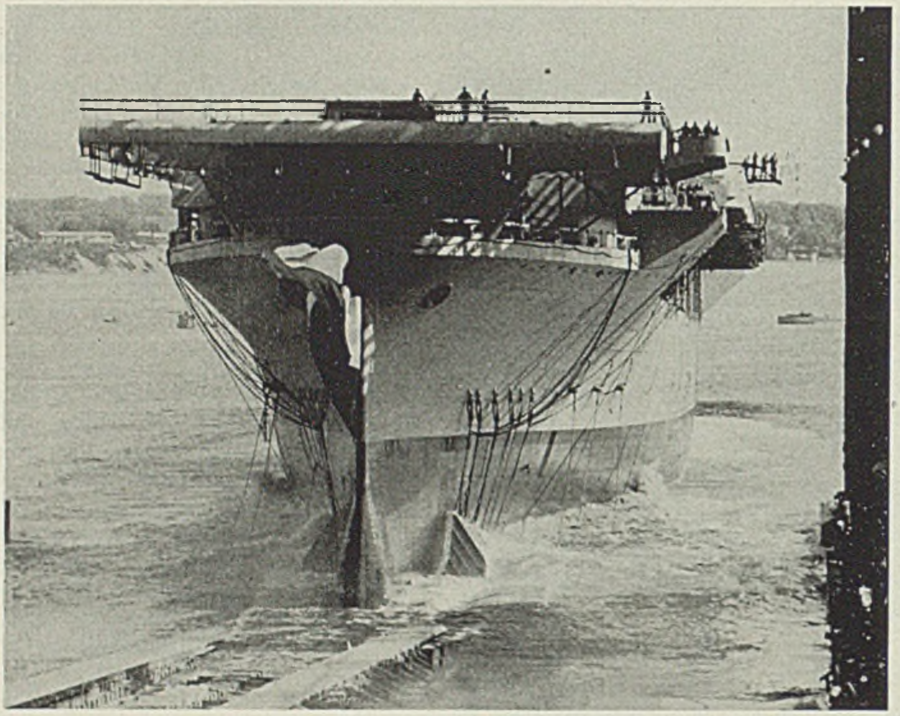
There is still a lack of understanding of the scrap problem and its seriousness in high places, both in government and in industry, according to E. T. Weir, chairman, National Steel Corp. Although some plants apparently now have adequate supplies, the availability will decline as winter comes on. The real test may come in the following winter when non-recurring sources of scrap have been cleaned up, Mr. Weir stated.

What is necessary now is "a universal drive to arouse public consciousness of this program and the need for scrap, not only from homes, but from every point at which it can be found."

Citing Weirton Steel as an example, he said producers are still digging into their scrap reserves instead of building up accumulations.

Regarding substitution of pig iron for scrap in production of steel, Mr. Weir indicated that "every pound of metal, either in the form of scrap, pig iron or

(*Please turn to Page* 308)



A full year ahead of schedule, the new aircraft carrier Lexington *slid down the ways last week at the Quincy, Mass., yards of Bethlehem Steel Co. Survivors of the old* Lexington, *sunk five months ago in the Coral sea, witnessed the launching. NEA photo*

Merchant Vessel Program "On Time"

ATTAINMENT of the shipbuilding goal of 8,000,000 tons during 1942 and 16,000,000 tons in 1943 appears reasonably certain of accomplishment, according to Rear Admiral Emory S. Land, chairman of the Maritime Commission.

Admiral Land said American yards now are producing at the rate of three ships a day—90 in September aggregating about 1,000,000 tons. Production time for Liberty ships has been reduced from an average of 241.8 days for all yards in January to 70 days in September.

"These records indicate still further reduction in average production rate," the admiral predicted.

Noteworthy among new ship construction records was the feat of Henry J. Kaiser's Portland, Oreg., yard in launching a 10,500-ton cargo vessel ten days after the keel was laid. The sensational records achieved by the Kaiser yards on the West Coast in breaking speed record after speed record has been credited in part to his possession of huge cranes which permit the assembly of large prefabricated sections.

Admiral Land is reporting to President Roosevelt on the first anniversary of the launching of a Liberty ship, said that 488 vessels had been delivered, aggregating 5,450,000 deadweight tons. Of these, 327 were Liberty vessels, 49 C-type cargo ships, 51 tankers, 5 ore carriers, and 56 cargo ships for private and British account.

Since January, 1941, the admiral said, shipyard capacity for the production of ocean-going merchant ships has been more than tripled, and the United States production now is considerably more than that of all other countries combined. This country has more than 60 yards and 700 plants in nearly all states are producing ship materials.

Twenty thousand workers from the New York labor market are being recruited by the Henry J. Kaiser organization for employment in his West Coast shipyards where records for speed in shipbuilding fall steadily. Lower left, some 500 of the easterners clamber aboard a special train in Hoboken, N. J., for the trip west. At right, a keel is laid in the Kaiser yard at Portland, Oreg., where a 10,500-ton Liberty ship recently was launched 10 days after the keel laying. NEA photos

Col. J. S. Seybold, United States Army, presents the production award to H. K. Porter Co. Inc., Pittsburgh, 76-year-old manufacturer of locomotives, now working 100 per cent on locomotives and other ordnance equipment for the United Nations. President T. M. Evans, at speaker's stand, receives the award for management; John Thiery, employe since 1894, accepts for workers. (Right)

August H. Tuechter, president, Cincinnati Bickford Tool Co., receives floral tribute on behalf of company directors from J. Schmudde, representing employes, at presentation of Army-Navy pennant to the firm. Looking on are Comm. H. Mosler, Navy; Col. F. A. McMahon and Lieut. Col. W. R. Martin, Army (below)

Employes cheer presentation of the "E" burgee to William Sellers & Co. Inc., Philadelphia, 94-year-old builder of machine tools. Holding the pennant are Maj. R. G. Allen, United States Army; Comm. J. F. Cleary, Navy; Eugene C. Clarke, president of the company, and Carl L. Wright, chairman of the employes' shop committee

More Firms Receive Production Pennants

Inspiration Consolidated Copper Co., Inspiration, Ariz.
Magma Copper Co., Superior, Ariz.
Miami Copper Co., Miami, Ariz.
Phelps Dodge Corp., Morenci Branch, Morenci, Ariz.; United Verde Branch, Jerome, Ariz.; New Cornelia Branch, Ajo, Ariz.
Kennecott Corp., Nevada Consolidated Corp., Ray, Ariz.
Aberfoyle Inc., Norfolk, Va.
Accurate Brass Co. Inc., Glendale, Long Island, N. Y.
Bonney Forge & Tool Works, Allentown, Pa.
Briggs Mfg. Co., Detroit.
Cessna Aircraft Co., Wichita, Kans.
Corbin Screw Corp., New Britain, Conn.
Couse Laboratories Inc., Newark, N. J.
Electric Auto-Lite Co., Toledo, O.
Federal Motor Truck Co., Detroit.
Ford Motor Co., Chester, Pa.
General Steel Castings, Granite City. Ill.
North American Aviation Inc., Inglewood, Calif.
North American Aviation Inc., Dallas.
O'Connor Machine Co., Sheffield, Pa.
Osgood Co., Marion, O.
Vultee Aircraft Inc., Vultee Field, Calif.
Westinghouse Electric & Mfg. Co., Baltimore.
American Tool Works Co., Cincinnati
Bausch & Lomb Optical Co., Rochester, N. Y.
Diamond-T Motor Car Co., Chicago.
Specialty Screw Machine Products Co. Lancaster, Pa.
Electro-Metallurgical Co., Niagara Falls.
Burgess-Norton Mfg. Co., Geneva, Ill.
American Zinc Co. of Illinois, Monsanto plant, Monsanto, Ill.
Budd Wheel Co., Detroit.
Colorado Fuel & Iron Corp., Pueblo, Colo.

Equality of Pay Granted to Them by Labor Board

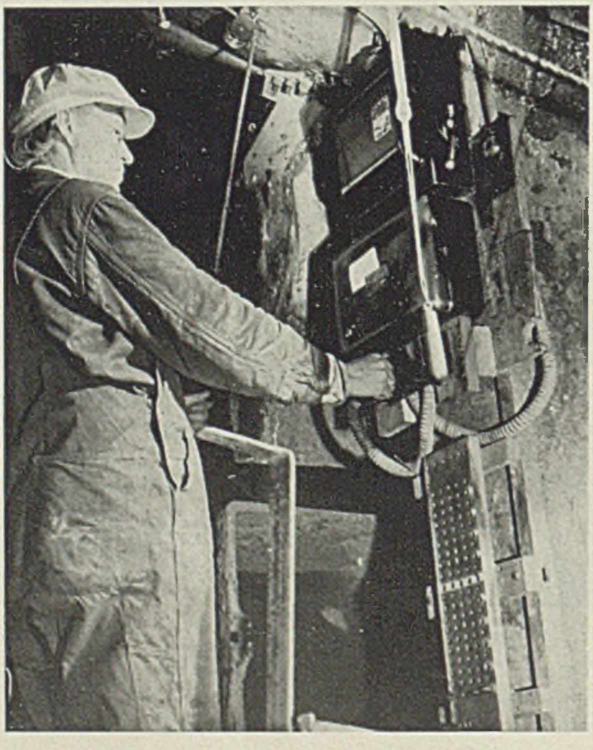
"EQUAL pay for equal work" by women in war industries was adopted in principle last week by the National War Labor Board in an opinion handed down in a case involving Brown & Sharpe Mfg. Co., Providence, R. I.

The board in an unanimous decision ruled: "there should be no discrimination between employes of equal ability employed on similar work where production is substantially the same."

The decision was regarded by labor officials as of comparable importance to that in the "Little Steel" case fixing wage raises at 15 per cent above January, 1941, levels, and the ruling in the Marshall Field case establishing the union maintenance-of-membership principle.

Added importance was attached to the decision by the influx of women workers into war industries as result of greatly expanded production and the induction of large numbers of men workers into the armed forces.

Seventy-eight per cent of the employes in Allis-Chalmers Mfg. Co.'s new supercharger plant, recently dedicated at Milwaukee, are women. Brig Gen. K. B. Wolfe, Wright Field, Dayton, O., and Walter Geist, Allis-Chalmers president, are shown at upper right watching one of the hundreds of women workers inspecting an impeller wheel. Speaking at the dedication, General Wolfe termed the superchargers to be built in the plant an "ace in the hole" which will permit American bombers to fly far above enemy antiaircraft fire



Woman worker operates a General Electric magnetic switch to control the movement at an aerial tram at the London Mines & Milling Co. gold and silver mine near Alma, Colo.

Poster issued by the War Manpower Commission emphasizes the importance women are assuming in the war production effort

Industrial Activity Steadily Advancing

INDUSTRIAL activity moved steadily upward throughout September, reflecting expanding output of war industries. STEEL's weekly index averaged 174.8 last month, to reach a new monthly peak. In the preceding month the index averaged 173.5. Since the first of the year the monthly index average has advanced 9.1 points.

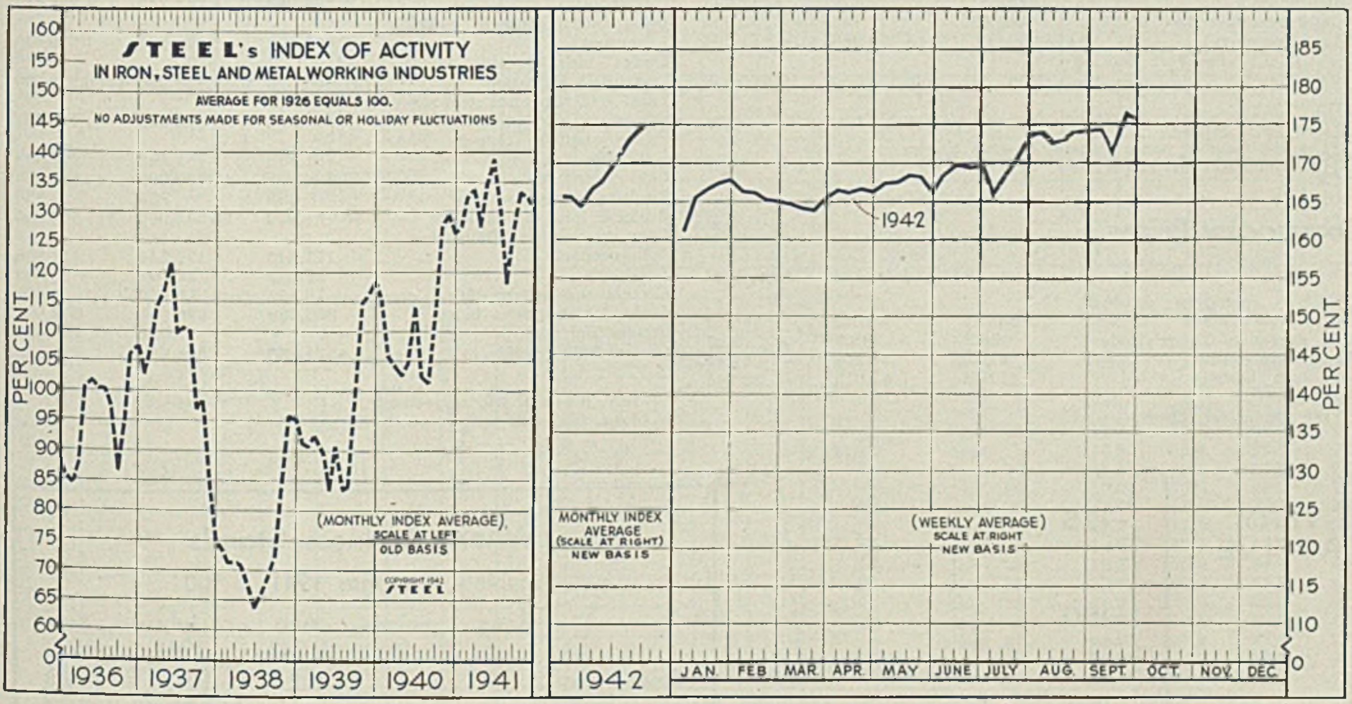
For the week ended Sept. 26 the index eased 0.8 to 176.0, due to a slight decline in revenue freight carloadings and electric power consumption.

During the latest period electric power output declined from the all time peak recorded in the preceding week. Compared with a year ago power consumption is up 13.7 per cent.

Early estimate of revenue freight carloadings for the week ended Sept. 26 shows a moderate decline to slightly below 900,000 cars. In the preceding week freight traffic had reached the highest level recorded this year of 903,099. Number of cars loaded during the summer months were below that reported last year. In this connection it is interesting to note that the Midwest Shippers Advisory Board estimates that in the final three months this year carloadings will be 7.6 per cent above that recorded in same period of 1941.

Steel ingot production during the week ended Sept. 26 held unchanged at 98 per cent for the fifth consecutive weekly period. So far this year the national steel rate has fluctuated between the narrow range of 95.5 and 99 per cent. Iron and steel scrap collections have improved.

Shortage of manpower is expected to soon become as important a factor in hampering production as raw material shortages are currently. This situation is expected to result in a sharp increase in the employment of women on jobs previously thought impossible for them to handle;



STEEL's index of activity declined 0.8 points to 176.0 in the week ending Sept. 26:

Week Ended	1942	1941	Mo. Data	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931
July 25	173.6	132.9	Jan.	165.7	127.3	114.7	91.1	73.3	102.9	85.9	74.2	58.8	48.6	54.6	69.1
Aug. 1	173.8	123.3	Feb.	165.6	132.3	105.8	90.8	71.1	106.8	84.3	82.0	73.9	48.2	55.3	75.5
Aug. 8	172.8	117.5	March	164.6	133.9	104.1	92.6	71.2	114.4	87.7	83.1	78.9	44.5	54.2	80.4
Aug. 15	173.3	118.2	April	166.7	127.2	102.7	89.8	70.8	116.6	100.8	85.0	83.6	52.4	52.8	81.0
Aug. 22	174.0	118.5	May	167.7	134.8	104.6	83.4	67.4	121.7	101.8	81.8	83.7	63.5	54.8	78.6
Aug. 29	174.5	118.2	June	169.4	138.7	114.1	90.9	63.4	109.9	100.3	77.4	80.6	70.3	51.4	72.1
Sept. 5	174.8	111.8	July	171.0	128.7	102.4	83.5	66.2	110.4	100.1	75.3	63.7	77.1	47.1	67.3
Sept. 12	171.2	131.3	Aug.	173.5	118.1	101.1	83.9	68.7	110.0	97.1	76.7	63.0	74.1	45.0	67.4
Sept. 19	176.8	130.6	Sept.	174.8	126.4	113.5	98.0	72.5	96.8	86.7	69.7	56.9	68.0	46.5	64.3
Sept. 26	176.0†	132.0	Oct.	....	133.1	127.8	114.9	83.6	98.1	94.8	77.0	56.4	63.1	48.4	59.2
			Nov.	....	132.2	129.5	116.2	95.9	84.1	106.4	88.1	54.9	52.8	47.5	54.4
			Dec.	....	130.2	126.3	118.9	95.1	74.7	107.6	88.2	58.9	54.0	46.2	51.3

†Preliminary.

Note: Weekly and monthly indexes for 1942 have been adjusted to offset the forced curtailment in automobile production and to more accurately reflect expanding steel production.

and the development of greater control over every person's job.

WPB reports output of munitions was 8 per cent above July but 14 per cent below the earlier forecast for the month. Board's index stood at 357 for August, compared with revised July index figure of 330. In August 1941 and 1940 the index stood at 72 and 22 respectively.

Aircraft production during August was up 6 per cent over July; Ordnance, 3; naval ship construction, 7; Merchant shipbuilding, 6; and other munitions, 14 per cent.

August output of machine tools advanced to $117,400,000, a gain of 3.3 per cent over July. Total production for eight months period amounted to $819,100,000, compared with the record 1941 output of $771,400,000. A peak plateau in monthly production is expected to be reached in the near future. The plant facilities program is being curtailed to make it possible for a greater volume of raw materials to be thrown into production.

BUSINESS BAROMETER

Financial Indicators

	Aug., 1942	July, 1942	Aug., 1941
30 Industrial Stocks†	106.08	106.94	126.67
20 Rail Stocks†	26.19	25.63	30.19
15 Utilities†	11.51	11.75	18.50
Value of Bonds (N.Y.S.E.)	$62,720	$61,277	$53,216
Bank Clear'gs daily average (000 omitted)	$1,120,946	$1,170,985	$1,020,137
Commercial Paper, interest rate, % (4-6 months)	0.69	0.69	0.50
Com'l loans (000 omitted)°	$10,382,000	$10,696,000	$9,861,000
Federal Reserve ratio (per cent)	86.3	87.1	91.0
Capital flotations (000 omitted)			
New Capital	$103,072	$40,679	$361,029
Refunding	$58,573	$101,472	$111.394
Federal gross debt. (mil. of dol.)	$81,635	$77.136	$50.936
Railroad earnings†	$133,001,365	$118,730,968	$106,381,904
Stock sales, New York Stock Exchange	7,387,341	8,373,550	10,874,650

†Dow Jones series.
°Leading member banks Federal Reserve System.
‡July, June and July respectively.

Commodity Prices

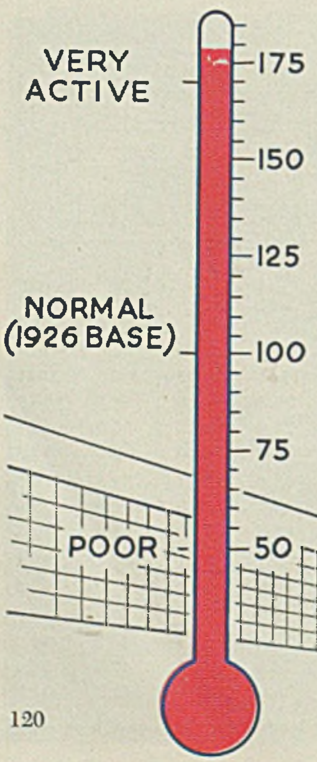
	Aug., 1942	July, 1942	Aug., 1941
STEEL'S composite finished steel price average	$56.73	$56.73	$56.73
U. S. Bureau of Labor's index	98.8	98.7	90.3
Wheat, cash (bushel)	$1.29	$1.268	$1.14
Corn, cash (bushel)	$1.045	$1.013	$0.845

†July, June and July respectively.

Industrial Indicators

	Aug., 1942	July, 1942	Aug., 1941
Munitions Output Index (WPB)†	350	303	64
Commerce Dept.'s Mfgs. Index†:			
Orders	253	314	196
Shipments	207	202	168
Inventories	174.7	172.9	140.0
Iron and Steel Scrap consumption (tons)	4,645,000	4,600,000	4,518,000
Gear Sales Index	380	344	276
Machine Tool Output†	$113,600,000	$111,100,100	$57,900,000
Foundry equipment new order index	510.8	800.8	312.9
Finished steel shipments (Net tons)	1,788,650	1,765,749	1,753,665
Ingot output (average weekly; net tons)	1,632,833	1,617,381	1,579,570
Dodge bldg. awards in 37 states ($ Valuation)	$721,028,000	$943,796,000	$760,233,000
Fabricated structural steel shipments (Tons)	165,212	182,626	189,251
Steel castings output (Net Tons)‡	131,458	131.492	113,988
Coal output, tons	47,160,000	47,700,000	46,651,000
Business failures; number	698	764	954
Business failures; liabilities	$6,781,000	$8,548,000	$11,134,000
Coke Production (Daily Ave.)			
By-product	171,443	170,244	161,900
Beehive	22 258	22.197	20.800
Cement production, bbls.†	16,833	16,022	16,000
Cotton consumption, bales	925,089	995,041	872,035
Freight Car Awards	0	1,025	2,668
Car loadings (weekly av.)	871,855	858,019	897,848

†July, June and July respectively.
‡June, May and June respectively.



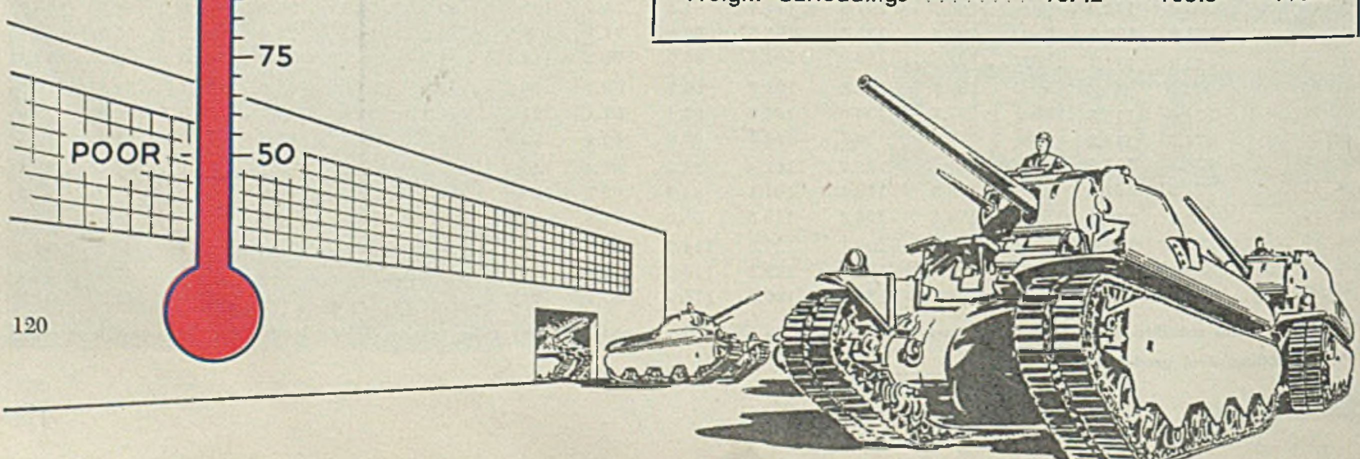
TREND:

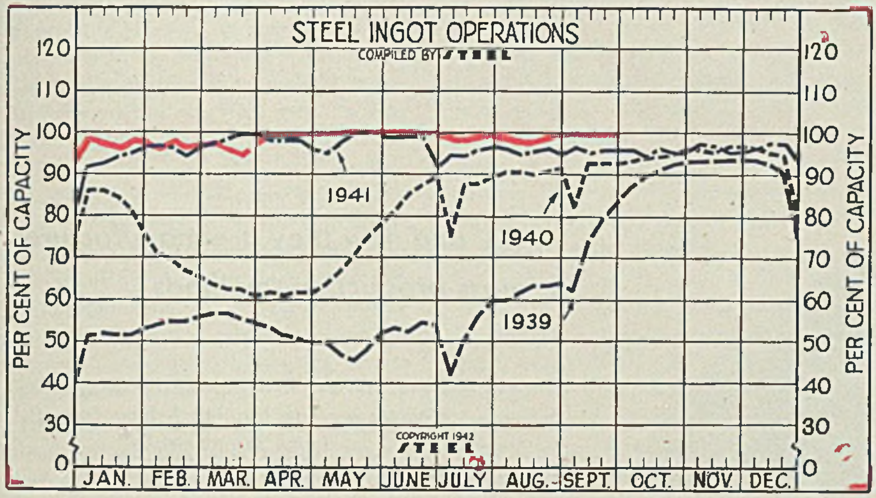
Upward

Where Business Stands

Monthly Averages 1941 = 100

	Aug. 1942	July 1942	Aug. 1941
Steel Ingot Output	102.7	101.7	99.3
Finished Steel Shipments	104.9	103.6	102.9
Structural Steel Shipments	88.1	96.6	100.8
Building Construction	144.0	188.5	151.8
Wholesale Prices	113.2	113.1	103.4
Freight Carloadings	107.2	105.5	110.4





Steel Ingot Operations

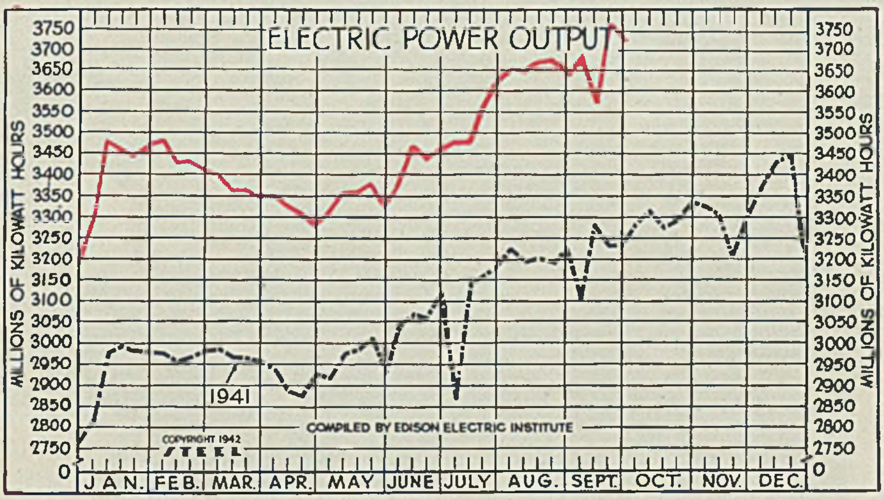
(Per Cent)

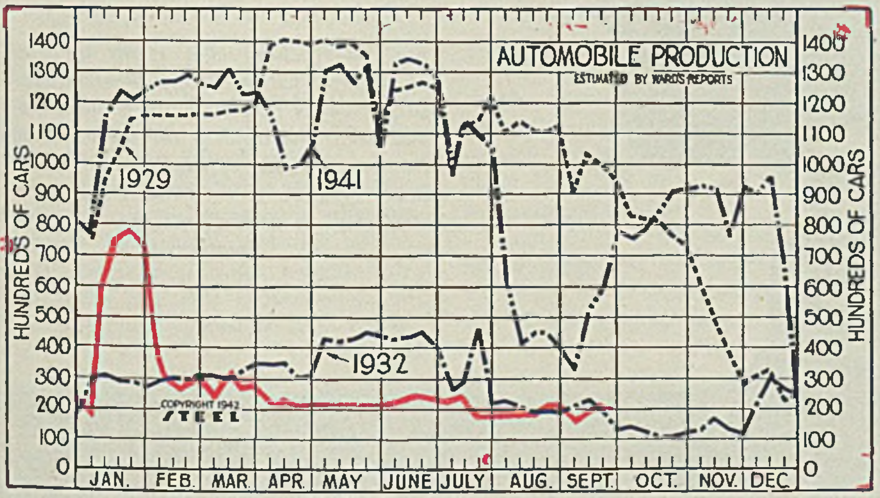
Week ended	1942	1941	1940	1939
Sept. 26	98.0	96.0	93.0	84.0
Sept. 19	98.0	96.0	93.0	79.5
Sept. 12	98.0	96.5	93.0	74.0
Sept. 5	98.0	95.5	82.0	62.0
Aug. 29	98.0	96.5	91.5	64.0
Aug. 22	97.5	96.0	90.5	63.5
Aug. 15	97.0	95.5	90.0	63.5
Aug. 8	97.5	96.5	90.5	62.0
Aug. 1	98.0	97.5	90.5	60.0
July 25	98.5	96.0	89.5	60.0
July 18	98.0	95.0	88.0	56.5
July 11	97.5	95.0	88.0	50.5
July 4	97.5	92.0	75.0	42.0
June 27	98.5	99.5	89.0	54.0
June 20	99.0	99.0	88.0	54.5
June 13	99.0	99.0	86.0	52.5
June 6	99.0	99.0	81.5	53.5

Electric Power Output

(Million KWH)

Week ended	1942	1941	1940	1939
Sept. 26	3,720	3,233	2,816	2,559
Sept. 19	3,757	3,232	2,769	2,538
Sept. 12	3,571	3,281	2,773	2,532
Sept. 5	3,673	3,096	2,592	2,376
Aug. 29	3,640	3,224	2,736	2,442
Aug. 22	3,674	3,193	2,714	2,434
Aug. 15	3,655	3,201	2,746	2,454
Aug. 8	3,649	3,196	2,743	2,414
Aug. 1	3,649	3,226	2,762	2,400
July 25	3,626	3,184	2,761	2,427
July 18	3,565	3,163	2,681	2,378
July 11	3,429	3,141	2,652	2,403
July 4	3,424	2,867	2,425	2,145
June 27	3,457	3,121	2,660	2,396
June 20	3,434	3,056	2,654	2,362
June 13	3,464	3,066	2,665	2,341





Auto Production

(1000 Units)

Week ended	1942	1941	1940	1939
Sept. 26	20.9	78.5	96.0	62.8
Sept. 19	21.0	60.6	78.8	54.0
Sept. 12	19.6	53.2	66.6	41.2
Sept. 5	16.9	32.9	39.7	26.9
Aug. 29	21.1	40.0	27.6	25.2
Aug. 22	20.2	45.5	23.7	17.5
Aug. 15	19.2	45.6	20.5	13.0
Aug. 8	19.2	41.8	12.6	24.9
Aug. 1	18.3	62.1	17.4	28.3
July 25	18.3	105.6	34.8	40.6
July 18	17.9	109.9	53.0	47.7
July 11	23.0	114.3	65.2	61.6
July 4	22.7	96.5	52.0	42.8
June 27	22.9	127.9	87.6	70.7
June 20	23.2	133.6	90.1	81.1
June 13	22.3	134.7	93.6	78.3

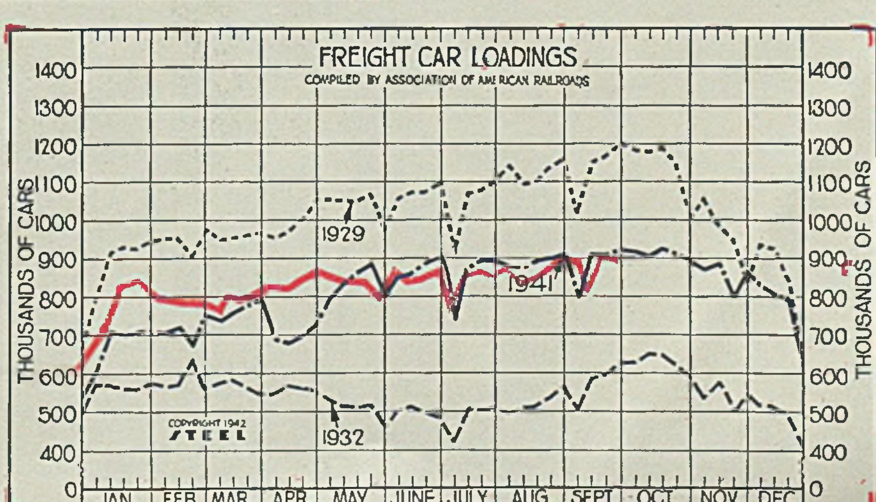
Figures since Feb. 21 last include Canadian trucks and automobiles and United States trucks.

Freight Car Loadings

(1000 Cars)

Week ended	1942	1941	1940	1939
Sept. 26	900†	920	822	835
Sept. 19	903	908	813	815
Sept. 12	815	914	804	806
Sept. 5	888	798	695	667
Aug. 29	899	913	769	722
Aug. 22	869	900	761	689
Aug. 15	869	890	743	674
Aug. 8	850	879	727	665
Aug. 1	864	883	718	661
July 25	856	897	718	660
July 18	857	899	730	656
July 11	855	876	740	674
July 4	759	741	637	559
June 27	853	909	752	660
June 20	840	886	728	643

†Preliminary.



New Combat Helmets

. . . . and how they are manufactured by mass-production methods

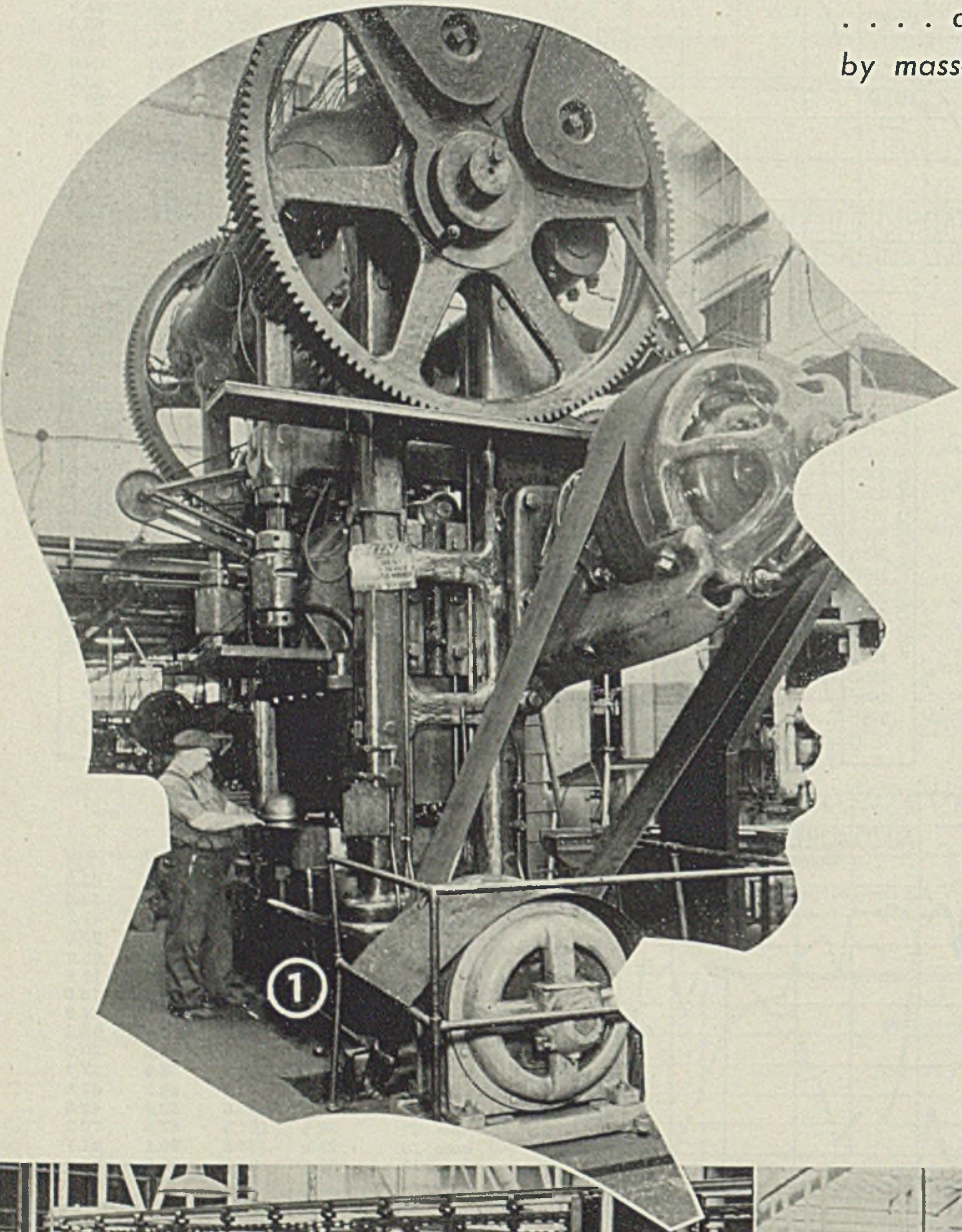


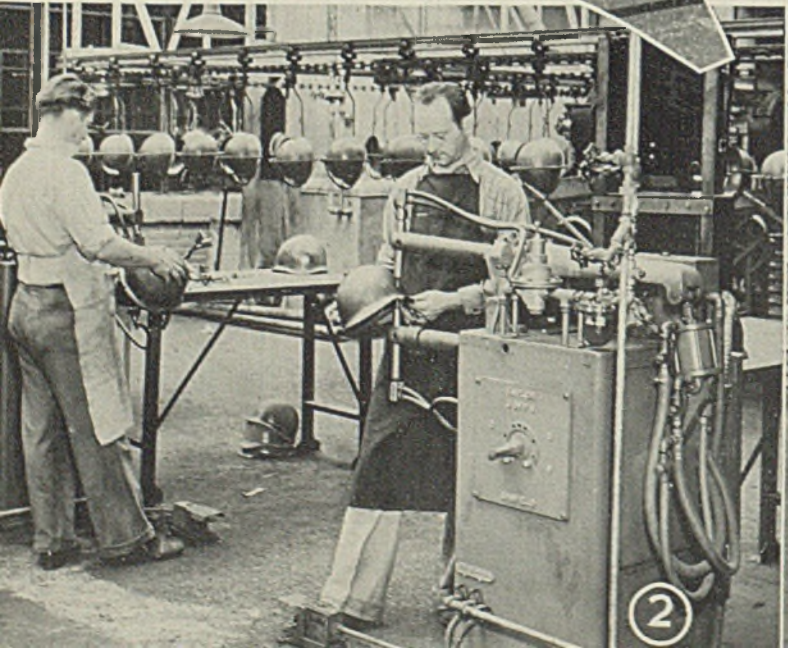
Fig. 1—Triple-die press of 500-ton capacity used in forming helmet from flat blank in one stroke

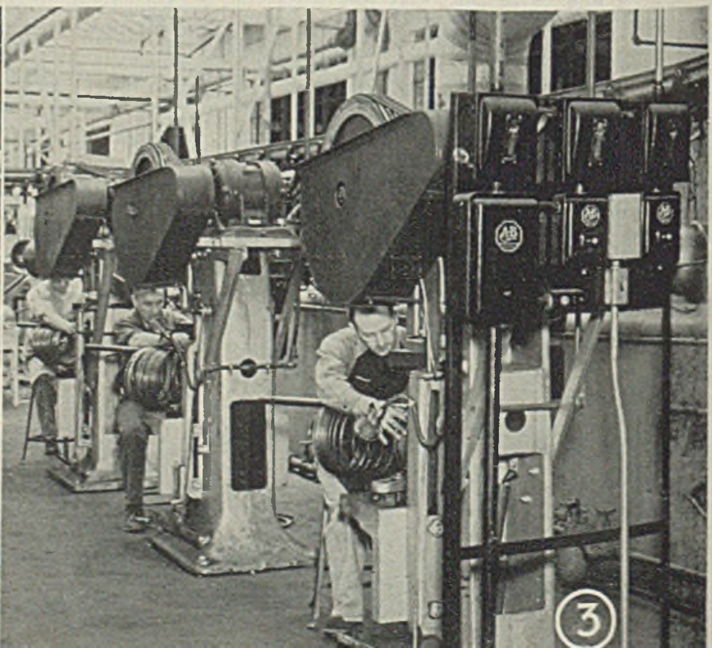
Fig. 2—Spot welding steel clips to hold chin strap on inside of formed helmet. Note conveyor line and special hooks to hold pieces in background

Fig. 3—Stainless steel strip is rolled into a channel-shaped bead and cut to proper length on these presses before being applied to brim of helmet

Fig. 4—Automatic paint spray setup for coating both inside and outside of helmets as they pass by on spindle conveyor

Fig. 5—Stitching chin straps to sides of molded helmet liner. Football-type suspension is riveted to these liners also and keeps the head of the wearer away from the surface of the helmet. These liners may be worn without the outer steel shell as protection against sun and weather





PICTURES of American forces landing on foreign soil in recent months show them to be equipped with an entirely new type of combat helmet, vastly different from the "tin hats" which doughboys wore in World War I. The latter is known as the "wash-basin" type of head armor or more technically as the M1917 type, standard equipment until late in 1940 when tests made in the light of events in Europe developed their inadequacies for a war of movement where missiles can come from all directions—even from below, as in the case of parachutists.

Problem of perfecting a new type of helmet was assigned the Infantry Board, which in an early report stated: "Research indicates that the ideal shaped helmet is one with a dome-shaped top and generally following the contour of the head, allowing sufficient uniform headspace for indentations extending down in the front to cover the forehead without impairing necessary vision, extending down on the sides as far as possible without interfering with the use of the rifle or other weapons, extending down the back of the head as far as possible without permitting the back of the neck to push the helmet forward on the head when the wearer assumes the prone position, with the frontal plate flanged forward to form a cap-style visor, and with the sides and rear slightly flanged outward to cause rain to clear the collar opening".

From these ambitious specifications the TS-3—now the M1—helmet was developed and is currently in mass production by McCord Radiator & Mfg. Co., Detroit. Well over a million of the helmets already have been produced.

In addition to the design specifications cited above, there are certain other essentials. The helmet must not be too heavy, maximum allowable weight, fully fitted, being 3 pounds. Certain minimum ballistic properties must be met. Resistance to penetration by a 230-grain, caliber .45 bullet with a velocity of 725 feet per second must be proved in firing tests. In common terms, the helmet must not be penetrated by a bullet from a service pistol fired at point-blank range. Further, the steel is nonmagnetic, presumably to avoid extraneous effects on certain types of electrical instruments operated by the field forces.

At the outset, it may be well to describe in detail just what the "helmet assembly" comprises. First is the one-piece outer steel shell, the edge of which is trimmed with a formed strip of stainless steel. On either side are welded clips to receive the chin strap. This protective shell fits tightly over a plastic molded liner in olive drab color and formed to the identical but slightly smaller shape of the steel shell.

Riveted to the liner is the hammock or football helmet type of suspension. It is made up of a narrow cloth band, around which are sewed six strips of fabric, looped over a tubular lacing ring at the top or dome of the liner. Headbands, adjustable for different-sized heads, are snapped inside the hammock at six points by metal snap fasteners. At the back of the liner is riveted another cloth strip known as the neck band which holds the wearer's neck away from contact with the liner. A chin strap also is provided. The liner weighs only a few ounces fully assembled and may be worn comfortably either with or without the closely fitting protective steel outer member. Naturally, combat requires the full assembly, but for protection against sun and weather, the light olive drab liner is ample. The suspension system keeps the wearer's head about 1½ inches away from front, back and sides of the liner.

Standard steel for helmets is Hadfield's manganese, an austenitic material which has the peculiar property of more than doubling in hardness as the result of cold work, and is of course nonmagnetic.

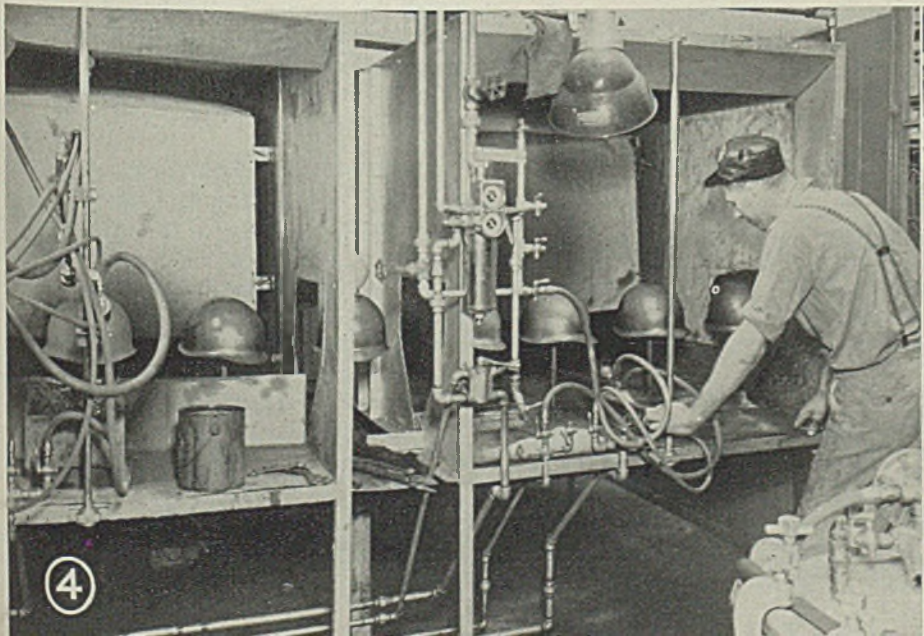
Hardness of the steel in the heat treated condition is 180 to 200 brinell. After cold working, this may increase to between 450 and 550, depending upon the degree of cold work.

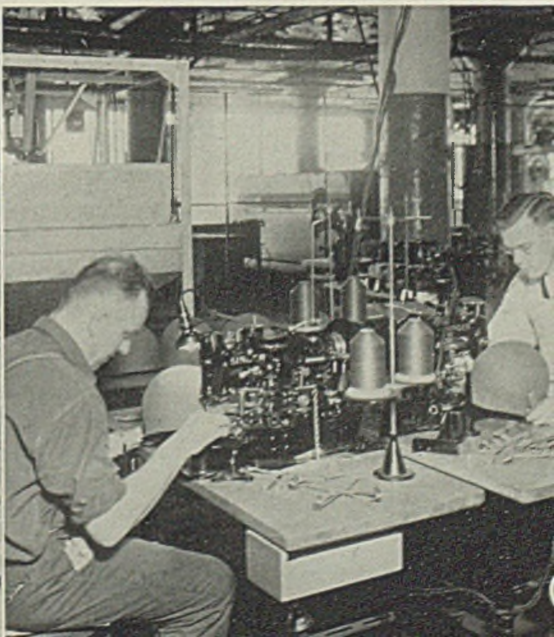
Hadfield's manganese steel for helmets is made in the basic 100-ton open-hearth furnaces. Careful attention to processing steps between the ingot and the final sheet is essential. Ingots are reduced to slabs, breakdowns and finally to sheets which are reheated and rolled in packs of four on hand mills to a final product which is approximately 34 inches wide and 70 inches long. After pack rolling the steel sheets are austenitized, or heated up and quenched in cold water to insure carbides being kept in solid solution in the austenite. Bend tests, cupping tests, grain size determination, chemical checks for decarburization, and microscopic examinations are made, after which the sheets are roller leveled, pickled and reinspected.

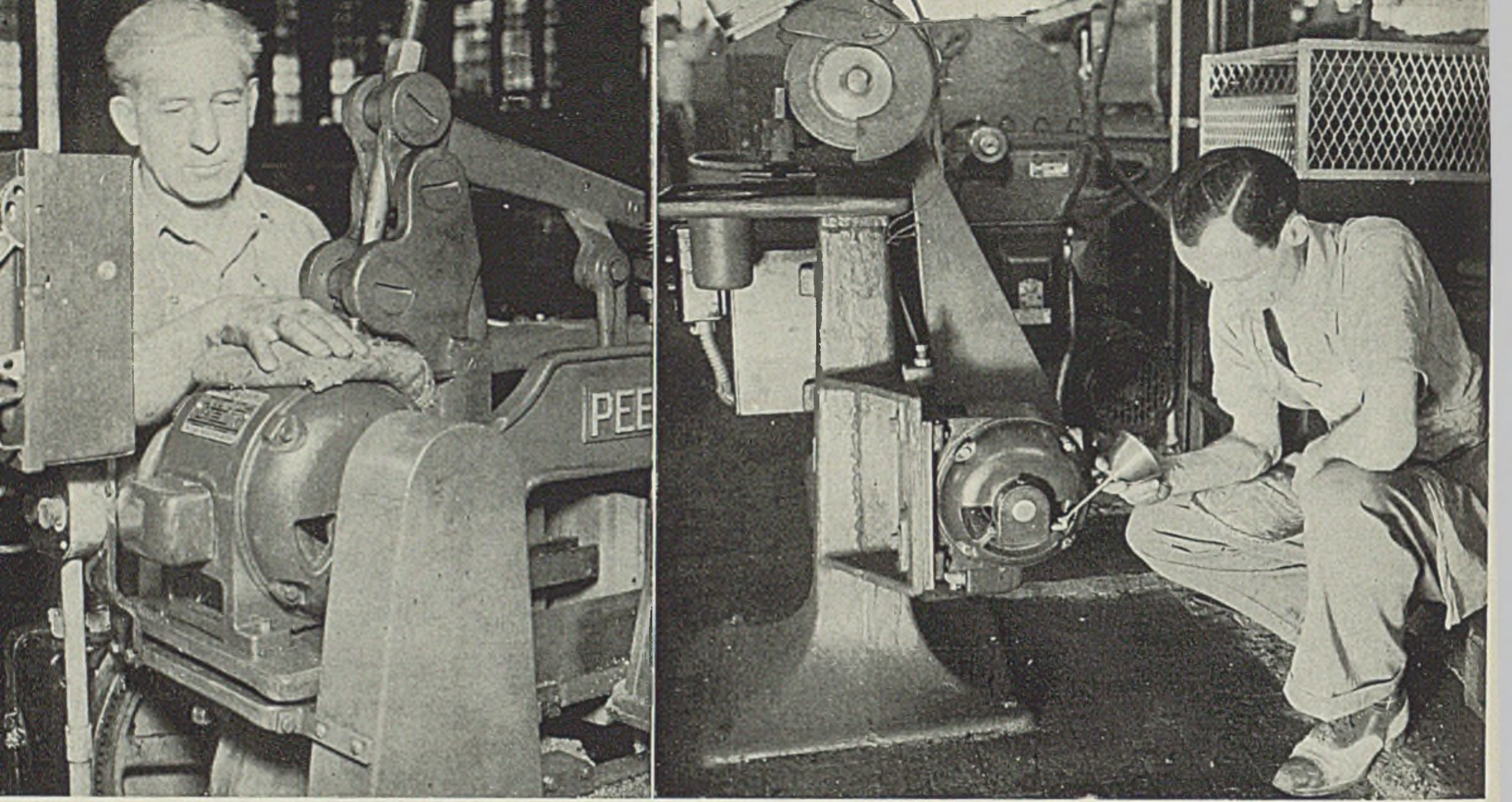
Close control of rolling temperatures and constant inspection during the various rolling operations are essential. Individual sheets finally are marked off in 16½-inch circles, and the heat number stamped in each circle. The sheet then is slit down the center, leaving four circles in each length. The strips are cut into squares and then each blank trimmed out in a circling shears. Further inspection then is made, the blanks slushed with oil and packed 400 in a stack, crated and shipped to the fabricator. Weight of blank must be within the limits of 2.5 to 2.8 pounds.

First operation in forming the helmets is to stamp both heat number and shipment number at the edge of each blank. This is done in a small punch press, using a fine-line steel stamp. The marking carries through to the final

(*Please turn to Page* 269)







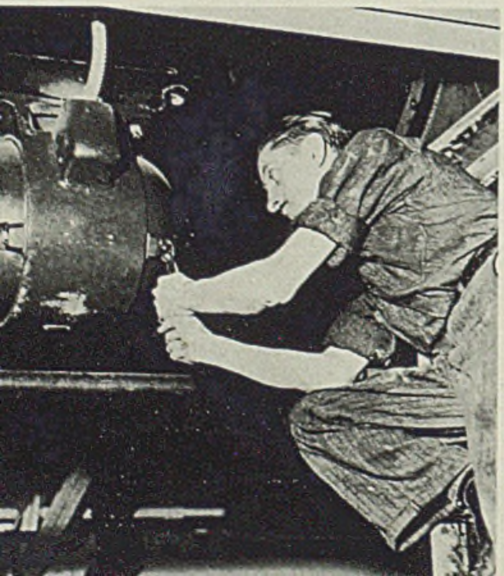
Left, motors will overheat if dirt and dust are allowed to accumulate. Frequent wiping is important. Note nameplate position for quick reading. Right, checking oil level in sleeve bearings frequently also important—especially with today's scarcity of bronze bearing metal

MOTOR MAINTENANCE— A "MUST"

By O. F. VEA
Motor Division
General Electric Co.
Schenectady, N. Y.

PRESENT-DAY conditions make it necessary to "baby" all electric motors. Maintenance pro rams must be intensified to prevent breakdowns, because 24-hour-a-day 7-day-a-week war production schedules cannot be interrupted—output lost today cannot be made up tomorrow. Even the failure of an inconspicuous piece of equipment can cause a considerable disruption in production.

On the other hand, industrials engaged in nonwar activities must "keep 'em turning" as long as possible because of the difficulty in obtaining new motors without the necessary priority rating. Therefore an effective general maintenance program such as is outlined here is of particular importance. Wherever available the specific instruction sheet accompanying each motor should be followed.



Selection and Installation: A real maintenance program begins with selection. Motors must be chosen that are properly rated and protected for their work. The selection involves a study of requirements, such as continuous or intermittent duty, starting, torque, speed regulation, and the like. These all have a bearing on just what type of motor to choose.

In addition, the environment in which the motor is to operate should be considered, as this determines whether an open motor or some form of enclosed motor should be used, and how the motor should be located with respect to the driven load.

Check motor foot bolts and end-shield bolts every six months to make sure that they are securely fastened. Loose mountings can cause misalignment, break motor feet

The next point to be considered is installation. The most important items from the standpoint of long, trouble-free life for a motor follow. The motor should be located in such a way that it is accessible for inspection and repairs. Of course, it is always advisable to install the motor in a place free from adverse conditions unless it is built in a protecting enclosure. It is also important to see that the motor has ample ventilation so that heat losses will be carried away.

A standard motor should not be installed where the ambient temperature or normal temperature rise is more than 40 degrees Cent. The motor should be installed on a solid foundation which is free from vibration. If it is direct-connected or belted, care should be taken to secure proper alignment, which should permit rotor end-play within reasonable limits.

All these factors must be taken into consideration if inspection and maintenance are not to be discouragingly difficult.

Connecting the Motor: All electrical connections to a motor should be made tightly enough so that the vibration of the equipment will not loosen them. Wires joined in a conduit box should be either twisted together and soldered, or bolted together. These joints should be wrapped first with rubber tape, and then with friction tape.

Wires issuing from a conduit box, especially rubber-covered extension cords, should be held in some way so that there is no strain on the connections themselves. Usually a knot in the wire inside the conduit box, or the use of conduit-box fittings that grip the wire where it leaves the box, are the most convenient ways to obtain this strain relief.

Starting the Motor: A little extra care when starting a motor for the first time is a good investment. For example, trouble may be avoided by a look at the brushes of a direct-current or single-phase repulsion motor to make sure that they are seating properly on the commutator, and with the proper pressure. It is always good practice to turn the motor over by hand before applying power to be sure that it turns freely, and that no foreign materials or objects have fallen into the motor during shipment or handling.

Inspection: When the motor has been properly selected, installed, and connected, the maintenance program really begins. To insure efficient operation and maximum production, inspection and servicing should be systematic.

Frequency of inspection and degree of thoroughness vary, and will have to be determined by the maintenance engineer. They will be governed by (1), the importance of the motors in the production scheme (that is, if the motor fails, will the whole works be shut down?); (2), percentage of time the motor operates; (3) nature of service; (4), environment.

An inspection schedule must, therefore, be elastic and adapted to the needs of each plant. The following schedule, covering both alternating and direct-current motors, is based on average conditions so far as duty and dirt are concerned:

Every Week:

—Examine commutator and brushes
—Check oil level in bearings
—See that oil rings turn with shaft
—See that shaft is free of oil and grease from bearings
—Examine starter, switch, fuses, and other controls
—Start motor and see that it is brought up to speed in normal time.

Every Six Months:

—Clean motor thoroughly, blowing out dirt from windings and wipe commutator and brushes
—Inspect commutator clamping ring
—Check brushes and renew any that are more than half worn
—Examine brush holders and clean them if dirty. Make sure that brushes ride free in the holders.
—Check brush pressure
—Check brush position
—Drain, wash out, and renew oil in sleeve bearings
—Check grease in ball or roller bearings
—Check operating speed or speeds
—See that end play of shaft is normal
—Inspect and tighten connections on motor and control
—Check current input and compare with normal
—Run motor and examine drive critically for smooth running, absence of vibration, worn gears, chains, or belts
—Check motor foot bolts, end-shield bolts, pulley, coupling, gear and journal setscrews, and keys
—See that all motor covers, belt and gear guards are in good order, in place and securely fastened

Once a Year:

—Clean out and renew grease in ball or roller bearing housings
—Test insulation by megger
—Check air gap
—Clean out magnetic dirt that may be hanging on poles
—Check clearance between shaft and journal boxes of sleeve-bearing motors, to prevent operation with worn bearings
—Clean out undercut slots in commutator
—Examine connections of commutator and armature coils
—Inspect armature bands

Records: The competent maintenance man will have a record card for every motor in the plant. All repair work, with its cost, and every inspection can be entered on the record. In this way, excessive amounts of attention or expense will show up and the causes can be determined and corrected.

(*Please turn to Page* 271)

H.P.	Syn. Speed	Make	Connection Diagram	Application	Shop or Mill No.	Card No.

Type	Frame	Poles	F. L. Speed	Volts	Form	Temp. Rating	F.L. Amp.	Phase	Cycles

Serial No. Model No.	Publication No.	**CONTROL EQUIPMENT** Type Make Pub. No
BRUSHES No. Per Motor Cat. No. Size Material Grade **LININGS** Front End, Cat. No. Pulley End, Cat. No.	**COILS** (Cat. or Spec. No.) Stator or Field Main Comm. Comp. Rotor or Armature Coils Bars No. per Set	Connection Diagram
PULLEY Diam. Face Belt Width Bore Keyway	Mfr's Order No. Our Order No. Date of Order Cost { Motor Control	User: Location:

SERVICE RECORD

Date	Building	Floor	Driving	Drive	Tested Hp.

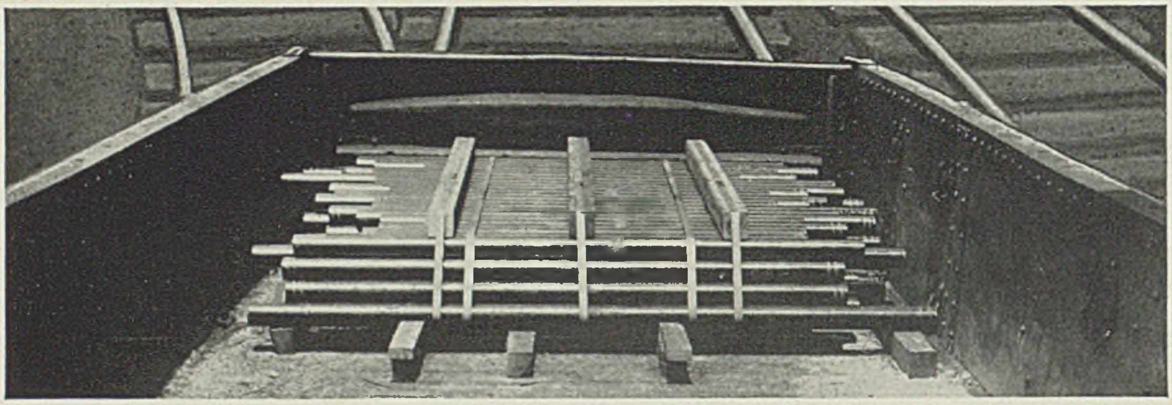
REPAIRS

Date	Condition	Due to	Repaired by	Cost

GENERAL ELECTRIC SERVICE SHOPS
are located in the following cities:

Atlanta				
Buffalo	Dallas	Kansas City, Mo.	Philadelphia	San Francisco
Charleston, W. Va.	Detroit	Los Angeles	Pittsburgh	Schenectady
Chicago	Erie	Milwaukee	Pittsfield	Seattle
Cincinnati	Fort Wayne	Minneapolis	St. Louis	West Lynn (River Works)
Cleveland	Houston	New York	Salt Lake City	West Lynn (West Lynn Works

The competent maintenance man will have a record card for every motor in the plant, and a record will be made of all servicing and repairs. Here are both sides of a suitable card



Highly finished steel products, such as cold drawn shell rounds shown in this view, can be coated with Carbozite black in the shop for protection during shipment and storage. No other protection is required

TEMPORARY PROTECTIVE COATING

. . . . permits steel to be shipped in open gondola cars—expands storage possibilities as steel so protected can be stored in the open

SEVERAL new protective coverings for metal, independent of supplies of imported or strategic raw materials, have been developed through researches on Wurtzilite, a pyrobituminous ore occurring naturally in some of our western states. Much of this work has been done by the Carbozite Corp., Pittsburgh.

The application that is probably of the greatest immediate importance is a series of shop coats—coats, applied for temporary protection of steel surfaces on bars and shafting during shipment or in storage. Known as "Carbozite", this material prevents corrosion from moisture and other elements in the atmosphere. As a result, it is especially important during the present shortage of packing materials, freight cars and cargo space for it provides the protection against exposure needed for shipping and storing steel in the open.

Steel covered with this coating can thus be shipped safely in open flat cars, on the decks of ships, or in open trailers without danger of rust or corrosion. When ready for use, the steel may be stripped of the coating through the use of any petroleum solvent, such as gasoline. Since the coat dries hard, it makes for easy handling and is not greasy or sticky.

The material is a black liquid which dries rapidly to a hard gloss. Physically, the coating resembles black gloss enamel, although it is not so hard. It may be brushed, dipped or sprayed. Drying time depends on the desired speed and varies from a few minutes in a baking process upward to an hour, if desirable.

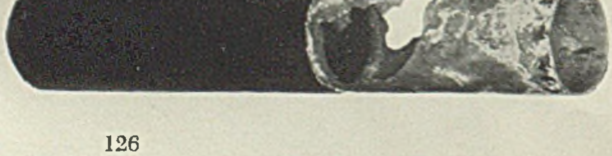
The composition of Carbozite is simple—it is 100 per cent Wurtzilite ore, dissolved in any desired vehicle. It weighs 7.5 pounds per gallon, and is tasteless and odorless. Wurtzilite as mined appears not unlike coal and is of the same general texture and weight. To this base and solvent are added other materials such as pigments to provide products with particular characteristics. None of the Carbozite products contains vegetable oils, tar oils or native asphalt substitutes. The vehicle used is derived from a crude base hydrocarbon, and oils being of nondrying character highly resistant to acids and alkalies and containing no saponifiable constituents. Analysis shows the product to be free from inorganic or organic acids.

Extensive tests of the standard Carbozite black have shown its resistance to all acids and alkalies, to heat or cold in a range from below zero to 400 degrees Fahr., and to various atmospheric conditions, including hot acid fumes and moist sea air. Flexibility tests, made by winding a strip of 26-gage steel coated with Carbozite around a ¼-inch mandrel, showed no evidence of cracking or peeling.

In the production of the material, the ore is given a processing treatment which eliminates all impurities and injurious substances and relines the crude material into a gum. This gum, chemically inert, is the base material of Carbozite products.

In addition to the shop coats, other products include black, red oxide and gray primers for metal, primers for wood and concrete, and top coats of black, red oxide, gray, aluminum and copper. Mastics for application by trowel or brush are also available by varying the solvent. All these coats have the same general properties in that they are odorless and tasteless as well as impervious to water, acid fumes, gases, salt solutions, salt air. They are also dielectric and offer adhesion to all surfaces. When applied hot, they even adhere strongly to moist surfaces.

Carbozite coats are not recommended for applications where heavy abrasion must be resisted. Since the coat remains pliable permanently, continued abrasion will gradually wear it off. It cannot be used where it is subject to contact with oils or oil derivatives since it is soluble in these substances. It is this property which gives it value as a temporary protective coating since it is easily removable by any petroleum solvent.



Corrosion resistant properties of the coatings are shown in this section of pipe, half of which was covered with one coat of black primer and one coat of standard black. The other half was uncoated. Note that after three weeks' exposure to sulphur mine water with high acid content, the coated section appears unaffected, the unprotected portion being eaten completely through

A.R.P. FOR THE FACTORY

American industry, now geared for war production, must be prepared against air raids. Adequate protective measures taken well in advance will do much to lessen the amount of damage from an air raid. As Mr. Baker shows, an efficient A.R.P. system not only protects the plant but enables production to be continued during alerts up to a point where planes are sighted. Here are told how British plants have tackled this problem, providing details of what has been learned by their experience with "blitzes"

By DENYS VAL BAKER
London

ALMOST every large British industrial area has suffered from air raids in the past 18 months. Before the raids began there were many (too many) factories whose managements scoffed at the idea of taking extensive air-raid precautionary measures, avowing that if there were raids full protection would be provided by our air force and anti-aircraft guns. Today there is not a single works in Britain which has not its own A.R.P. personnel, including both first-aid and fire-fighting parties, and its own numerous A.R.P. protections such as shelters, life-saving apparatus, blast-resistant coverings, etc.

We have learned three important lessons from bitter experience: First, that not all the military protection in the world can guarantee complete immunity from bombing; second, that when a factory is caught unprepared, one or two small bombs (even a few incendiaries) may cause untold damage and destruction; third, that when adequate A.R.P. measures *have* been taken, bombing damage can invariably be localized and dealt with so that it has minimum effect. This article explains some of the A.R.P. methods that have been found valuable in Britain so that American industry may be saved some of the unnecessary hardships which we endured over here owing to our ignorance.

There are many aspects of factory A.R.P., but for a general summary these may be classified as follows: Warning system, personnel mobilization, shelter organization, fire-fighting, first-aid, bomb-damage clearance. In addition, of course, there is the very important field of protection against blast and other possible damage. And, finally, all these activities depend upon the formation and training of the necessary A.R.P. groups or squads. The British arrangement, which would probably be equally suitable for America, starts with the Ministry of Home Security, which is responsible for the organization of the country's A.R.P. as a whole—private, public and industrial. One department of this ministry specializes in factory A.R.P. and supplies trained men who are loaned out to plants to help organize an A.R.P. system.

The usual method of collecting personnel is to hold a joint meeting of workers' and employers' representatives at which the trained A.R.P. man gives an outline of what is required and a scheme is settled on, requiring the services of workers to act as part-time wardens, part-time ambulance men, part-time fire-fighters, roof spotters, repair workers, and so on. As far as possible the part-time principle is employed because this is encouraged by the Ministry of Home Security and because it has been found that, generally speaking, workers are keen to do their bit toward protecting what is, after all, their livelihood.

At the same time, most large factories have found it necessary to form a small full-time A.R.P. staff, consisting usually of an A.R.P. controller, a deputy controller, a chief fire-fighter and perhaps a deputy and one or two other men who are responsible for various sections of A.R.P. work. The duties of the controller are quite arduous—in addition to being responsible for ordering equipment, engaging staff, arranging the duty shifts and so on, he has to conduct correspondence and negotiations with the Ministry of Home Security in connection with various A.R.P. orders that are issued, and he has to be in continual contact with both workers and the directors. Consequently there is a big demand for the services of really qualified controllers and their salaries are frequently in the neighborhood of between $1600 and $2000 a year (this for factories with about 3000 or more workers). Most of these controllers are men who have been through special training courses run by the Ministry of Home Security, but many of the correspondence schools are also now arranging courses.

So much for formation of an A.R.P. factory staff. Now to describe something of how they work. Usually the controller has a big central room or office from which he is able to contact all sections of the factory. In the event of a raid or a warning, he takes complete charge and all sections of factory personnel—including directors—have to take orders from him. Under the usual system, every floor, or perhaps every shop or machine-room has its own air-raid warden. He or she is responsible for that section, during raids or alerts, and takes orders from the controller direct. According to the directions received from the controller, the warden either advises workers to carry on with their work or (if raiders are overhead) to file down in orderly fashion to the factory air raid shelter, which is either in the basement or on the ground-floor (in which case it would be specially strengthened with concrete). In this way the A.R.P. controller is able to manipulate the bulk of the works staff as he wishes and in a manner most likely to avoid loss of production and to assure maximum safety to workers.

Deep shelters are best. In factories, they can be reached in the basements. Walls and roofs should be strengthened with concrete or steel. Sufficient regard must be paid to such points as hygiene (it is essential to presume that occupants may be there a long time, and therefore washing arrangements and lavatories and sleeping accomodations must be provided—bunks being preferable for the latter). There is also the catering problem, and it would be wise to install a small mobile cooking range in the shelter, or rather in one part. Chairs and benches and tables would be necessary. Ventilation is an important problem. Experience has shown that in many cases a forced type of ventilation is preferable. Installation of a centrifugal fan and a complete range of air duct work should provide an outlet in each compartment. Extract vents can be formed over and at the rear of the lavatories. With this type of installation the air in all parts of the shelter is adequately changed and no areas or pockets of stagnant air are allowed to form. Furthermore, with a system of forced ventilation, heating elements can easily be fixed in the main duct. The ducting system then will carry the warm air to all parts of the shelter, thus obviating the cost of providing convectors in each of the various divisions.

All that, however, is more in the nature of negative protection of workers, and the more bombing we have experienced, the more we have come to realize that it is one of the least important functions of A.R.P. It is important insofar as it insures protection of the *bulk* of workers and prevents any danger of a panic, but there is far more *constructive*

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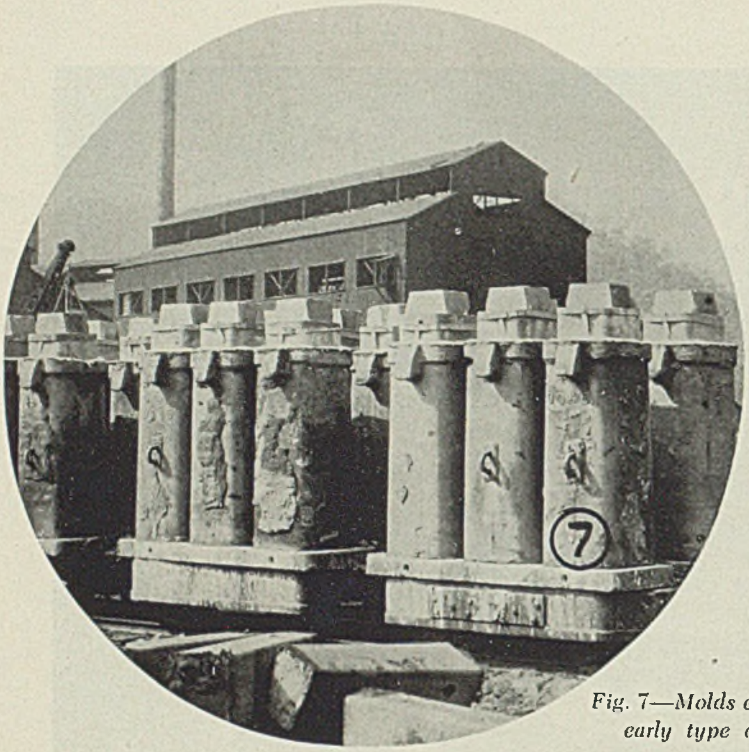


Fig. 7—Molds equipped with early type of hot top

The Manufacture of

HIGH-QUALITY, LOW-COST STEEL

Heterogeneity of Ingots

By PAUL J. McKIMM
Cleveland

(Concluded from last week)

TESTS of different types of caps on regular rimmed ingots were conducted to determine the chemical and physical difference between ingots capped with cast-iron caps 3 inches thick and with sheet bar crops upon completion of the rimming action. Several heats were made capping half of each with the cast-iron caps and the balance with the bar crops.

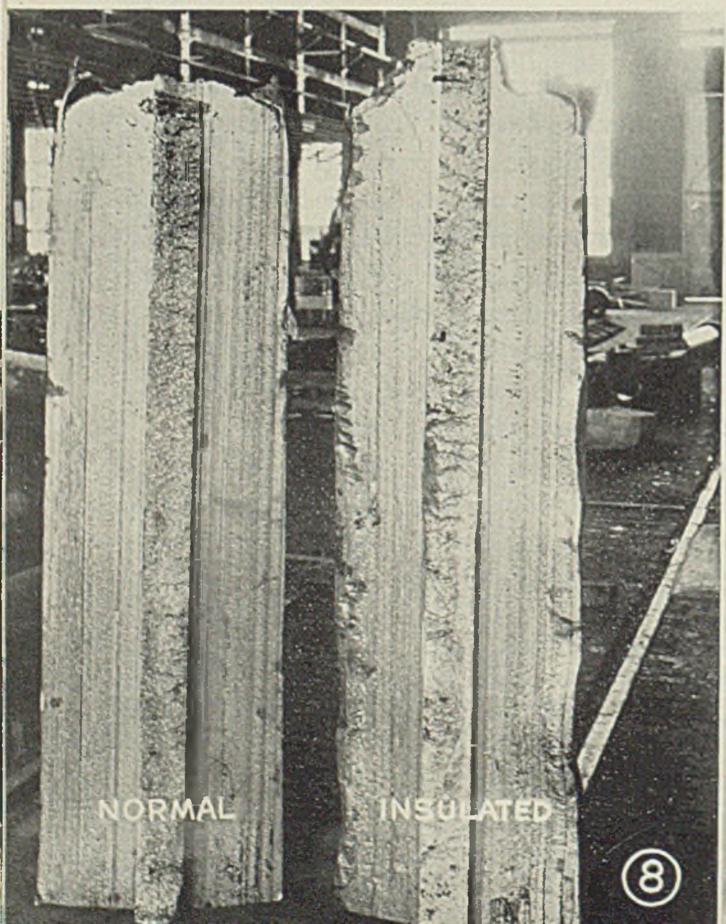
Tests disclosed that ingots capped with heavy cast-iron caps are far inferior to those capped with a lighter or thinner cap from the standpoint of sulphur.

Phases of Solidification

In the system of solidification immediately after casting, a wall forms with chill crystals extending from this wall inward. This is known as primary crystallization. The more impure mother liquor is forced on ahead, while the interior of the ingot is composed of free crystals. This is called secondary solidification.

On solidifying both systems of crystallization behave differently. The chill crystals form a solid, compact mass; these upon cooling contract and eject the more impure molten metal. The

Fig. 8—Split ingots showing the structure of steel that has been poured into normal and insulated molds. Fig. 9—Split ingot of special steel poured without a hot top



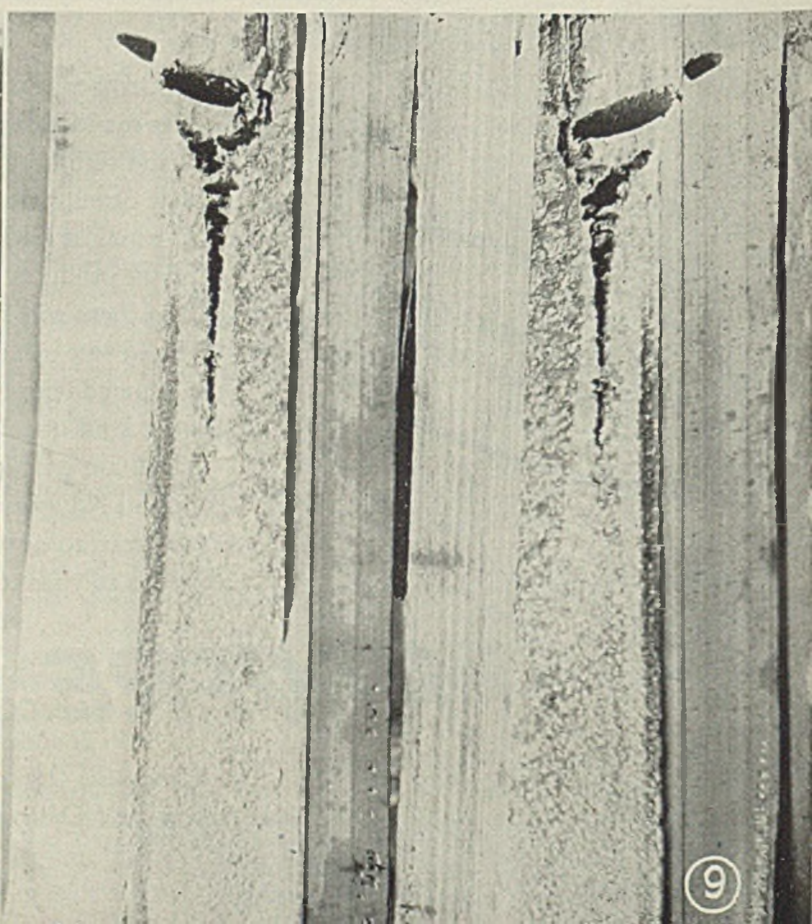
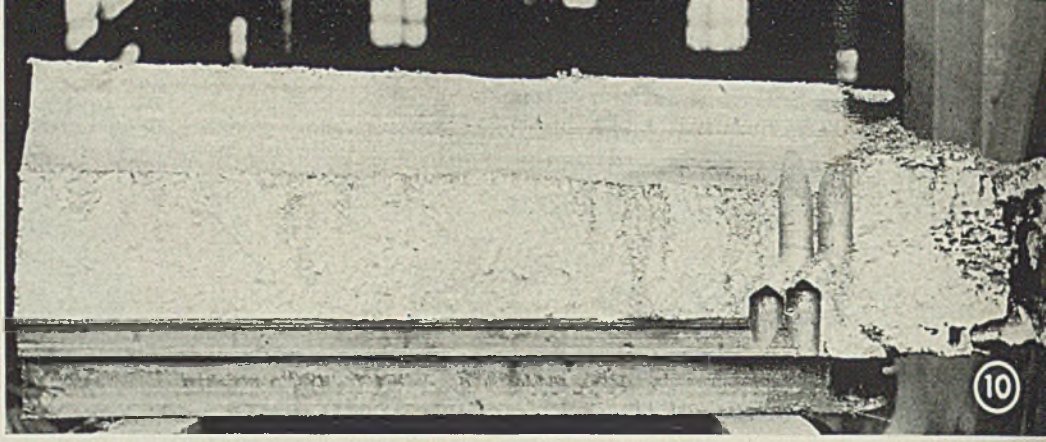
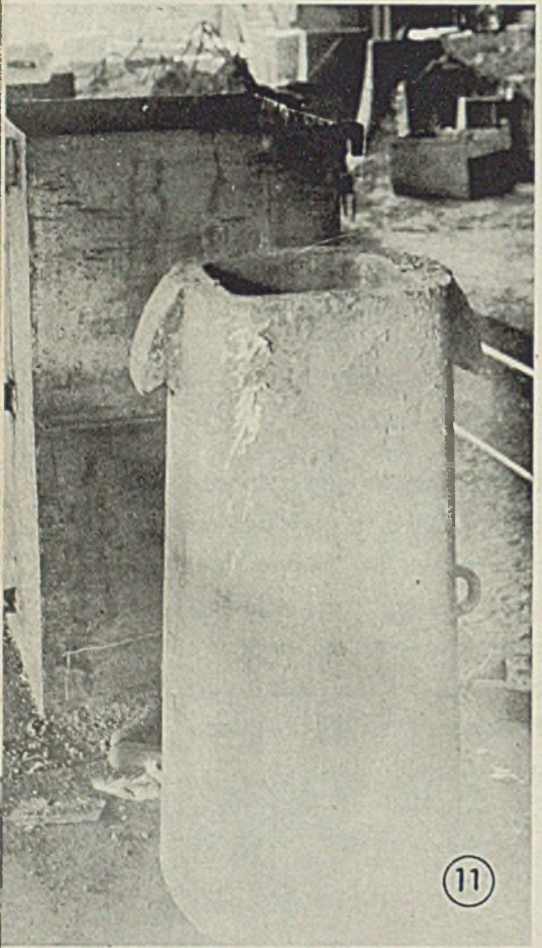


Fig. 10—Split ingot of special steel poured with a hot top

Fig. 11—Standard mold in foreground and insulated mold in background

Fig. 12—Split ingot at left was poured under normal procedure; that at the right was jarred during the pouring operation





ejected liquor moves toward the bottom of each individual free crystals, filling the cavities and then moves upward toward the top section of the ingot. There free crystals lie more loosely and the mother liquor forces between them and fills the contracted void areas and spaces as long as it remains fluid or even plastic, which time will be extended with increase impurities.

In order to further investigate factors influencing segregation adjacent ingots were studied, one being insulated and the other not. The insulation, approximately 8 inches thick, was composed of dry foundry sand up to about 10 inches of mold top. The 10 inches were composed of asbestos. After the ingot was poured a cover filled with asbestos was applied. Fig. 11 shows the setup of the two 22 x 24-inch molds, the one in the foreground being a standard mold and the one in the background an insulated mold.

Details of Heat

The heat herewith represented had a ladle analysis of carbon 0.08, manganese 0.32, phosphorus 0.010, sulphur 0.028 and copper 0.13 per cent. Pouring time per ingot was 35 seconds. Time from the finish of the pour until the removal of the insulation was 21 hours and the time from the finish of the pour until stripping the mold was 25 hours.

The regular ingot conformed to good rimming practice while the insulated ingot rimmed poorly and grew considerable. Fig. 8 shows the two types of ingots after splitting to within 8 inches of the axial area and then fractured. It will be noted by the indentations along the surface of the insulated ingot that a greater number of blows were required by the "drop" for fracturing because of the porous structure.

The regular ingot had a carbon variation of 0.04 to 0.07 per cent and sulphur of 0.017 to 0.036 per cent. The insulated ingot had a variation in carbon of 0.04 to 0.09 per cent. The sulphur varied from 0.018 to 0.068 per cent which is considerably in excess of that found in the normal ingot.

It appears impractical to produce ingots by general insulation. The mold expands excessively and thus permits the molten metal to break through at numerous places (bleeders) yielding a surface that has to be chipped or scarfed excessively. The steel is far too porous and excessive croppage is required. Segregation is far too excessive to secure the desired quality for special drawing quality sheets and hot and cold rolled strip.

Mold Casings Were Tried

A plan suggested a few years ago and said to have a beneficial influence on improving segregation and promoting greater soundness in rimmed ingots involved placing casings in the mold. Two methods were followed. The first method was to equip half or 12 molds with casings made of 12-gage 18 x 76-inch sheets and weighing 342 pounds per ingot. These strips were pickled to prevent any reaction with the molten steel and spaced equally apart, except for allowing a 4-inch space in the center for teeming. Segregation tests showed little difference in the physical characteristics of ingots poured with or without casings.

Another method employed four nested steel boxes of pickled scrap. These were approximately 5, 9, 13 and 17 inches square and extended the full length of the mold with openings at the bottom for the flow of metal as usual. This arrangement afforded no improvement in segregation, density, soundness nor wall thickness, and therefore had no value.

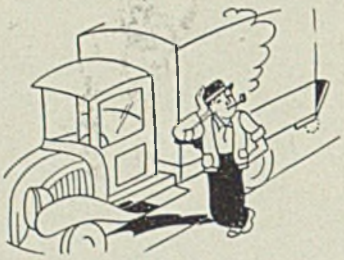
A method of producing sound ingots is that of jarring or shaking the molds while the ingot is being poured and thereafter while the metal is still in a molten condition. Some plants using the steam locomotive shook several buggies during the pouring operation; others had a system of an up-and-down motion by using a crane.

Obviously it is desirable to obtain sound ingots substantially free from slag inclusions, gas cavities, etc., and without great initial expenditures for equipment changes irrespective of whether ingots are cast on buggies or in a pouring pit with or without the use of hot-tops. As it is not convenient nor practical to anchor molds to the stools the jarring necessary to produce the desired ingot characteristics must be of such

(*Please turn to Page* 277)

More Tons Per Trip.

Many war plants are getting more work from their battery lift trucks by using them as tractors. Each carries one skid load and at the same time pull one or more additional skid loads on trailers. They pick up the loads and put them on the trailers, then set them off at the destination and spot them wherever wanted. The same method can be applied to fork trucks and pallet loads, and is useful for relatively long hauls. It yields more tons per trip and, because of the relatively small dead weight of the trailers, also results in more tons per kw-hr.



Waiting Is Not Working.

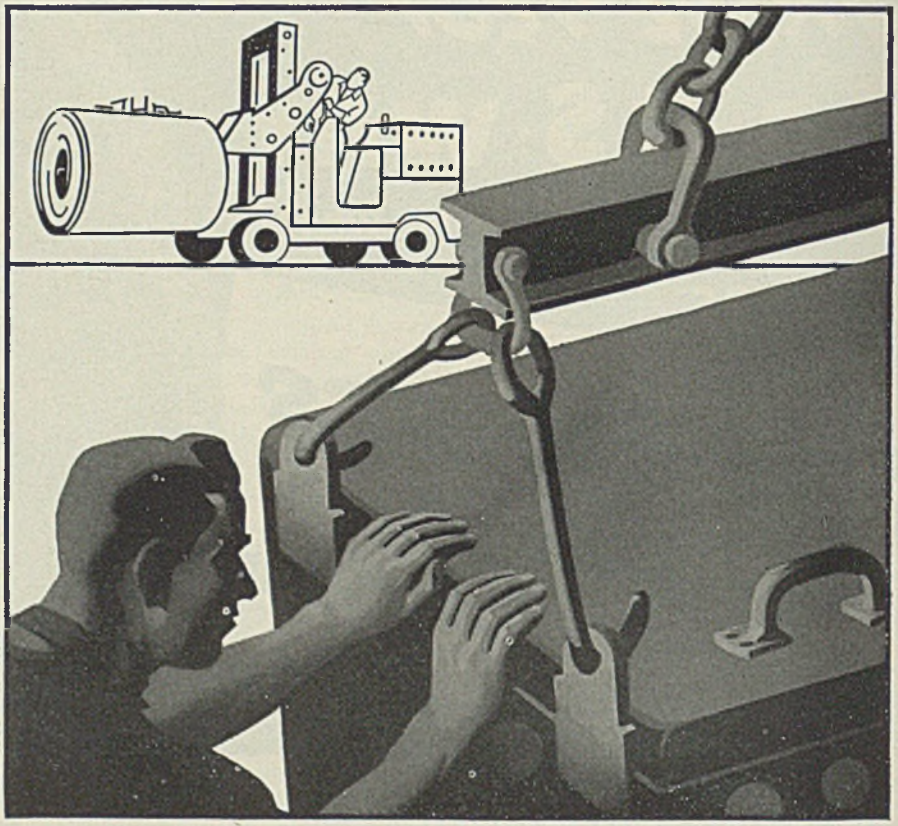
Highway trucks handling interplant shipments spend more time on the road and less time waiting at the loading docks when goods are shipped on skids or pallets or, if boxed, are provided with battens underneath. Then battery fork trucks can be used to stow the loads, and they can do it in a mere fraction of the time it takes to do the job by hand, thus conserving precious man-hours as well as truck hours. Both savings are doubled when the consignee uses the same method to unload.

Dependability Is Twins.

The fact that an alkaline battery as the power unit of a material-handling truck almost never has to be pulled off the job for repairs saves two ways: First, it avoids delays on the job itself—which makes it a real ally of the production superintendent. Second, it conserves the time of maintenance men by permitting their full time on maintenance rather than repairs. This is what we mean when we say that the Edison Battery's performance is predictable: the slight care it needs can be regularly scheduled.

Edison Storage Battery Division
Thomas A. Edison, Inc.
WEST ORANGE, N. J.

THIS POWER is predictable

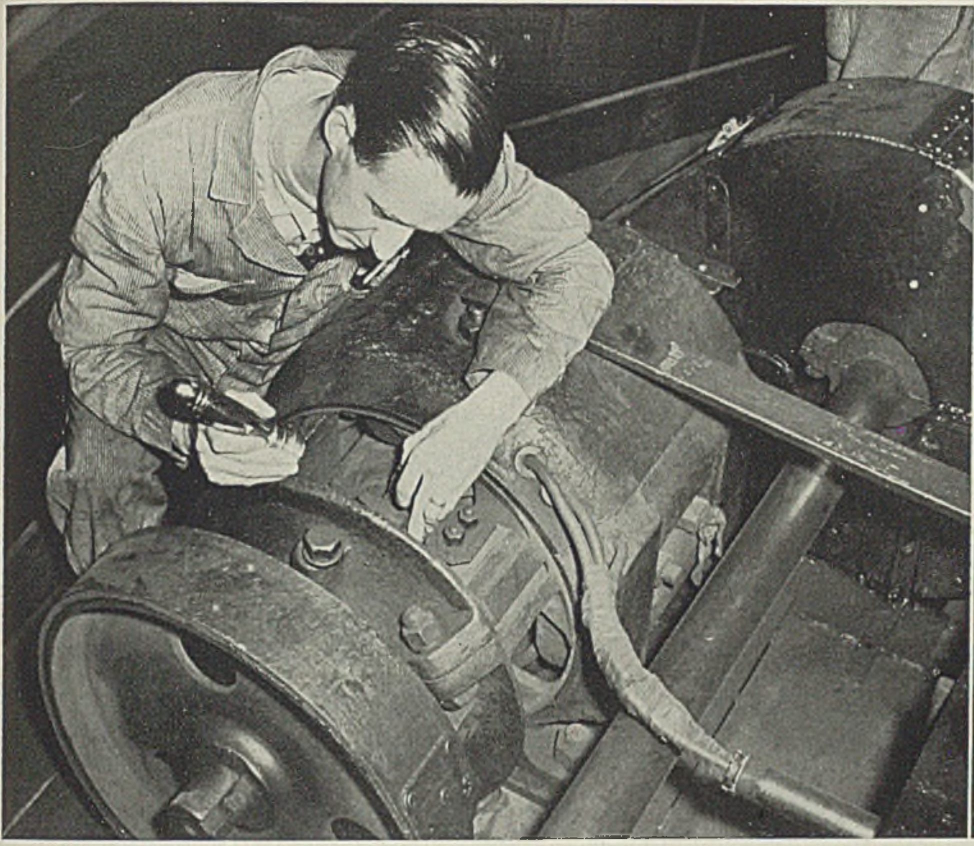


America depends upon you to deliver—just as you depend upon your battery industrial trucks to expedite material-handling without congestion, bottlenecks or delay. Your production and the power unit in your industrial trucks are inseparably linked. When alkaline batteries power your trucks you *know* their performance is predictable because you *know* the batteries are designed that way. They are so rugged structurally and so foolproof electrically that they are your guarantee of an uninterrupted flow of production. Therefore, they help you get more from your present material-handling equipment, you save precious man-hours — and above all they help insure your ability to produce from the minute materials enter your plant until the finished product leaves it.

Throughout industry, in mines and on railroads, the predictable qualities of Edison Alkaline Batteries are paying big rewards. Yes—

INDUSTRY NEEDS THE RELIABILITY OF

Edison Alkaline BATTERIES



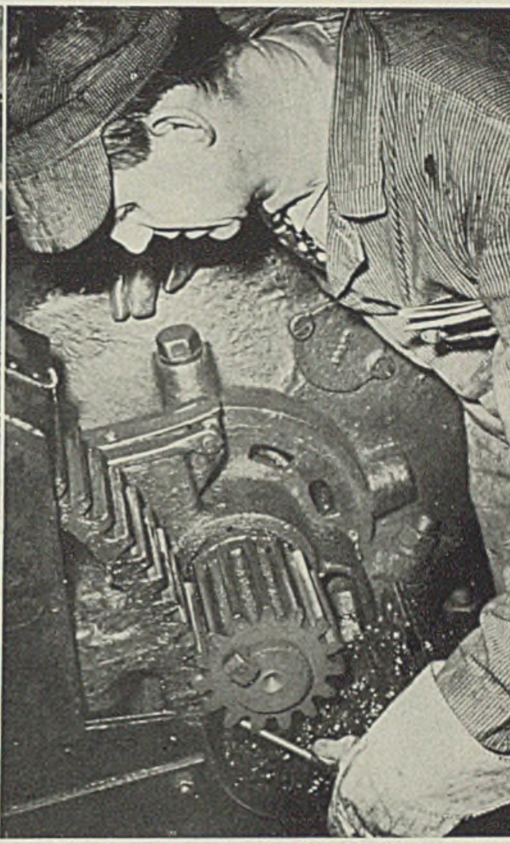


Fig. 1. (Left)—Checking condition of brushes, brush holders and commutator. Carbon brushes should move freely in brush holders. Also spring tension in brush is checked and adjusted if necessary. Too much tension will cause unnecessary wear; too little causes poor commutation

Fig. 2. (Right)—Wear in armature bearings is checked by placing lever between teeth of gear and under motor pinion. By raising lever, wear in this bearing is easily detected. Bearing at pinion end of motor invariably wears faster

REGULAR CRANE INSPECTION

reduces maintenance—avoids breakdowns—assures safety

By TOM MARNEY
Crane Inspector
Factory Service Division
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

IN A LARGE manufacturing plant like the Westinghouse Electric & Mfg. Co., at East Pittsburgh, Pa., where there are about 260 overhead electric cranes and some 420 electric hoists, the crane inspection department is an important unit.

While the primary duty of the inspector is safety, the reporting and prompt repairing of defective equipment, which would not affect the safety of workmen on the floor, sometimes avoids major repairs and reduces maintenance costs. Since a minor defect takes only a fraction of the time to repair if repaired promptly, a more continuous crane service is assured. This is an important factor in the war effort.

The duties of the crane inspector can be defined as follows: Inspect electric travelling cranes, electric hoists, crane runways, trolley wires, load cables and chains attached to cranes; give full reports at regular intervals on these inspections, and keep reports on file for reference of the state department of labor and industry; authorize corrections to be made, check repairs when made; and inspect all new crane installations or major repair jobs.

Since it is imperative that the cranes be inspected at regular intervals without too much time elapsing between inspections, a system of procedure is followed. Each part is inspected in its proper order as shown on the crane inspector's report. When the inspection is completed, any defects are noted down in the same order, later to be written on however, is telephoned to the factory the official report. Any serious defect, service department. If conditions warrant, a defective apparatus tag is attached to the crane by the inspector. This tag may only be removed by the inspector after repairs have been completed to his satisfaction. The routine of crane inspection is as follows:

—Inspect cage for security.

—Check and try control.

—Examine hoist cable or chain.

—Inspect bridge motors, bearings, gears, track wheels, lubrication, etc.

—Check hoist motors, bearings, gears, limit switches, guards and brakes.

—Check trolley motors, bearings, gears, wheels, guards and open wires.

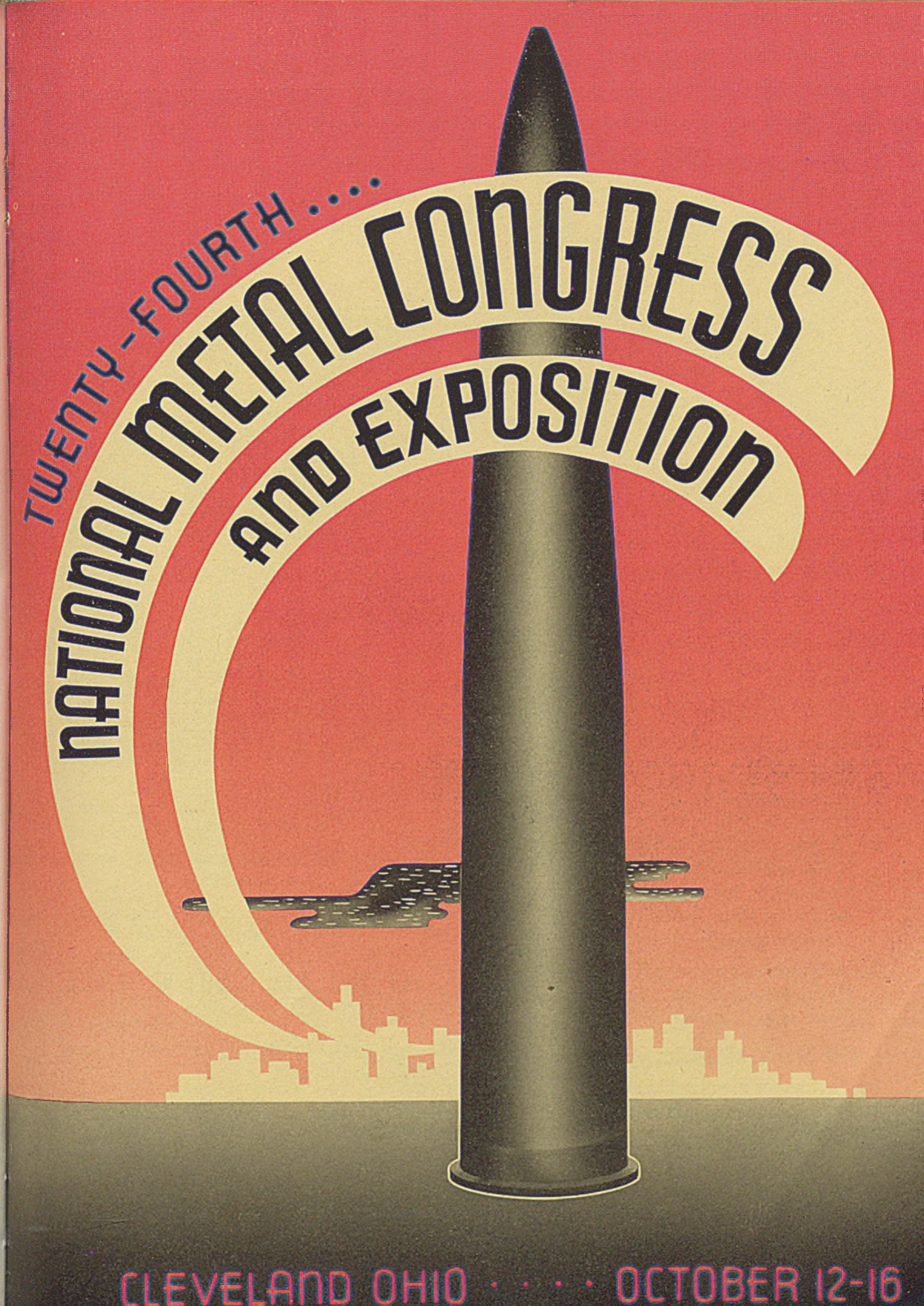
—Main trolley wires.

Crane Inspection Routine: Suppose we make a mythical inspection of a 15-ton crane with control in one of our large manufacturing aisles, note down the defects and diagnose their causes.

In entering the crane, the cage is inspected for security. At all times throughout the examination the inspector must be on the lookout for loose bolts, cracked castings or wheel spokes, and the like. Tapping with a small hammer which is part of the inspector's equipment will determine their condition. The master switches, control panel and resistors are next checked. With the exception of a few dirty and slightly burned contacts on the panels everything appears to be normal.

The switch is now closed and the crane operated with the power on. In

(*Please turn to Page* 282)


TWENTY-FOURTH ....
NATIONAL METAL CONGRESS
AND EXPOSITION
CLEVELAND OHIO . . . . OCTOBER 12-16

TAM ZIRCONITE PRODUCTS AVAILABLE

TAM

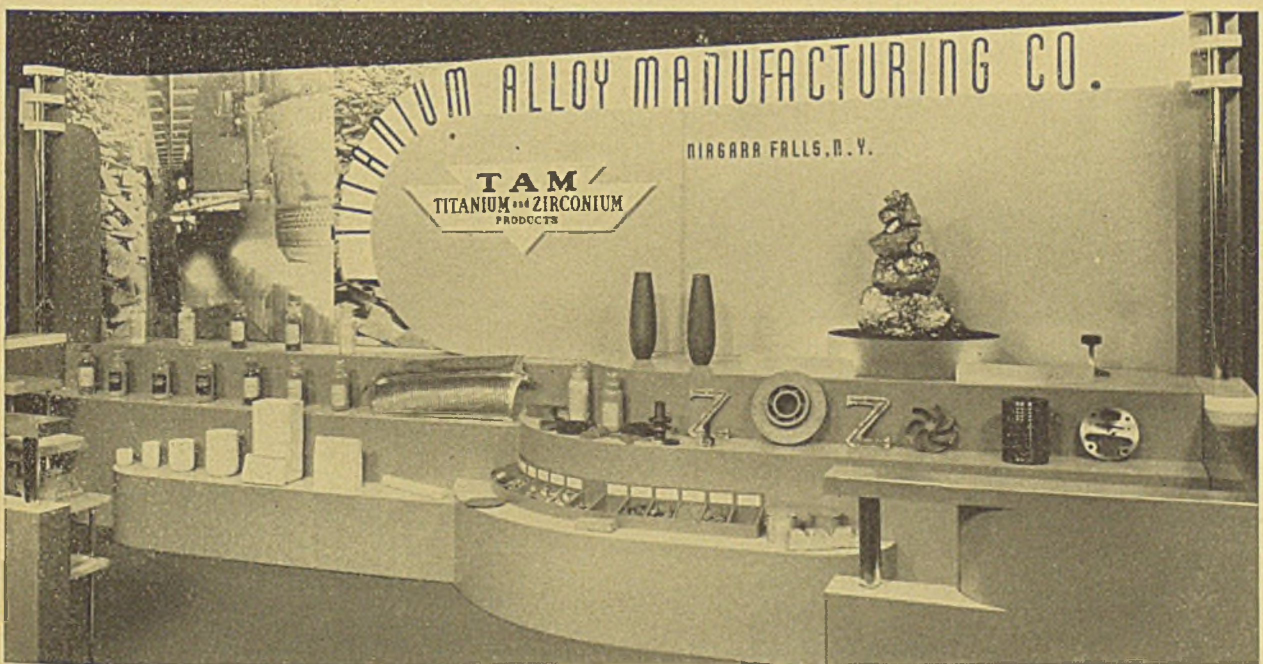
Foundry Zirconite Sand (in three grades)
Melting Points from 3650° F to 3950° F

TAM

Foundry Zirconite Flour (in two grades)
Melting Points from 3650° F to 3812° F

TAM

Foundry Zirconite Mold and Core Washes (in three grades)
Super-refractory compounds with melting points from 3600° F to 3775° F



(ZIRCONITE PRODUCTS SHIPPED TO CANADA DUTY FREE)

Representatives for the Pacific Coast . . . . Balfour, Guthrie & Co., San Francisco, Los Angeles, Portland, Seattle, Tacoma

Representatives for Canada . . Railway & Power Eng. Corp., Ltd., Toronto, Montreal, Hamilton, Winnipeg, Vancouver, Sydney

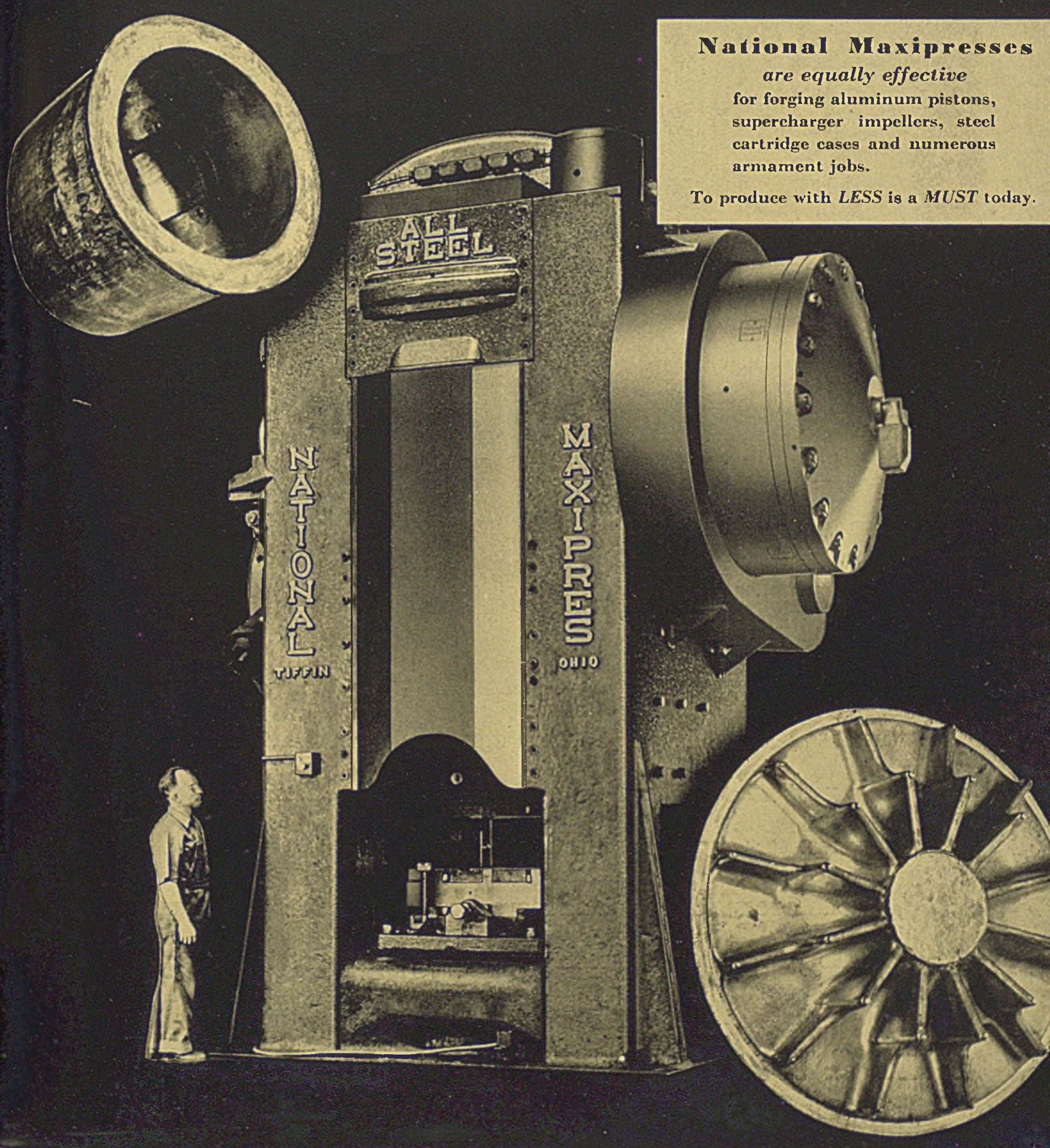
Representatives for Europe . . . . T. Rowlands & Co., Ltd., 23-27 Broomhall St., Sheffield, England


Forging~
National Forging Machines
are doing
"Their Part"
by using
LESS STEEL
to make shells, bombs, air-
plane cylinders and limitless
forgings for our armed forces.
NATIONAL
NATIONAL
THE NATIONAL MACHINER

for Victory

National Maxipresses
are equally effective
for forging aluminum pistons, supercharger impellers, steel cartridge cases and numerous armament jobs.

To produce with *LESS* is a *MUST* today.



COMPANY, TIFFIN, OHIO, U.S.A.

"GET IN YOUR SCRAP—

WE'LL PRODUCE THE FIGHTING STEELS!"

. . . this headline statement is a challenge that comes to you from the thousands of steel workers throughout America. Like the men in your own plant, these steel men are doing their fighting by producing war materials in greater volume than ever before, and they are doing it largely with existing furnaces and machines. Men in steel are determined to hold *their* production records, and even to better them, so that your workers may have the steel they need.

To do this requires scrap and more scrap, and the steel workers look to you to help yourself by helping them get the scrap.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

PARTNER TO INDUSTRY IN WAR PRODUCTION

J&L STEEL

READY REFERENCE DATA

FOR YOUR HELP IN FABRICATING SEYMOUR PHOSPHOR BRONZE--

SEYMOUR PHOSPHOR BRONZE

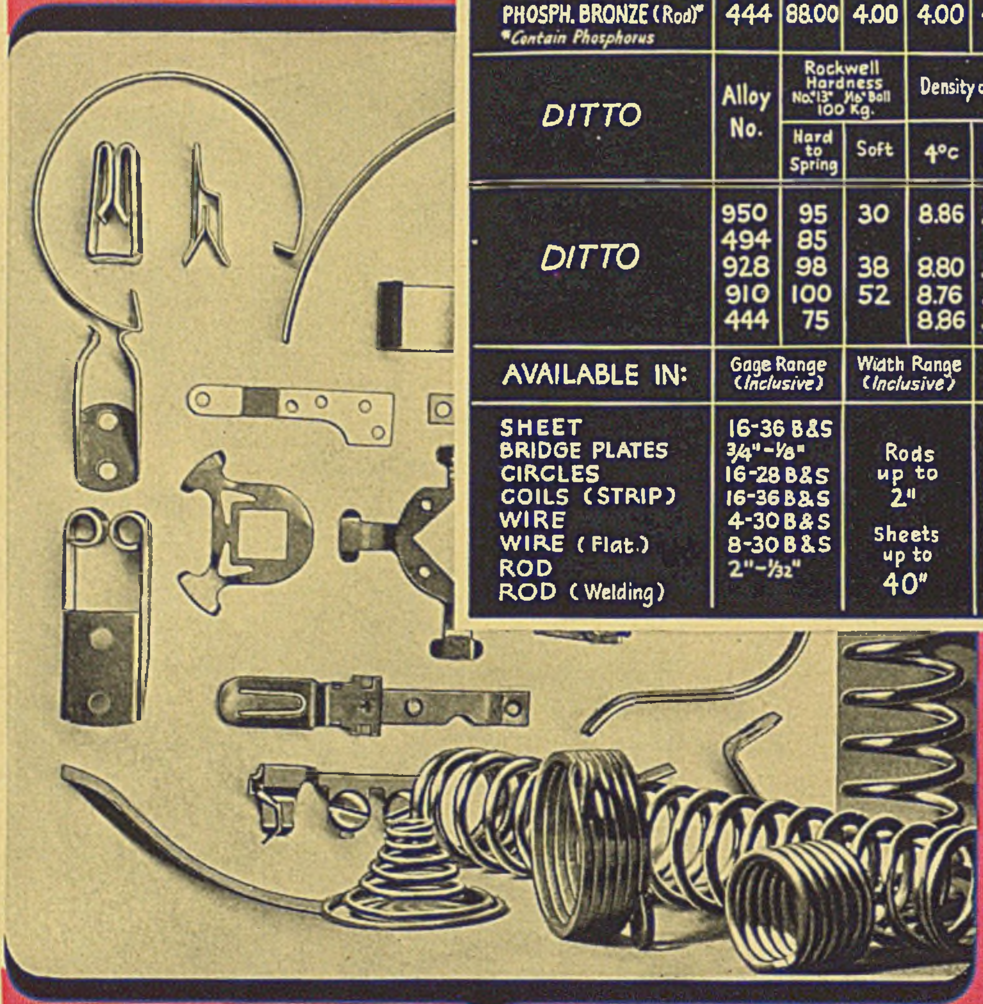
ALLOY	Alloy No.	Composition Approximate Percent: Copper	Zinc	Tin	Lead	Tensile Strength lbs. per sq. in.: Hard to Spring	Soft	Elongation Percent in 2 in. min.: Hard to Spring	Soft
GRADE A (Sheet)*	950	95.00		5.00		105,000	45,000	1.5	50
" B (Rod)*	494	94.00		5.00	1.00	61,000	50,000		40
" C (Sheet)*	928	92.00		8.00		112,000	55,000	3	
" D (")*	910	90.00		10.00		115,000	60,000	5	65
PHOSPH. BRONZE (Rod)*	444	88.00	4.00	4.00	4.00	*60,000		20	

*Contain Phosphorus

*(Small Size Only)

DITTO	Alloy No.	Rockwell Hardness No. "13" 1/16" Ball 100 Kg.: Hard to Spring	Soft	Density or Spec. Grav.: 4°c	lbs. per cu. in.	lbs. per cu. ft.	Melting Point °F	Elec. Resistance	Elec. Conductivity % I.A.C.S 20°c
DITTO	950	95	30	8.86	.320	552	1920	6.1	16.5
	494	85						6.0	16.8
	928	98	38	8.80	.318	549		7.8	12.8
	910	100	52	8.76	.316	546		9.4	10.6
	444	75		8.86	.320	552	1830	8.2	12.2

AVAILABLE IN:	Gage Range (Inclusive)	Width Range (Inclusive)	MISCELLANEOUS
SHEET	16-36 B&S	Rods up to 2"	*WIRE AND ROD supplied Round, Half-Round, Quarter-Round, Oval, Half-Oval, Hexagon, Octagon, Square, Triangular or Fancy-tinned or bare.*
BRIDGE PLATES	3/4"-1/8"		*SHEET AND STRIP in roll finish or Patent Level. Strip tinned if desired.*
CIRCLES	16-28 B&S	Sheets up to 40"	
COILS (STRIP)	16-36 B&S		
WIRE	4-30 B&S		
WIRE (Flat.)	8-30 B&S		
ROD	2"-1/32"		
ROD (Welding)			



THE SEYMOUR MFG. CO.
SEYMOUR, CONN.

•

NON-FERROUS ALLOYS SINCE 1878

SEYMOUR
PHOSPHOR BRONZE

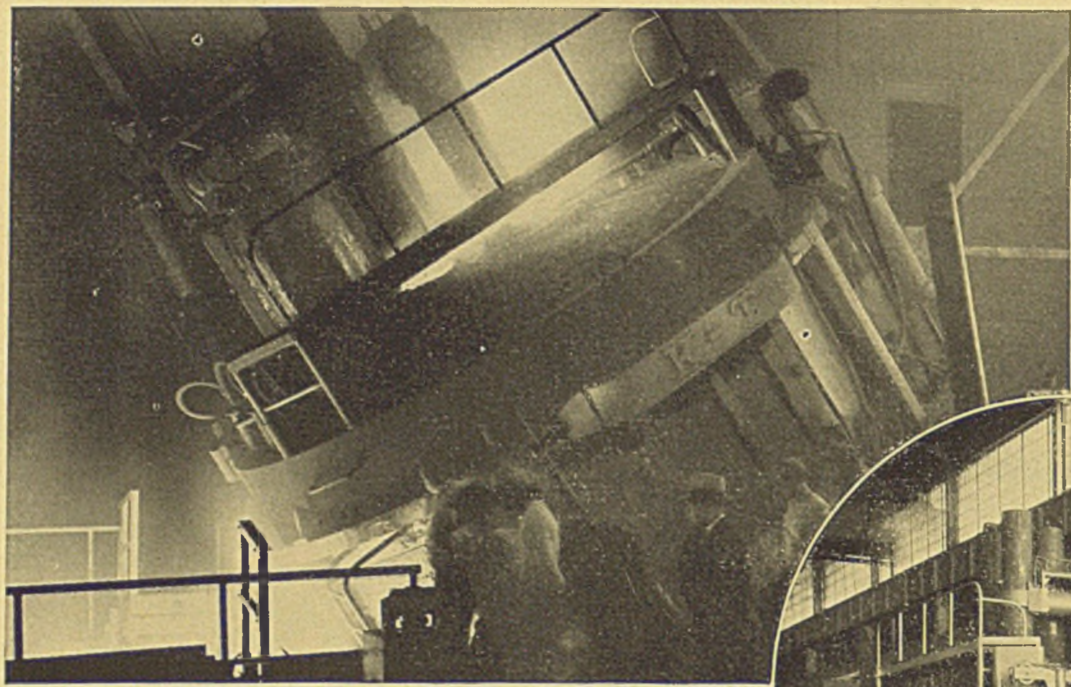
...SPEED WORK IN SHIPYARDS AND INDUSTRIAL YARDS ON DOCKS AND IN PORTS

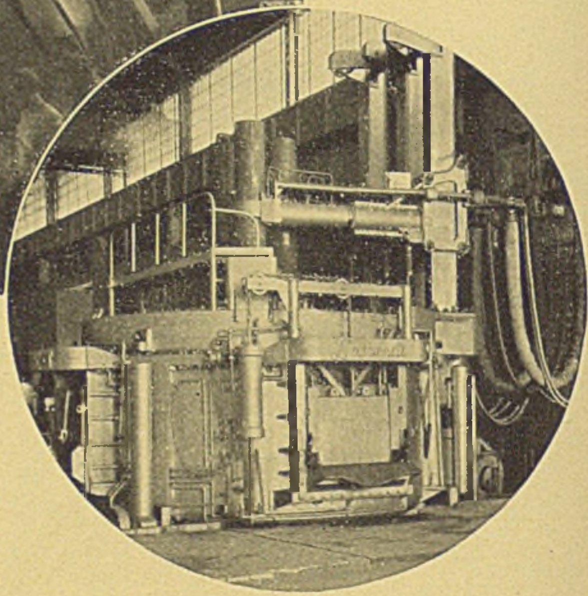
Operated by one man and powered by one engine, they conserve vital time, fuel and material. They move about fast on pneumatic tired wheels without damage to roadways.

Available in a wide range of sizes for jobs with high priority, these fine new Cranes are helping to win the War. Descriptive literature available on request.

THE OSGOOD CO.
MARION, OHIO
MOBILCRANES

THE GENERAL EXCAVATOR CO.
MARION, OHIO
SUPERCRANES





(Above) Tapping a 50 ton top charge Lectromelt furnace.
(Right) The same furnace in normal operating position.

Speeding Up... Steel Production

With the largest TOP CHARGE electric furnace

★ The fine performance and reliability of Lectromelt furnaces are contributing in a vital manner to the increased tempo of the armament program.

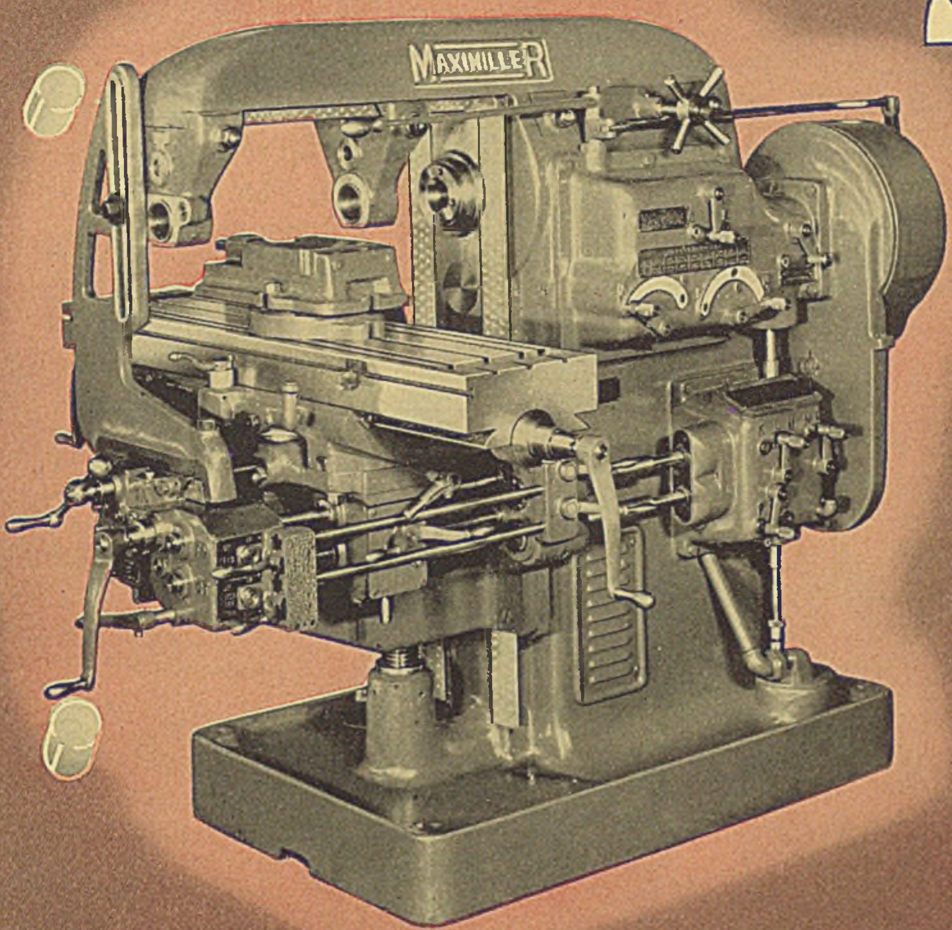
Pictured above is the largest top charge electric furnace in the United States. This is one of the 17′ diameter, size KT-50 ton capacity Lectromelts now on alloy steel production. Similar capacity furnaces are turning out heats of 50 tons of plain carbon steel. The top charge type Lectromelt furnaces increase steel production, and their use results in savings in power, electrodes, refractories and man hours.

Lectromelts are built in standard sizes from 100 tons down to 25 pounds capacity. Both top charge and door charge types are available, and detailed information will be gladly furnished on request.

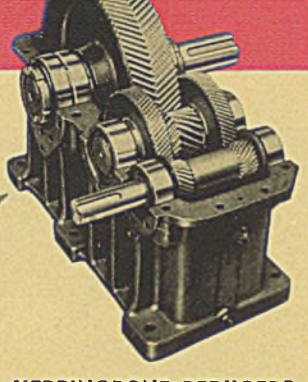
MOORE RAPID
Lectromelt
FURNACES

PITTSBURGH LECTROMELT FURNACE CORPORATION

Pittsburgh, Pennsylvania

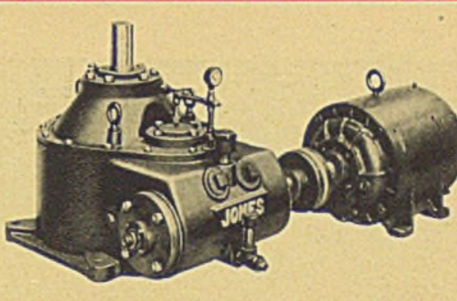

MAXIMILLER

To help you SPEED PRODUCTION



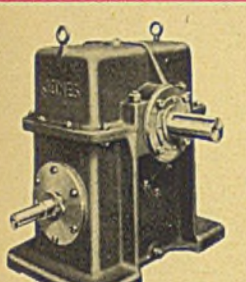
HERRINGBONE REDUCERS

Available in single, double and triple reduction types in a wide range of ratios and ratings.



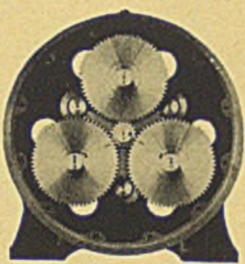
WORM-HELICAL SPEED REDUCERS

A versatile line of double reduction units for agitators, mixers or other applications requiring a vertical shaft drive.



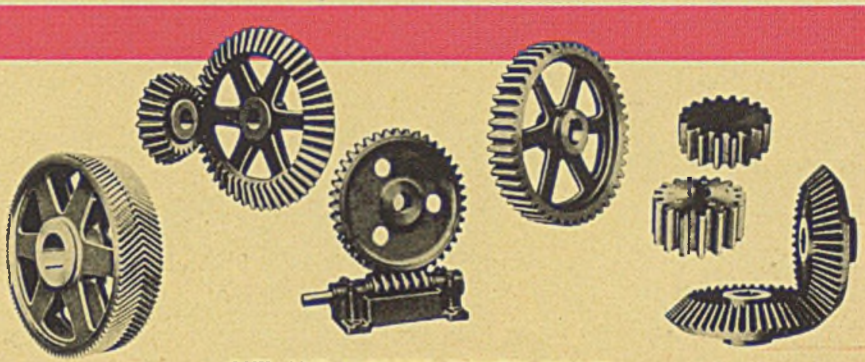
WORM GEAR REDUCERS

Built in light and heavy duty types and in various styles to suit the conditions.



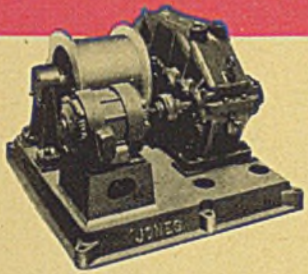
SPUR GEAR REDUCERS

Concentric straight line drive in single and double reduction units.



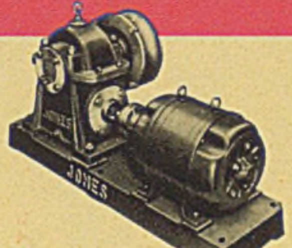
CUT AND MOLDED TOOTH GEARS

Jones gear cutting practice represents the accumulated technical knowledge of 50 years backed by the finest gear cutting equipment and craftsmanship.
The line covers cut tooth spur, helical, herringbone, worm, bevel, and mitre gears of high test cast iron, steel, bronze, or non-metallic material. An extensive line of patterns is also available for high test cast iron molded tooth, spur, bevel and mitre gears.



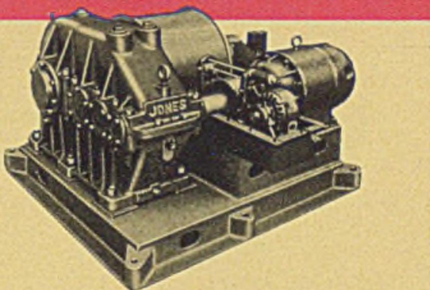
CAR PULLERS

These car pullers are built by Jones as complete units with motor included if desired, or with base to take purchaser's motor. The cable drum is driven by a Jones double or triple reduction Herringbone speed reducer and the control station may be located at a point to give the operator a clear view of the tracks and spotting positions.



DOOR HOISTS

The Jones Door Hoist is a simple, compact and sturdy heavy duty worm gear driven unit that has been widely used in the steel industry for handling furnace doors. It is also applicable to other services where doors of various types must be opened and closed and where it is desired to avoid the complications of limit switches.



SKIP HOIST DRIVES

Jones Skip Hoist Drives are equipped with all the modern protective devices such as cam or nut type limit switches, solenoid or disc type brakes and slack cable switches. Drives are standard Jones Herringbone Speed Reducers.

PULLEYS

Jones pulleys are machine molded, poured of high test cast iron, and are accurately finished and balanced. Single arm, double arm, multiple piece and extra heavy conveyor pulleys and flywheels can be supplied.

V-BELT SHEAVES

Made of high test cast iron. Sheaves for "AB" light duty combination and "C" belts in stock with keyseated bushings. Standard and special sheaves for all industrial belt sections made to order.

CLUTCHES

Built for a broad range of shaft sizes and ratings in both enclosed and open types for sleeve and coupling work. In addition they are available in a line of friction clutch pulleys. This clutch modification is also used with gears, V-belt sheaves or sprocket wheels.

COUPLINGS

High and low speed flexible couplings, flange, keyless compression, ribbed and jaw clutch couplings.

PILLOW BLOCKS

Jones Pillow Blocks have double row Timken Roller Bearings locked firmly to the shaft by means of a tapered split steel adaptor and clamp nut. Effective seal retains lubricant . . . easily removed from shaft.

HANGERS

Jones drop hangers, post hangers and bracket hangers are strongly reinforced with arch bracing. Free universal adjustment. Feet are ground.

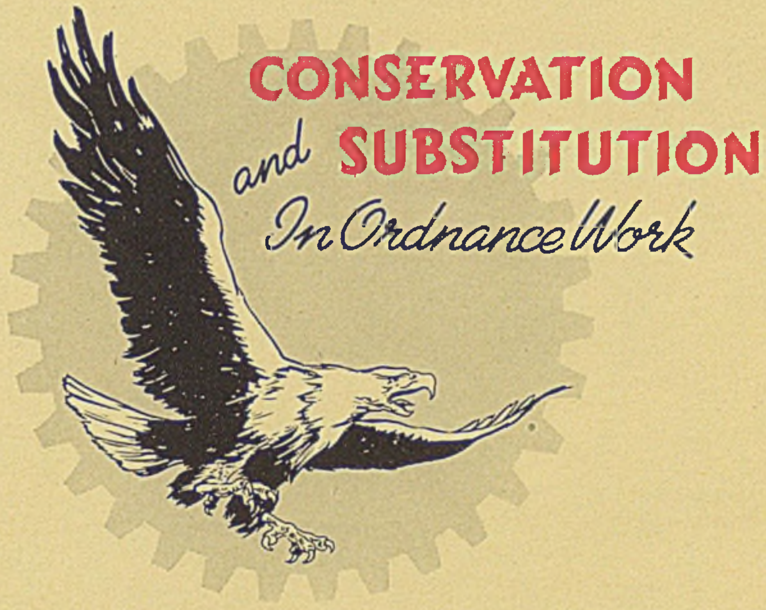
Jones

W. A. JONES FOUNDRY & MACHINE COMPANY
4437 Roosevelt Road, Chicago, Illinois

BULLETIN No. 80

"Jones Drives for Industry" may be helpful in giving you a complete picture of the Jones products, engineering services and manufacturing facilities that are available. Your request will

National Metal Congress and Exposition to aid



Today's No. 1 Problem

For two years our war industries have been expanding at a tremendous rate till today there is real danger of material shortages hampering their capacity operation. Yet our need for war goods continues to increase.

From the materials standpoint, we are in many ways in a much worse condition than the Axis, particularly Germany, inasmuch as we have lost vast quantities of war materiel by capture. Too, we cannot so readily recover scrap such as cartridge cases due to our long transport lines extending to all parts of the world.

At the same time, our need for war goods climbs a steep spiral, for we must be prepared to meet the threat of attack at whatever point it may be delivered. Then to mass an effective supply of arms for any offensive action requires yet more military equipment.

WE CANNOT AFFORD TO LET MATERIAL SHORTAGES CUT WAR PRODUCTION.

Here and in succeeding issues, STEEL's editors describe some of the moves being made by the United States Army Ordnance Department in co-operation with American industry on the complicated chequer-board of materials supplies, in the interests of conservation. They directly supplement the production shortcuts scheduled for a series of meetings on Ordnance Production featuring the 1942 National Metal Congress and Exposition. See p. 209.

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War's Destruction...

spotlights need for conservation and substitution of critical raw materials

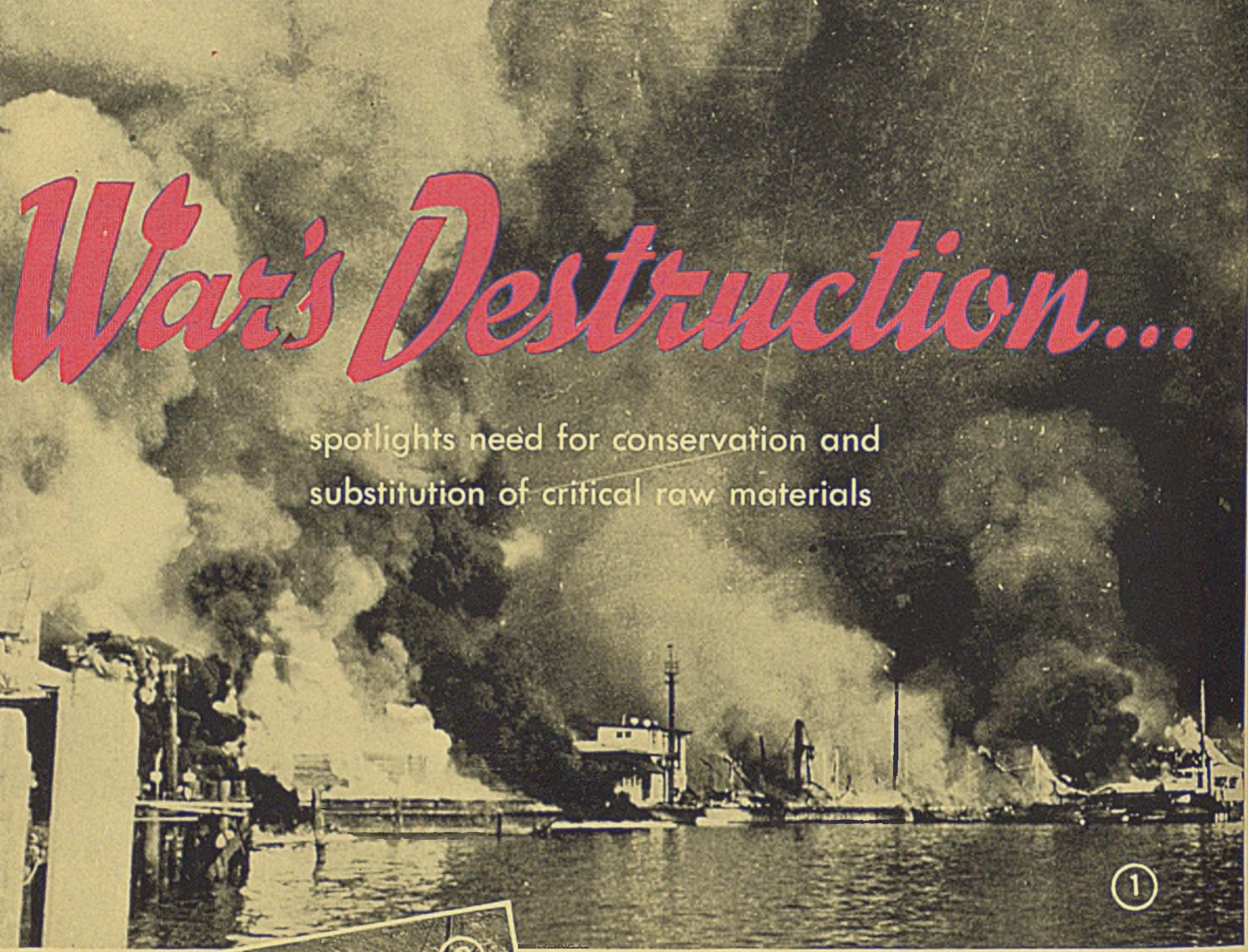
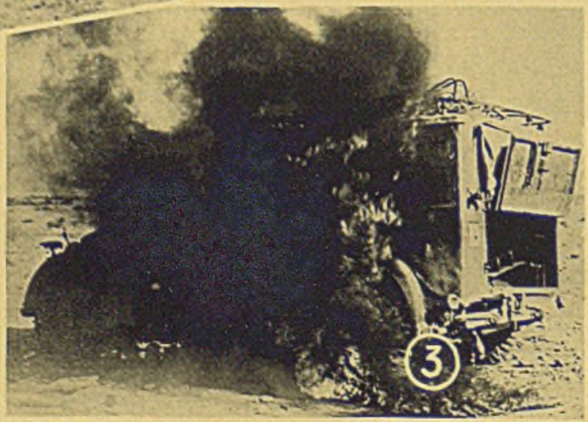
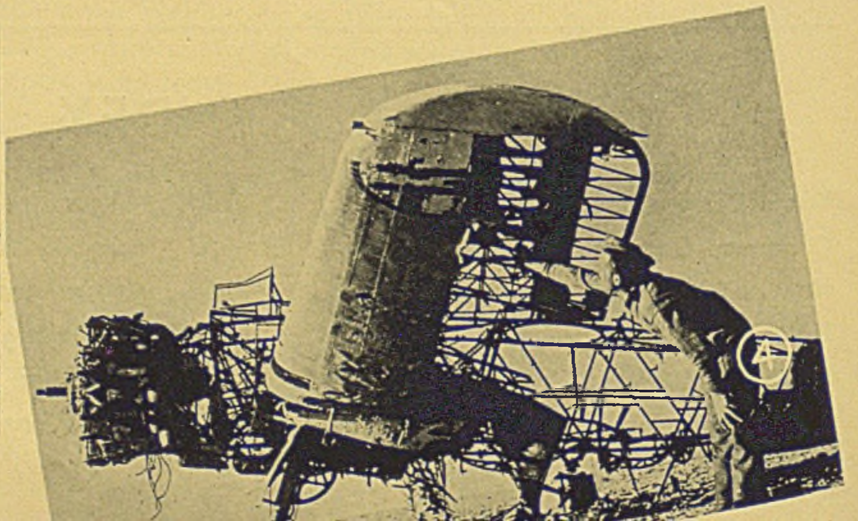


Fig. 1—*To replace vital war materials lost, it is necessary to employ every possible means of conservation. This U. S. Army Signal Corps photo shows result of Japanese attack on Cavite Navy Yards, Philippine Islands, Dec. 10, 1941. Barge No. 181, right center, is loaded with burning torpedoes. Small arms ammunition is exploding in center of heavy blaze on left*

Fig. 2—*Libyan campaign. Bombed Axis merchant vessel sinks in harbor after fierce attack by Allied air forces on day Bardia was recaptured. British official photo*

Fig. 3—*British gunfire set this German radio truck burning fiercely. British official photo taken during big raid far behind enemy lines in western desert in North Africa*





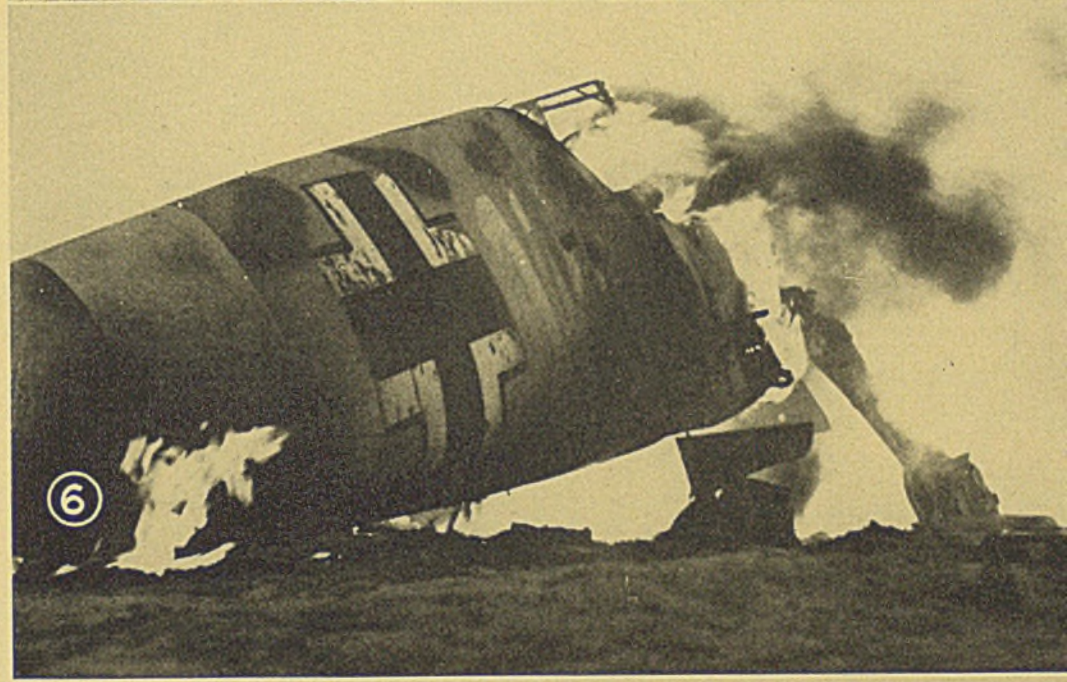
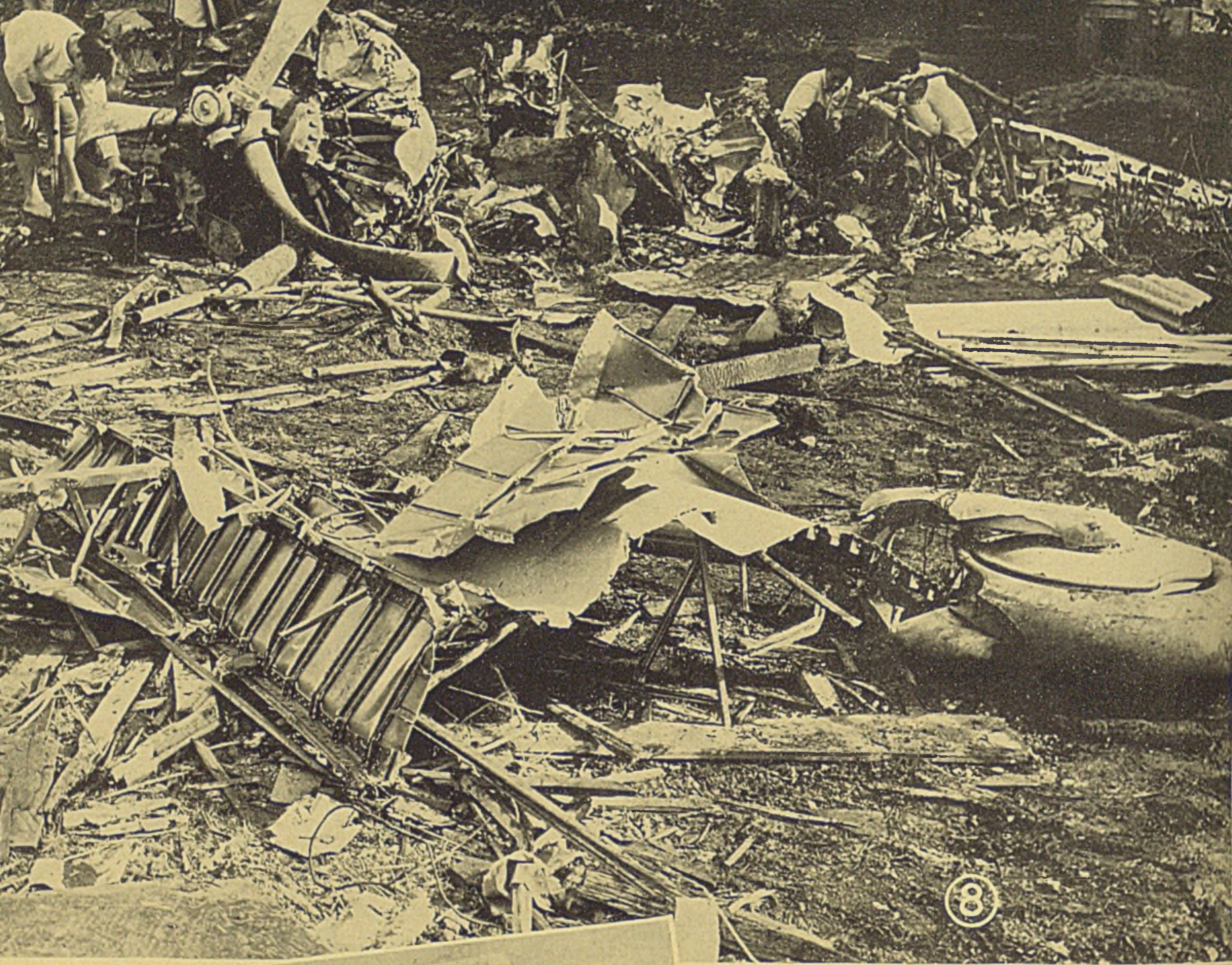


Fig. 4—Inspecting wrecked skeleton of an Italian plane shot down in Libyan desert. British official photo

Fig. 5—Bombed truck still burning off Hickam parade ground, Hawaii, at 11:15 A.M. Dec. 7, 1941. U. S. Army Signal Corps photo

Fig. 6—One of many Messerschmitts brought down by an Australian fighter squadron operating over the western front. British official photo

Fig. 7—Remains of tents and barracks after fire caused by Jap attack on Wheeler Field, Hawaii, Dec. 7, 1941. Practically all were killed by machine gunning. U. S. Army Signal Corps photo



CONSERVATION *and* SUBSTITUTION
In Ordnance Work

Fig. 8—Wreckage of Jap plane shot down near CCC Camp in Hawaii the morning of Dec. 7, 1941. U. S. Army Signal Corps photo

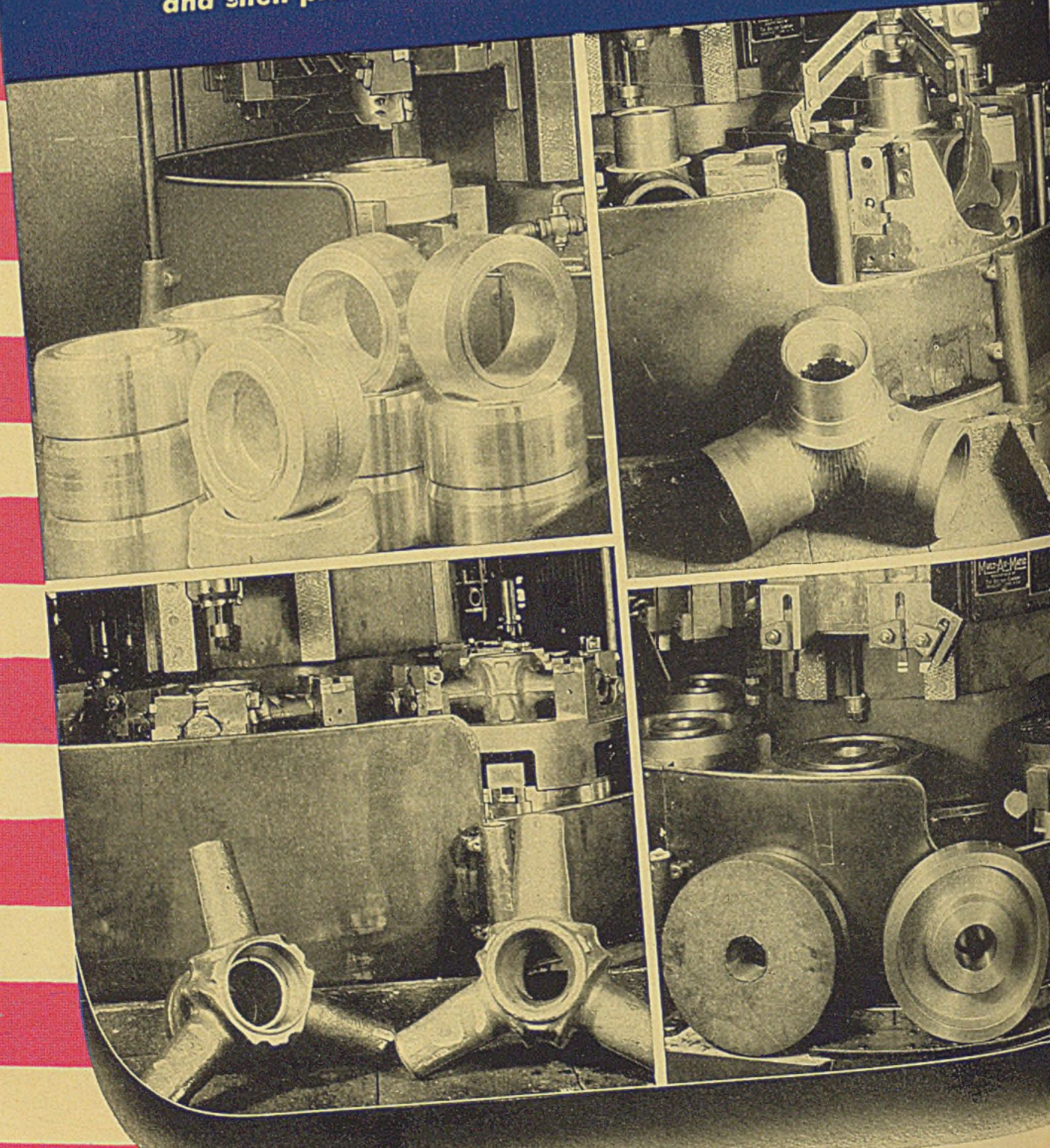
Fig. 9—Collection of Axis guns captured near Tobruk. Some show results of effective British range-finding. British official photo


WE
SHALL
Keep 'em Flying
BULLARD

No Job "Too Big" for A Mult-Au-Matic

If it involves machining metal — particularly at the rates and to the requirements that 24-hour-a-day war work demands, have it estimated for a Mult-Au-Matic.

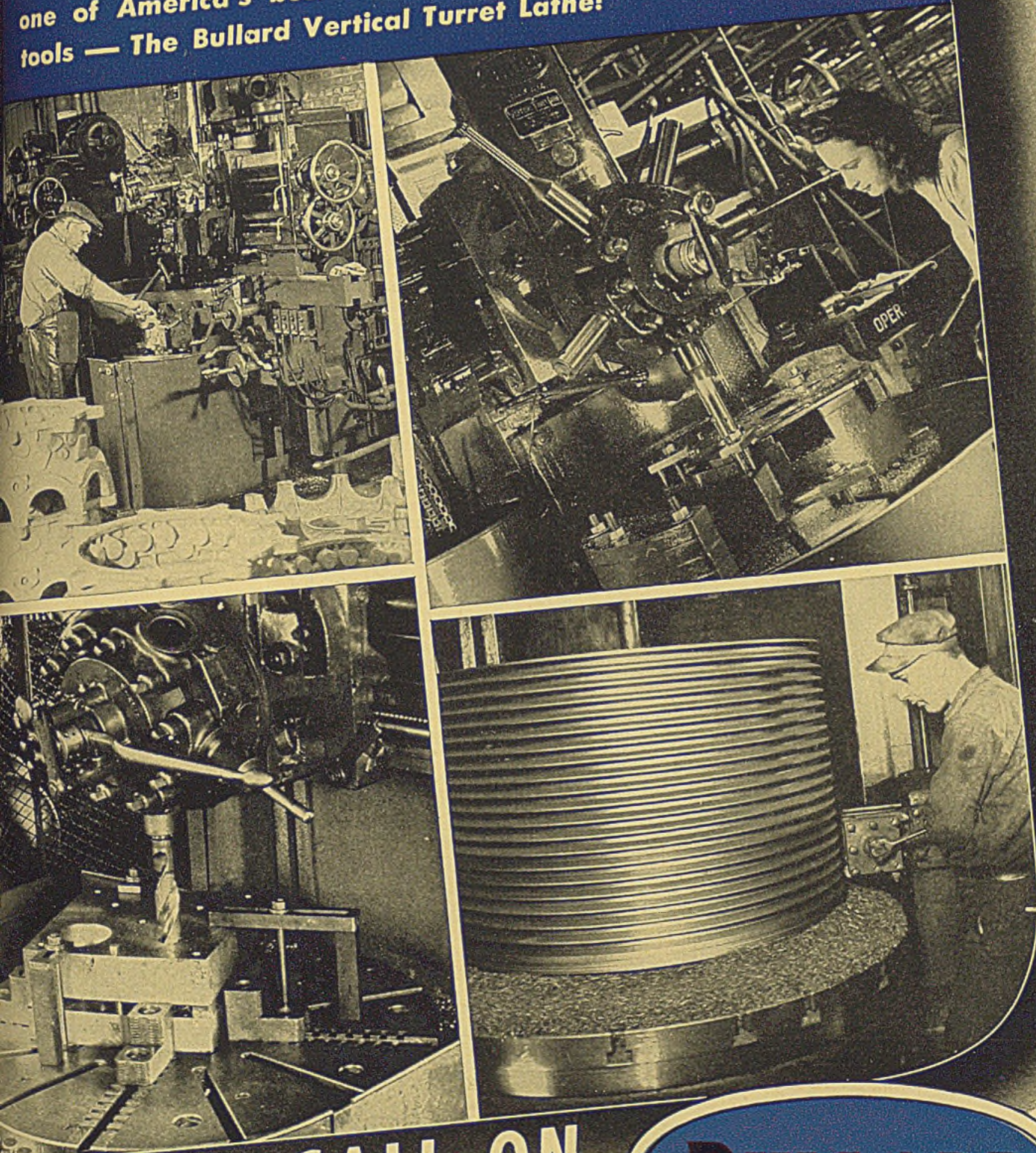
What is being done in hundreds of engine, plane, tank, gun and shell plants can be done in your plant.



THE BULLARD

No Part "Too Complicated" for V.T.L.

Here are big parts, little parts, simple parts, complex parts. One and all, they come off a V.T.L. faster, more accurate, and with a lower cost than you can meet anywhere else. Put to work, in your plant, the experience that has created one of America's best known and most reliable machine tools — The Bullard Vertical Turret Lathe!



CALL ON BULLARD

The Ordnance Department

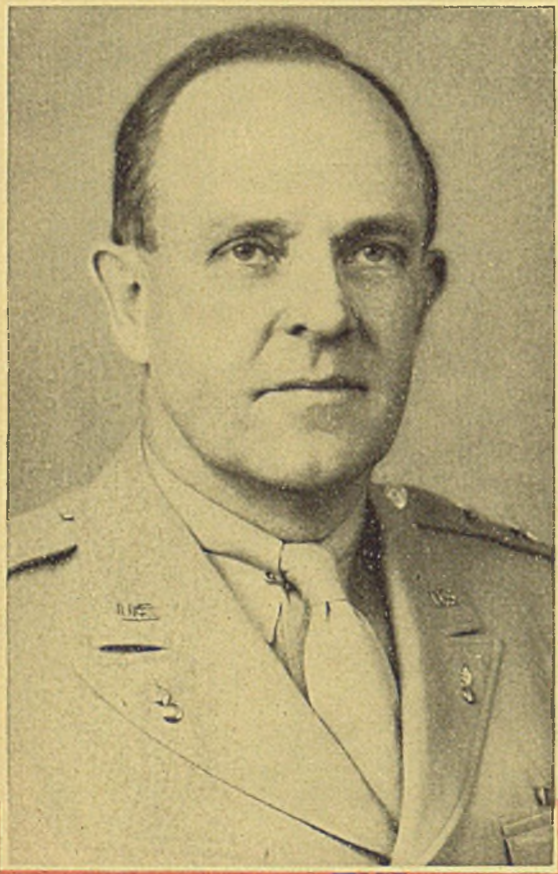
. . . . and its conservation control program

TWO YEARS ago the Ordnance Department recognized the need for centralized conservation control and set up a program whereby every part of component containing 1 per cent or more of any strategic metal or alloying element was closely examined and substitutes made mandatory wherever possible.

This huge task is still very much in the active status. Already literally millions of drawings and specifications have been reviewed and revised. The organization accomplishing this important job was established by order of Chief of Ordnance Major General L. H. Campbell Jr. who set up a conservation unit in each of the four operating divisions—Tank and Combat Vehicle Division, Small Arms Division, Artillery Division and Ammunition Division. At the same time, a central authority was organized to co-ordinate and supervise the activities of all of these various division units.

Ordnance Department men concerned with conservation work include Brigadier General G. M. Barnes, assistant chief of industrial service in charge of research and engineering; Deputy Chief, Technical Division, Colonel Wm. A. Borden; Executive Assistant Major H. S. Turner; Service Branch, Colonel S. B. Ritchie; Materials Section, Lieutenant Colonel J. H. Frye; Conservation Section, Mr. H. M. Huxley.

Associated with members of the Ordnance Department conservation units are outstanding civilian engineers in the various technical fields of diecasting, stamping, plastics, grey and malleable iron castings, welding and the like. Committees from professional and engineering societies also act in an advisory capacity and assist with the solution of design and materials problems.



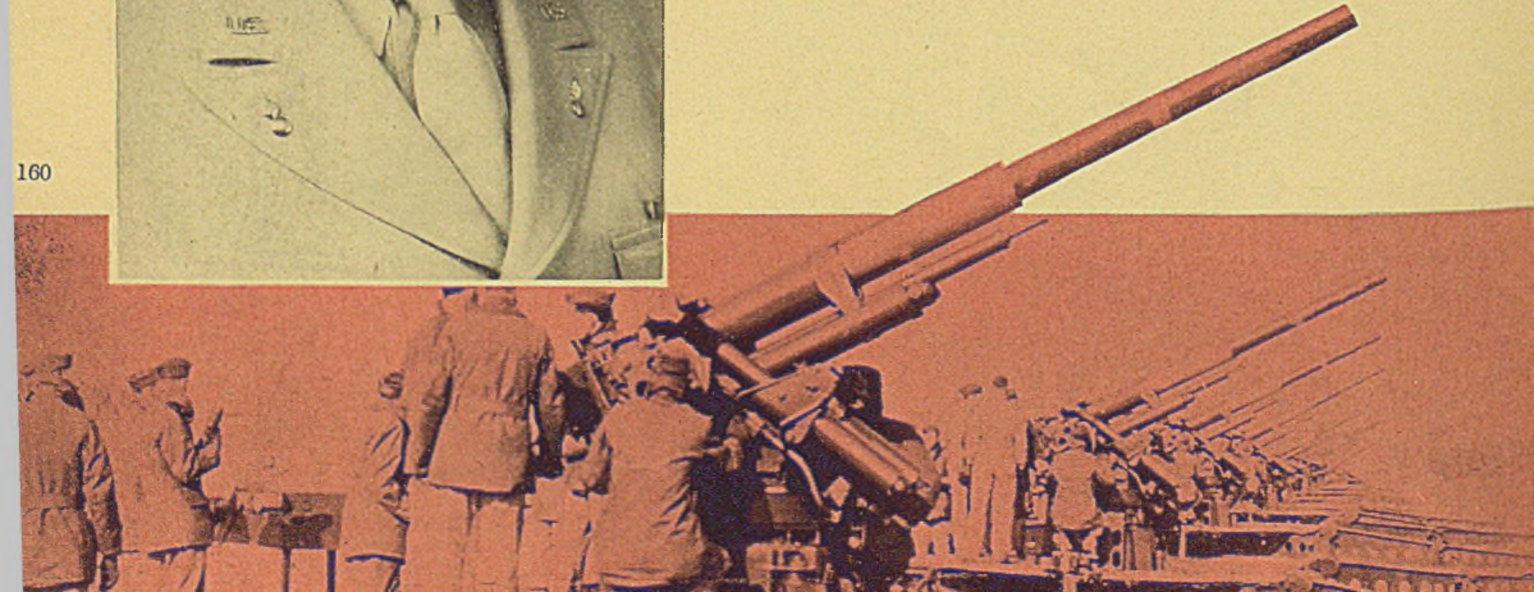
Major General L. H. Campbell Jr.

Made Chief of Ordnance June 1, 1942, for a 4-year term, General Campbell was born in Washington, Nov. 23, 1886. Graduated from United States Naval Academy in 1909, he was appointed second lieutenant, Coast Artillery Corps in 1911.

Promotions: To first lieutenant, 1916; to captain 1917; to major (temporary), 1918; to lieutenant colonel (temporary), 1918; reverted to captain, 1920; promoted to major, 1920; to lieutenant colonel, 1935; to brigadier general (temporary), 1940; to major general (temporary), 1942; to major general (permanent), June 1, 1942.

Service: Fort Monroe, Va.; Fort Williams, Me., till 1915; Panama Canal till 1918; to Office of Chief of Ordnance till September 1920; to Stockton, Cal., to study artillery materiel production at Holt Mfg. plant till summer of 1921; to Aberdeen Proving Ground, Md., as proof officer in charge of tanks, tractors, self-propelling mounts and mobile artillery till September 1923; in charge of Design Section, Rock Island arsenal, till April, 1926: in charge of Automotive Section, Artillery Division, Office of Chief of Ordnance till June, 1930;

Then he was officer in charge of manufacture at Rock Island Arsenal till June, 1935; in charge of Artillery Ammunition Department, Frankford Arsenal, Philadelphia, until summer of 1940; Assistant Chief, Industrial Service Facilities to Oct. 1, 1940; in charge of Development of Facilities, Office of Chief of Ordnance, to June 1, 1942 when he became Chief of Ordnance.

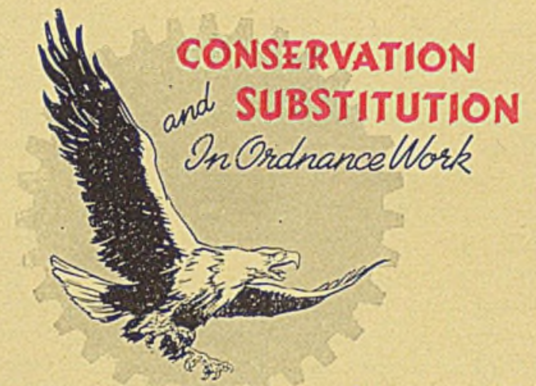


Brigadier General G. M. Barnes

Assistant Chief of Industrial Service in charge of engineering and research since July 10, 1940, General Barnes was born in Vermontsville, Mich., graduating from the University of Michigan with a bachelor of science degree in civil engineering in 1910. He also attended Ordnance School of Technology, 1914; Ordnance School of Application, 1916-17; Army Industrial College, 1935-36; Officers' Course, Chemical Warfare, 1936-37; Army War College, 1937-38. He received an honorary degree (Master of Engineering) from University of Michigan, June 1941.

Promotions and Service: Second lieutenant, Coast Artillery, United States Army, 1910; first lieutenant, Coast Artillery and Ordnance Department, 1913-16; captain, 1916-17; major, Ordnance Department, National Army, 1918; lieutenant colonel, Ordnance Department, 1918; in charge of design and production of railway and seacoast artillery, 1917-21; assistant ordnance officer of American forces in Germany and inspector of foreign munition plants and materials in European countries, 1922; charge of development of anti-aircraft artillery, 1922-27; inspector at government ordnance and manufacturing plants in Europe, 1928; chief engineer, Watertown Arsenal, in charge of development and engineering, 1928-32; chief proof officer, Automotive Division, Aberdeen Proving Ground, Md., 1932-35; in charge of procurement planning, office of Assistant Secretary of War, 1936-37; chief of Technical Staff, 1939-40.

Member of Newcomen Society of England, Army Ordnance Association, Tau Beta Phi. Conservation is one of General Barnes many responsibilities.

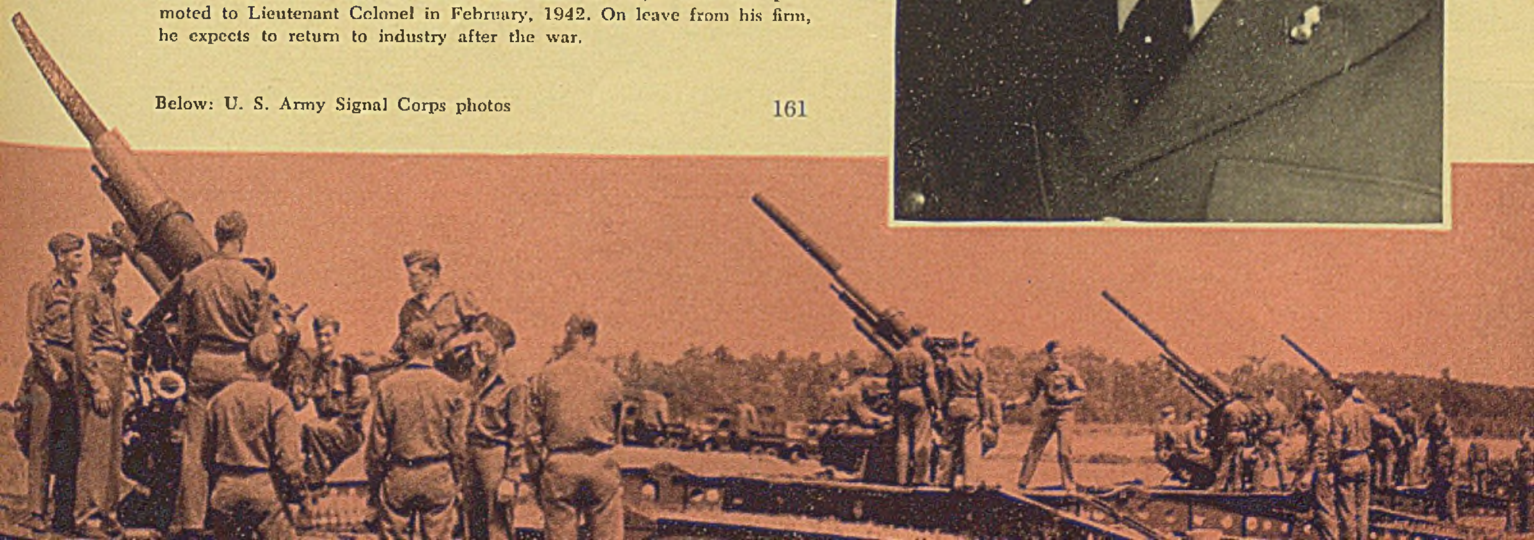


Lieutenant Colonel J. H. Frye

The onerous task of making the best possible use of our available supplies of copper, tin, aluminum, zinc, lead, tungsten, vanadium, etc. in the manufacture of tanks, guns and ammunition required by the Army rests upon the shoulders of Lieutenant Colonel J. H. Frye as head of the Materials Section.

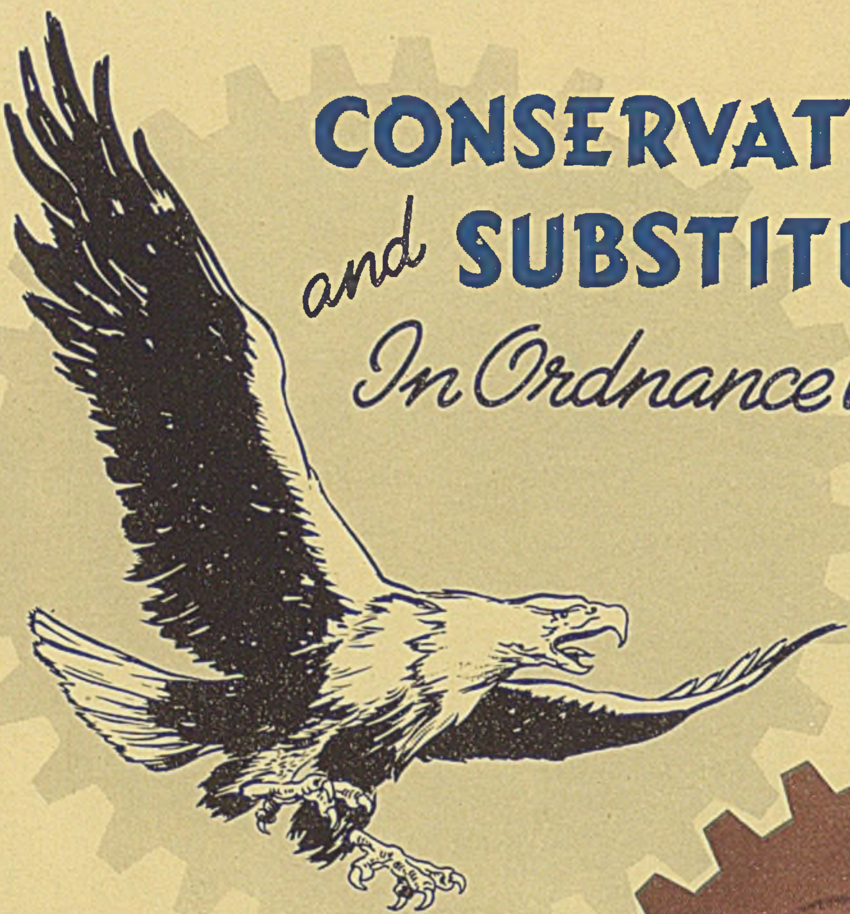
Still comparatively young (he graduated from Ohio State University in 1926, in Metallurgical Engineering), he has had a varied industrial experience as metallurgical engineer with Columbia Steel & Shafting Co.; Edgar T. Wards, Sons & Co. and elsewhere. He entered the Ordnance Department Oct. 1, 1940, with rank of Major and was promoted to Lieutenant Colonel in February, 1942. On leave from his firm, he expects to return to industry after the war.

Below: U. S. Army Signal Corps photos



The WHY and HOW of CONSERVATION and SUBSTITUTION In Ordnance Work

By ARTHUR F. MACCONOCHIE
Head, Department of Mechanical Engineeri
University of Virginia
University Station, Va.
And
Contributing Editor, STEEL



What is conservation? Supply and demand in ordnance; some materials cannot be replaced; changes in design; acute need for conservation now upon us; savings—past, present and prospective

(Section 1 in a Series on Conservation and Substitution in Ordnance Work)

NATURE of the effort to conserve strategic and critical materials and some conception of its vast significance was first brought home strongly to the writer about a year ago on his appointment as a member of the special research committee of the American Society of Mechanical Engineers on the forging of steel shell bodies—one of the civilian committees associated with the Ordnance Department. Since then he has had valuable opportunities for first-hand observation of this problem and its progressive solution by Brig. Gen. G. M. Barnes and his assistants. Much has been done by the joint effort of industry and the Army; much remains to be done. Carping criticism does not help, but thoughtful and understanding co-operation will. (See p. 160 and 161.)

All that conservation implies might be summed up by observing that a certain result in terms of planes, tanks, guns, ships and shell must be achieved by the most economical application of available materials. When we speak of a certain result, we think no longer in the familiar terms of peace-time sufficiency; rather do we visualize the victorious conclusion of this struggle, whatever be the cost. And by economy we do not mean a saving in dollars and cents, but in the life blood of our fighting men. Truly we live in a topsy-turvy world where the old familiar landmarks of value have largely disappeared and where new measures of worth have taken their place.

If we could take a bird's eye view of the stock piles, both actual and potential, of all the substances which are required for the complex tools of war; and if at the same time we had an understanding of the demands upon them, we could more readily adjust our thinking to the realities of the case. Suppose, for example, we cast our eyes upon our stockpile of vanadium. We will note that by no possibility can we meet prospective requirements based upon existing specifications. Clearly some changes MUST be made; *and made without any sacrifice of quality.* This is of the first importance.

Or let us turn to the copper pile. Once more we observe that the exercise of the greatest prudence in its use cannot reconcile supply and demand if we continue to specify brass for cartridge cases. So we turn to our gigantic, but not inexhaustible, reservoir of steel and substitute one critical material for another which can more readily be spared. So it goes from rung to rung down

Fig. 1—"God help me if this is a dud." Conservation does NOT mean the substitution of inferior material. The exacting standards of quality which are providing the American soldier with the finest fighting tools in the world are being maintained rigidly. Figs 1 to 6 are OEM photos, by Palmer

Fig. 2—"Slow down, Adolph! The road ahead is blocked." There is no better gun in the armies of all the warring nations than the American Garand. No specification changes have altered or will be permitted to affect the fighting qualities of this deadly weapon

Fig. 3—Machine gunner. We may yet make these small arms cartridge cases and bullet envelopes of steel, but not until the present exhaustive experiments and tests conclusively demonstrate its adaptability

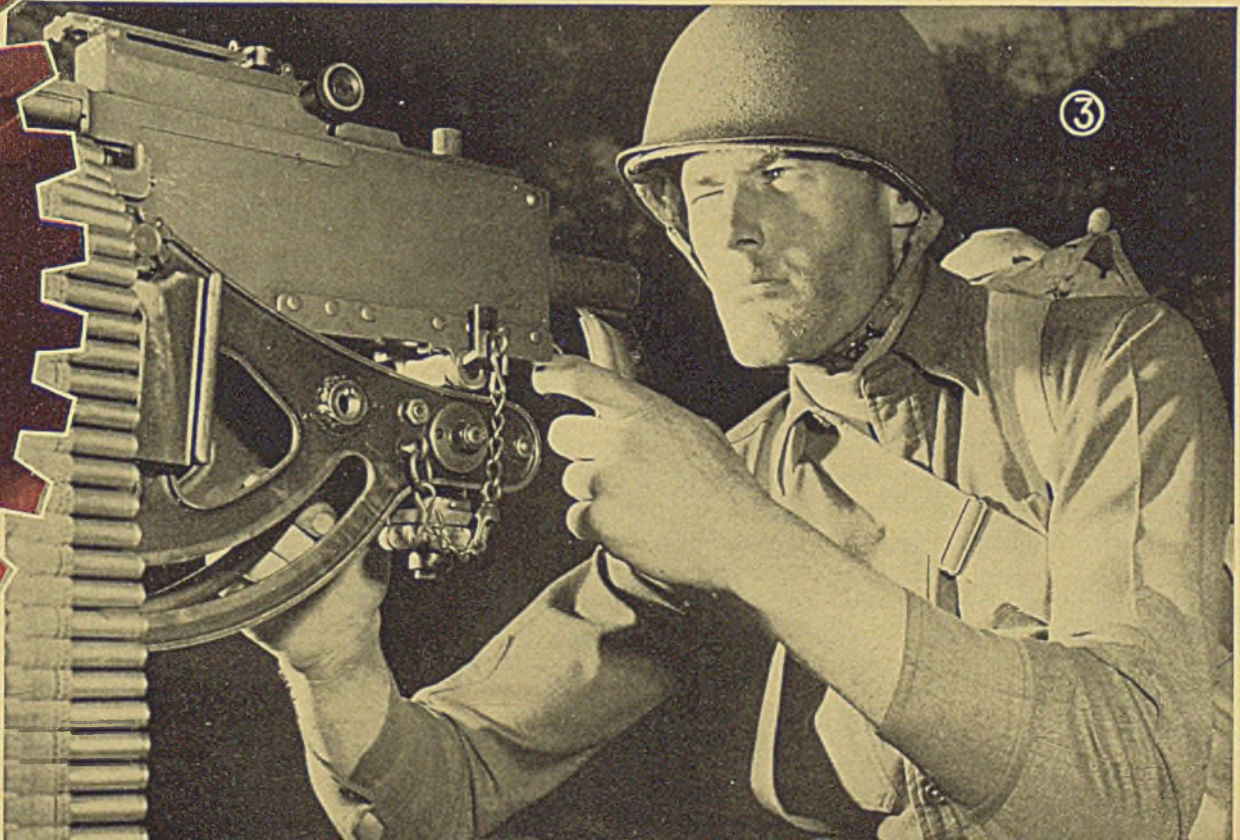


Fig. 4—Cartridge cases for 3-inch anti-aircraft guns. Copper of which we are short, constitutes 70 per cent of the billions of brass cartridge cases we need. Intensive research and experiment have produced a successful steel case, adequately proofed against chemical interaction with the powder charge

the new measure of worth where only war values count.

The strangeness of our situation may best be understood by noting that gold is not in the list with tin, magnesium, vanadium, molybdenum, aluminum, copper, tungsten, chromium, high-grade zinc, magnesium and steel—materials which the war machine demands. Now that lovely and relatively useless metal, which men have striven for through the ages and died to win, is of no consequence. Its very presence is merely an added incitement to our enemies . . . a monument to love's labor, lost in a hole in Kentucky. *How much better had we buried copper and tungsten and nickel!*

Well, these billions of man-hours worked in the fields of Africa, California and Alaska are over the dam, for now we face the problem of how best to allocate our accumulations of useful metals in a desperate endeavor to match supply and overwhelming demand.

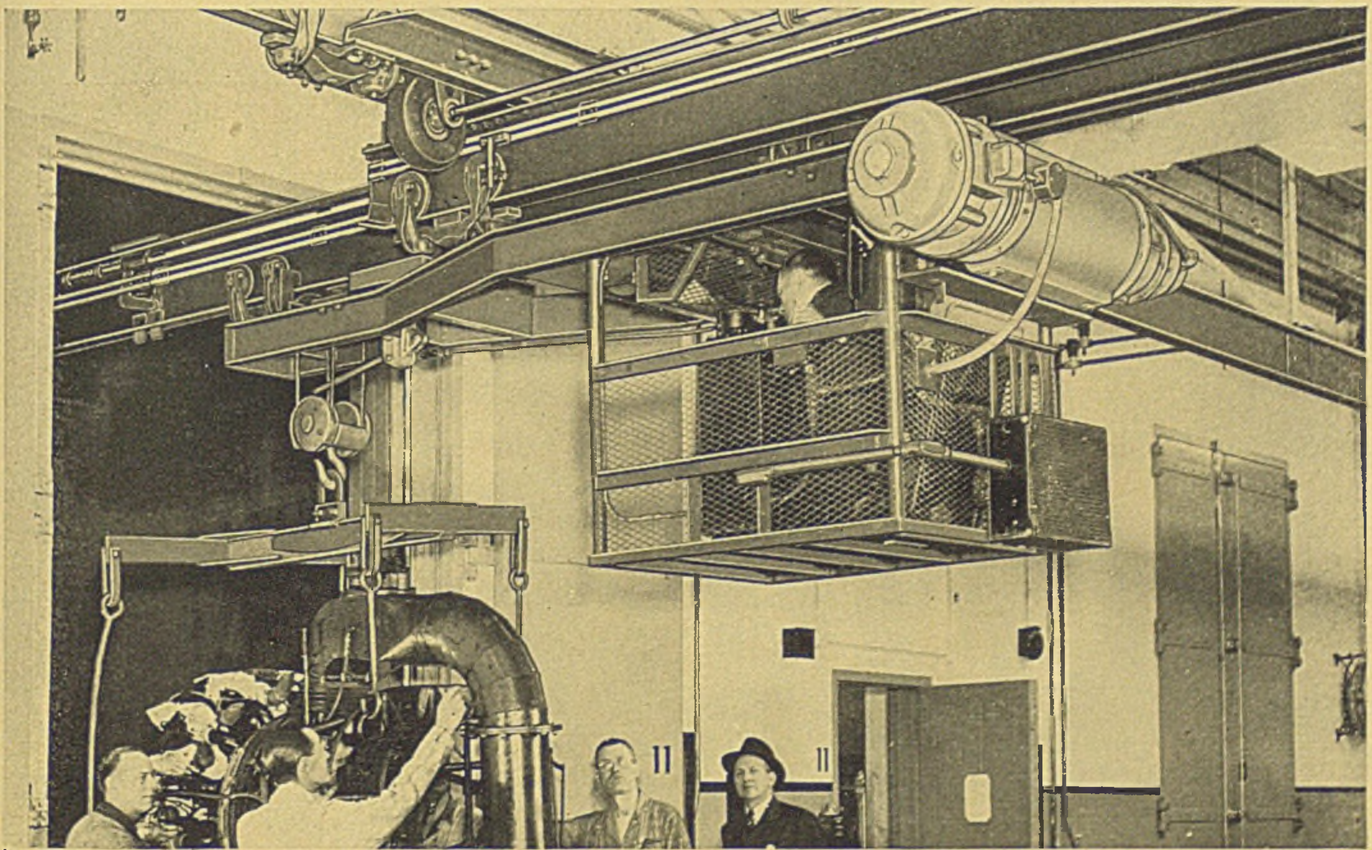
The nature of this mighty task may be clarified at the outset by noting that many of our piles of critical material stocks are subject to replenishment from the natural resources of this fortunate land; but we are already painfully aware that other strategic essentials are sea-borne and cannot be replaced until sea and air lanes are cleared. While we can replenish some of these stock piles of strategic materials, others must inevitably decline. Thus should no relief come and the war last long enough, the bottom of these bins will finally be reached.

How is this problem approached? A first consideration, no doubt, would be economy in design and manufacture. A prime illustration of this latter thought is the work which has been done and is now in progress on saving shell steel.

In the ordinary course of manufacture, the high-explosive shell starts as a billet which is pierced and subsequently drawn or cross-rolled to form. By improvement in techniques, the initial weight of the billet may be reduced substantially. Likewise the percentage of components rejected can be cut. But this, of course, is only one facet of the solution, although an extremely important one in terms of steel tonnage.

When we ask the question, "Can the design be changed with advantage from the standpoint of material saving?" we are on more difficult ground. As a vivid and no doubt rather extreme case, consider the mechanical fuze, a device which has been more than 15 years developing and perfecting. Alterations, obviously, cannot be made on short order. What is true of this particular item is also true, in greater or less degree, of most war materiel (especially ammunition components). For the sake of illustration, suppose we cannot tolerate more than one premature explosion of the shell in the barrel of the gun in hundreds of thousands of rounds, how many rounds have to be fired before the design can be accepted.

The third major approach to conservation is by way of the substitution of one material for another. On the face of it this would seem to be the most hopeful of all; but because of differences in the physical properties between

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one metal and another, or between some particular alloy and a plastic, it may be necessary to modify the design of the part or the unit. For instance, zinc alloy has been proposed for fuzes to replace brass and aluminum. As far as strength and impact resistance are concerned, this substitution could be made, but because of a difference in density, the center of gravity of the entire shell assembly is changed and the ballistic characteristics altered.

When the use of alternate materials is possible, there are three natural divisions into which components under consideration fall. In the first and most favorable case, no design changes are necessary, and limited testing only is necessary before acceptance. Next in order come those parts which have to be redesigned and consequently require more extended tests; and finally we become involved both in design changes and extensive development work. It is therefore reasonable to inquire how this situation has arisen and why our present condition was not foreseen.

If Mr. Average Citizen will cast his mind back to the two decades which preceded our virtual entry into the present war, he may remember our sincere efforts to encourage peaceful relations with the rest of the world by what has proved to be the misguided policy of failure to prepare for the inevitable. Not only were private armament firms the object of attack, but the Ordnance Department itself was obliged to subsist on the most meager appropriations for the maintenance of its many arsenals. Consequently ordnance design engineers were largely restricted to manufacturing methods which could produce parts in relatively small quantities and which were less well adapted to the stamping, diecasting and powder metallurgy techniques of mass production.

Probably no one, in his wildest imaginings, even if he felt another world war to be inevitable, had the remotest conception of the amount of assorted hardware the greatest war of all time would require. Is it surprising, then, that ammunition fuze components were designed to be machined out of solid aluminum and brass bar stock, when they could, under present conditions, be made more quickly and economically by diecasting or from plastics? Shall we be critical if forgings were specified when the less critical steel stamping must now be employed? Was the use of aluminum and brass castings an error of judgment when malleable and gray iron would suffice? Expediency, at least, played no part in these decisions; at the most the charge of a certain lack of imagination might be leveled. But who among us will be the first to make it?

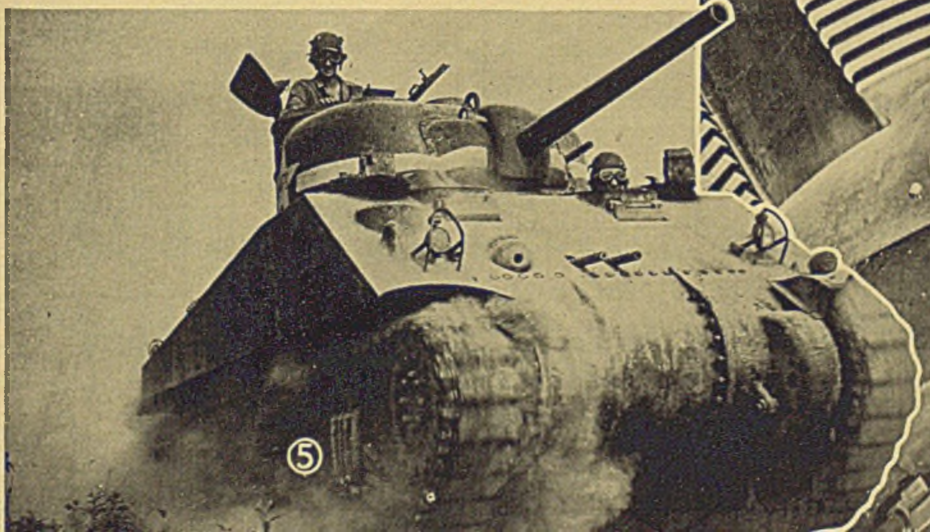
While much of the foregoing has an important historic interest and may serve as a valuable object lesson in years to come, no useful purpose is served by crying over spilt milk. Nearly two years ago the need for conservation was recognized by the procurement services and a large and extending program instituted. In the early days aluminum, magnesium, nickel and zinc alone came within its purview; now practically all materials required by the fighting services—even steel itself—are included.

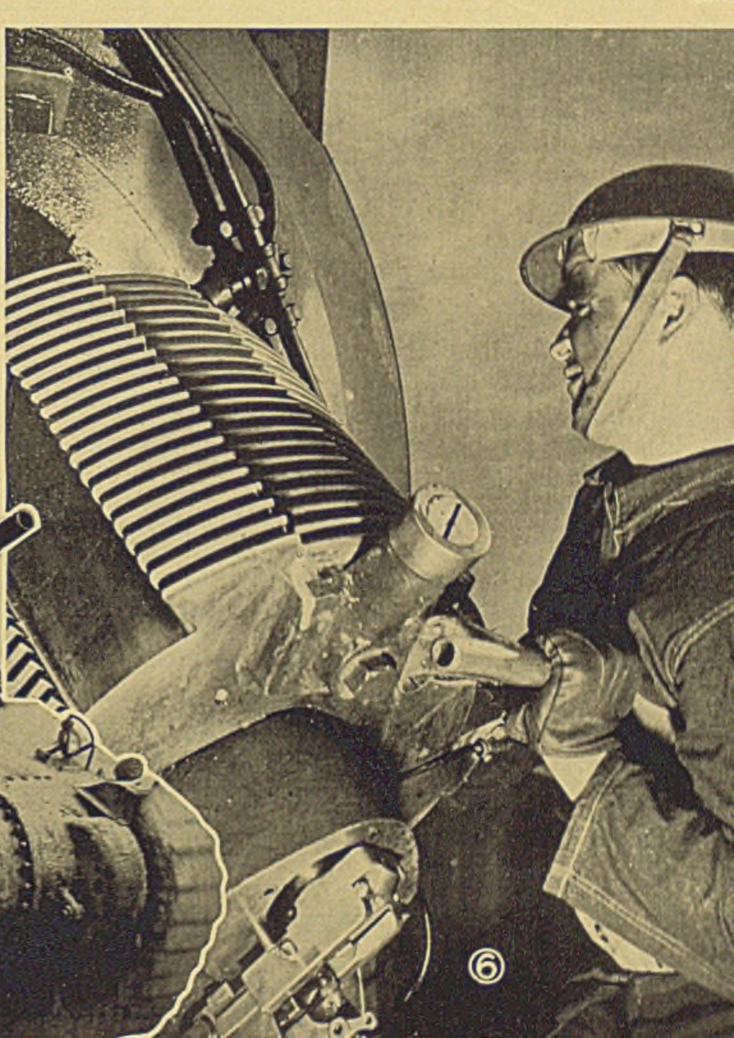
This centralized conservation control first initiated a survey of all ordnance materiel. Every part or component containing one or more per cent of strategic metals or alloys was listed on forms prepared for the purpose and from the information so secured, substitutes of less critical for more critical materials were indicated wherever possible, *and their use made mandatory*. Concurrently, existing specifications and drawings were rewritten and revised in accord with these decisions. How extensive this task is may be judged from the fact that literally millions of drawings must be reviewed.

The mechanism by which this job is being accomplished was set in motion by an order of the Chief of Ordnance, establishing a conservation unit in each of the four operating divisions, viz., the Tank and Combat Vehicle Division, the Small Arms Division, the Artillery Division and

Fig. 5—Back to the days of the stegosaur. All that American ingenuity and engineering experience can suggest is built into this hard-hitting, well protected tank. If one alloying element for the armorplate becomes scarce, we select another that gives equal or superior results. Note the welded hull

Fig. 6—Closing the breech of a 16-inch howitzer at an eastern coastal fort





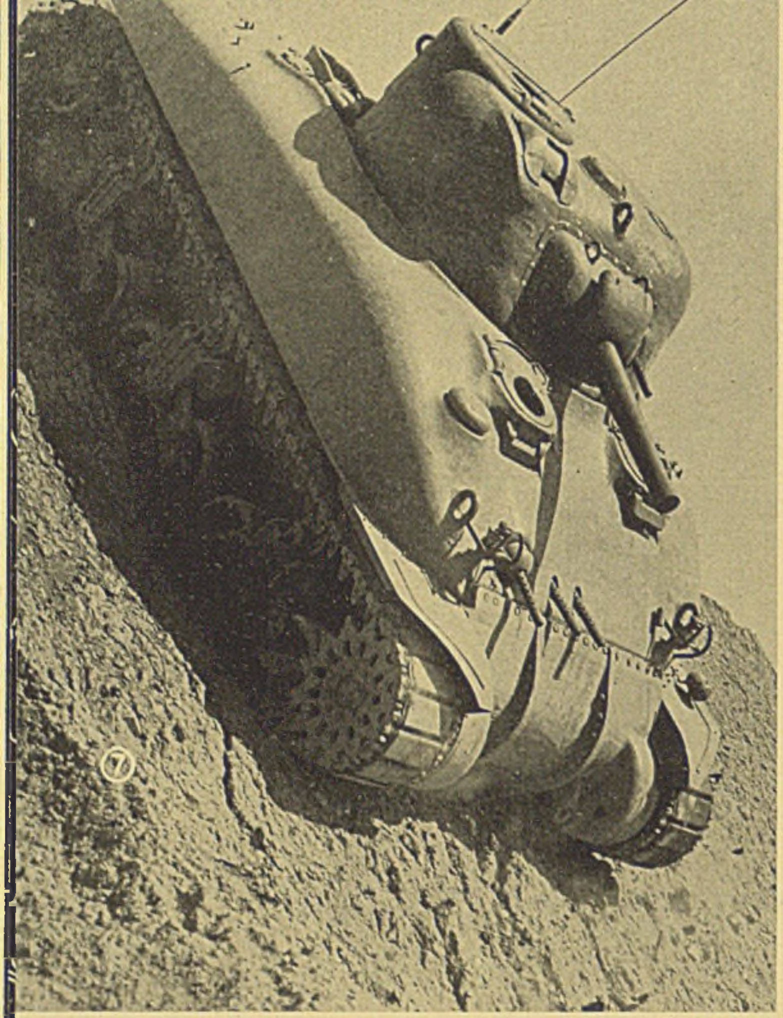


Fig. 7—Streamlined to face shell fire. Cast steel hulls are giving as good an account of themselves as those fabricated from rolled plate. Rolling mill capacity thus is conserved and enemy shell get less of a "bite" from these curved surfaces. Office of War Information photo, by Palmer

the Ammunition Division, and a centralized authority—a function of technical service—set up to co-ordinate and supervise the activities of the division units. Associated with members of the Ordnance Department conservation unit are civilian engineers of high reputation in the automotive, diecasting, metal stamping, plastics, gray and malleable iron castings, welding and other fields, together with committees of various professional engineering societies who not only act in an advisory capacity but assist with design and materials problems.

As supplies flow in mounting volume to the battle fronts the allocation of available metals and other materials enters a more intensive phase. In this sense, the task of conserving essential raw and semifinished products has just begun. It may be of interest to record, however, that up to this present time, the following known savings have been made:

Nickel	49,000,000 lb.
Chromium	9,700,000 lb.
Vanadium	1,250,000 lb.
Tungsten	17,500,000 lb.

In addition to these alloying elements,

170,000,000 lb. of primary aluminum
12,000,000 lb. of tin
60,000,000 lb. of rubber and
700,000,000 lb. of copper

will be conserved on the basis of our requirements for the remainder of this year and through 1943.

The steel cartridge case will show how conservation works. Despite the undeniable skill of the Germans, who have been at war for three years, analyses of the alloy steels from captured planes show no evidence of a decline in quality. They do not appear, however, to have been as successful in the substitution of steel for brass cartridge cases as we. Advices to hand indicate that these German cases stick in the chamber of the gun and occasionally have to be dislodged by ramming. This cuts the rate of fire materially and prevents their employment in barrage and other rapid fire. Despite rumors to the contrary, our cases are every bit as satisfactory as those made of brass, and production orders have been placed with more than 45 manufacturers.

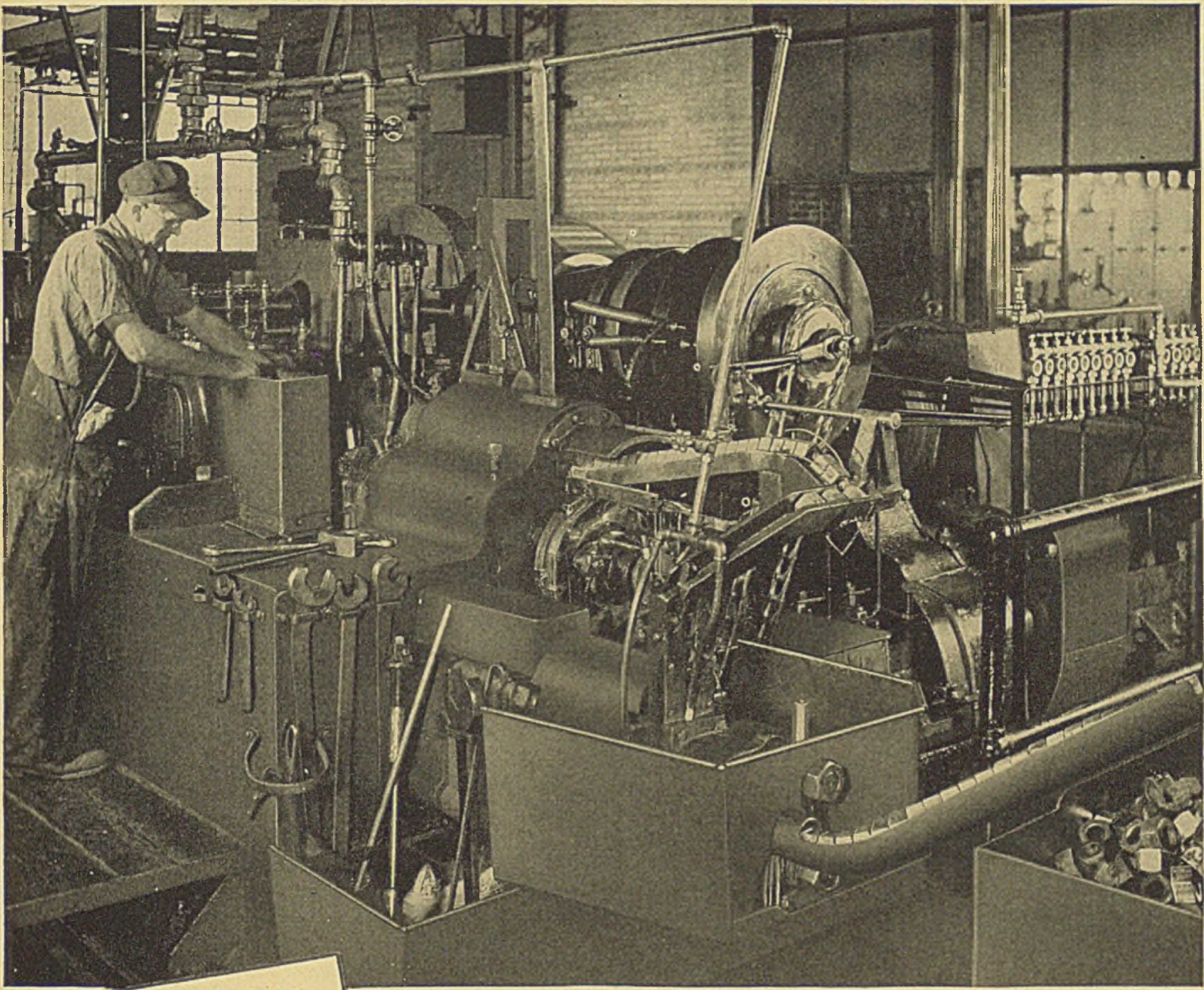
As many people are aware, the cartridge case performs several functions. Primarily it serves as a weather-proof container for the propellant charge; but by "obturation"—that is, expansion against the tapered walls of the gun chamber at the instant of firing—it also serves as a gas check. After this action, the case must not rest ballooned against the gun, but must possess sufficient resilience to contract and permit its ready withdrawal. This is not a characteristic which is easy to develop, but American industry, backed by the experience of Army Ordnance proved equal to the task.

We are not at liberty to divulge the exact means by which this result has been achieved, but we can say that the case consists of a single piece. All previous attempts, in Europe and elsewhere, to fabricate this item by welding on the head to the body, for example, have ended in failure. Difficulties of extraction and failures by bursting have attended all such efforts. Nor did the attempt to force the partially closed end of the steel body into a brass head meet with any better success.

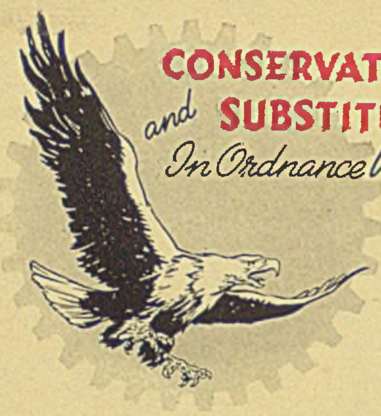
Thinking this problem over, and being aware of the wreckage of past hopes, the average engineer familiar with deep drawing and extrusion processes would probably select a high-quantity low-carbon steel and attempt the formation of the cup by familiar methods. Thereafter by careful attention to annealing in which spheroidized structures played a large part, the case could be drawn cold in a more or less well established series of drawing, tapering and necking operations.

Other interesting case histories of conservation include the redesign of the 90-millimeter anti-aircraft gun platform to save aluminum and of the tank track to save rubber. In the former case steel was substituted without increase in the time required for the battery to go into action. Indeed a few seconds were actually saved. While in the latter many thousands of tons of rubber were saved by various substitutions in the shape of castings, forgings, etc. This particular problem was complicated by the fact that bottlenecks in the forge and foundry and also the machine shop necessitated the development of several different designs.

Needless to say, the many changes forced upon us by the necessities of conservation have been made without sacrifice of either safety or quality. We all remember the ancient adage, "For lack of the nail the shoe was lost. . ." Translated into modern terms, the failure of the fuzes in an airplane bomb is something we must take every possible precaution to prevent. In general terms, war materiel must function with the highest degree of efficiency and reliability when the need arises. A lack of appreciation of the point of view of the ordnance engineer is thus the cause of occasional criticism of his attitude toward conservation.



CONSERVATION and SUBSTITUTION In Ordnance Work



Conserving the Alloying Elements of. . . LIGHT

Armor—ancient and modern; is body armor practical today; various types of light armor; how percentages of alloy content are being reduced; armor plate testing methods; data on savings of nickel, chromium and vanadium

(Section II in a Series on Conservation and Substitution of Critical Materials in Ordnance Work)

By ARTHUR F. MACCONOCHIE
Head, Department of Mechanical Engineering
University of Virginia
University Station, Va.
And
Contributing Editor, STEEL

IN DAYS of old when knights were bold, the employment of light armor enabled the one horsepower prototypes of our modern tanks to over-run Southern Europe and conquer the Holy Land, and at a much later date aided the Spaniards in their destruction of the ancient Aztec civilization of Mexico. But the advent of the gun tended to neutralize the advantage possessed by armored forces. Indeed so violently had the pendulum swung in the direction of mobility as opposed to protection that during the last world war masses of men exposed their unprotected bodies to artillery and machine gun fire and suffered appalling casualties, while Winston Churchill pled desperately for the introduction of the tank.

Looking backwards over these troubled years, it seems rather strange that the advances in metallurgy which had made the armored ship worth while were not more quickly put to use by land forces. Even Germany with her dangerous mechanical aptitudes had not realized the potentialities of high alloy steels for this purpose; but she too turned the lessons of the first world war to account and succeeded in her surprising conquests of the countries of Europe with the aid of her mobile fleets of land cruisers.

While various attempts have been made to revive the use of *body armor,* it is rather generally agreed that, save for the "tin hat", protection is best afforded by an independent housing. During the last war the experimental work of the equipment section of the engineering division of the United States Army Ordnance Department experimented with various models of helmets and body armor designed to afford protection against missiles of low and middle velocity. Amongst these types were a laminated form having sponge rubber cushions to absorb shock through contact at points of the bony structure. This is shown in Fig. 2.

The jazeran, a scale type of flexible defense, fitting the body closely and worn either over or under the tunic is shown in Fig. 1. One model of the latter successfully withstood

Note: Views and observations set forth in this article are those of the author. Although this material has been reviewed and released for publication by the War Department, no statments herein are to b construed as emanating from the War Department.

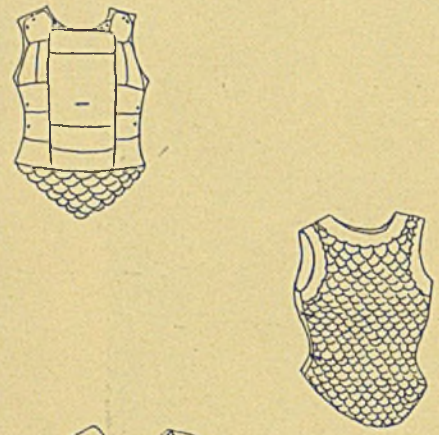


Fig. 1. (*Top two, at left*)—*The jazeran, a flexible type light body armor designed to be worn either over or under the tunic. Armor of this type has successfully withstood the impact of bullet traveling 800 feet per second fired from an automatic pistol at 10 feet. Wounds causing a high percentage of deaths from hemorrhage during the last war could have been prevented by such protection. Medieval form of chain mail might be helpful. It could be made from austempered plain carbon steel wire, using no critical alloys. Austempered steel has given*

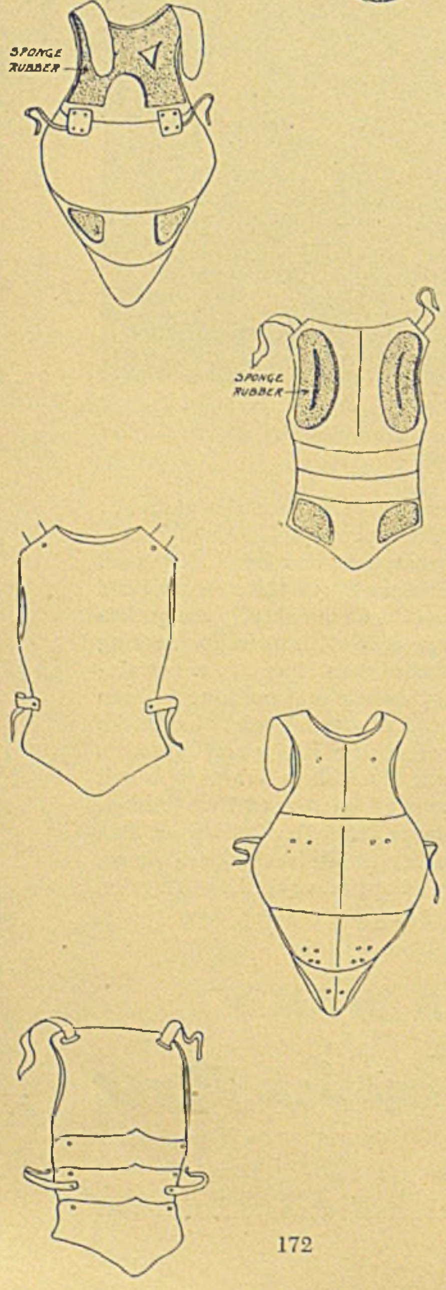
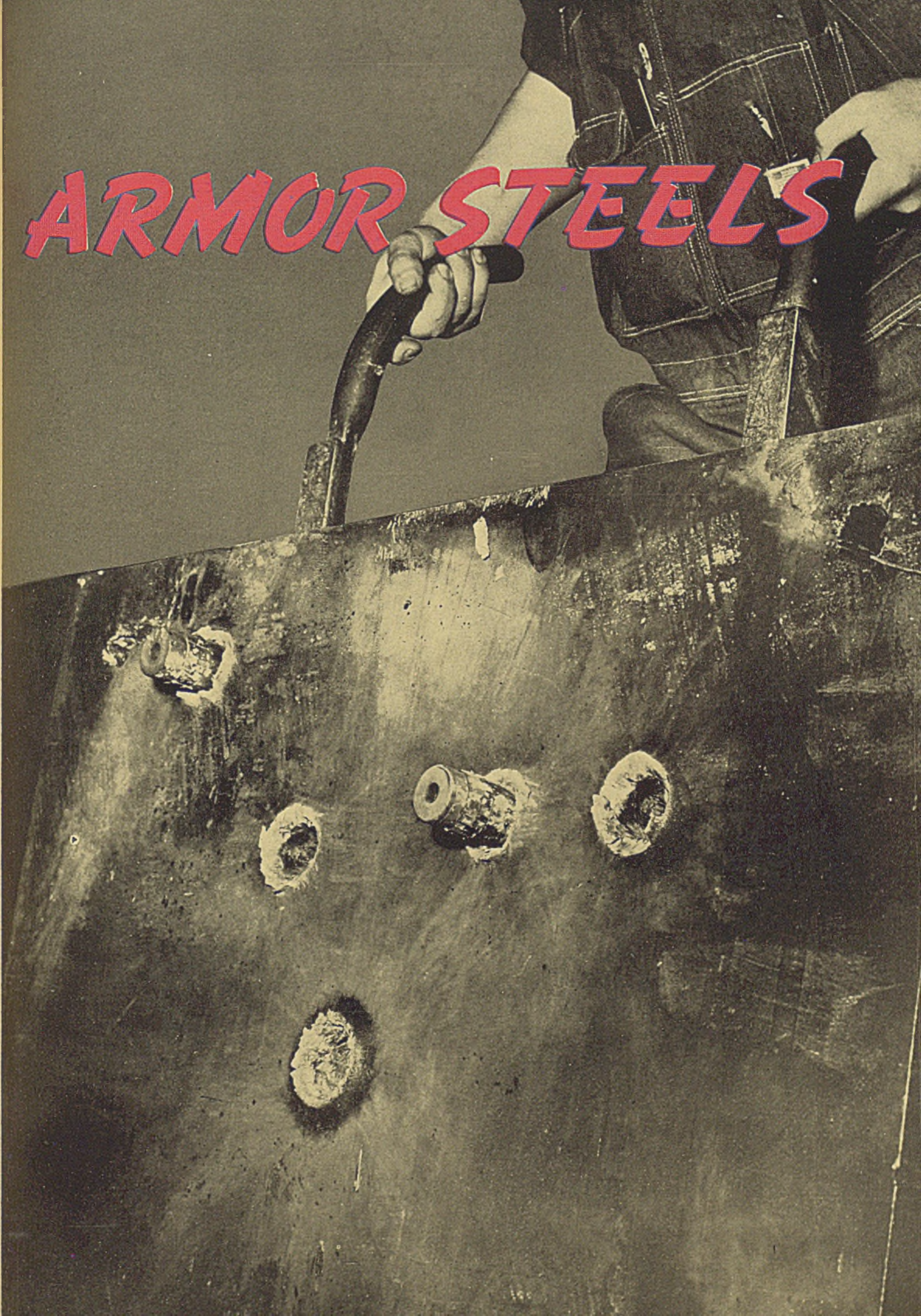
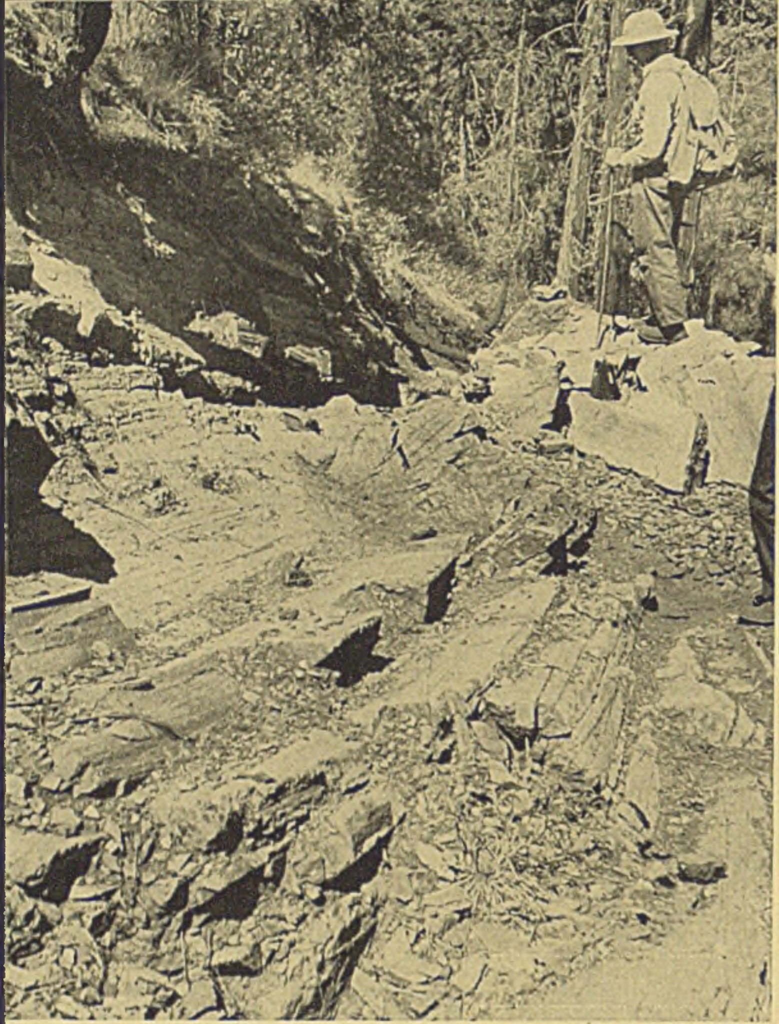


Fig. 2. (*Lower sketches at left*)—*Various designs of light body armor for protection of the breast, abdomen and back. This laminated type was proposed and designed by Engineering Division of the United States Army Ordnance Department during World War I. It was intended as a light body defense that would not hamper movement yet would be proof against missiles o flow or medium velocity. Sponge rubber cushions helped absorb shocks*

Fig. 3. (*Opposite page*)—*Piece of armor plate tested at Aberdeen proving grounds. Armor must not crack. When velocity of projectile is stepped up to point where it pierces armor completely, a clean hole must be punched, spalling is not permitted. Photo furnished by Life magazine*

ARMOR STEELS





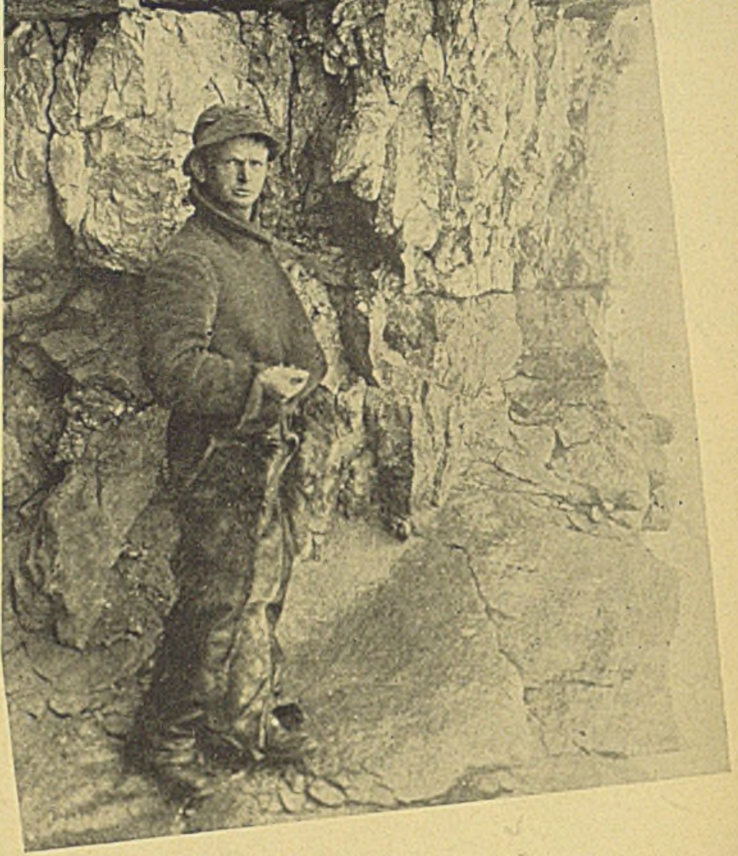


Fig. 4. (Left)—Outcrop of chromite in California. From Bureau of Mines, Department of Interior

Fig. 5. (Above)—Quartz vein by miner's head carries molybdenite. At Crown Point Mine, Railroad Creek, Chelan Co., Washington. Bureau of Mines photo

an automatic pistol shot at 10 feet, traveling at 800 feet per second. A careful review of the results of these experiments led to the conclusion that a steel helmet was universally demanded but a body defense was only required to a limited degree. Armor for arms and legs, while produced in experimental lots, notably in France, was not recommended for active service.

More recently—in 1940—some work was carried out in this country, using laminated sections of 0.65 per cent carbon, 0.65 per cent manganese, 0.025 inches thick. A number of these pieces were austempered to various hardnesses ranging from 48 to 63 rockwell C and exhibited definite superiority to the usual quenched and tempered materials. Nothing further appears to have been done.

Light armor less than one and a half inches thick such as for tanks and motorized transport must possess the ability to defeat the projectile and resist cracking or shattering on impact. Then it must be sufficiently "tough" to avoid spalling on the inside and throwing buttons and slivers among the crew of the vehicle.

Cast armor has been used to a limited extent in recent years, especially where complicated shapes are concerned. Now its use is being rapidly extended partly on account of the need for conserving rolling mill capacity but also because it is more readily possible to "streamline" the contour of the tank and so offer encouragement to glancing blows.

Homogeneous plate, like cast armor, is consistently hard throughout. Thus some sacrifice of toughness and ductility is essential if the necessary degree of hardness is to be attained. Face-hardened plate is only used to a limited extent in our service. While the resistance offered to the projectile is enhanced and its resistance to injury under repeated impacts is high, it raises rather serious problems of heat treatment, manufacturing losses as a result of warping and cracking being rather high.

In the past the United States Army Ordnance Department has required only that armor in all classes meet certain ballistic requirements, no attempt having been made to control analyses or processing methods. As a result, the manufacturer has used his own good judgment in the selection of his steels, all of which, however, were rich in nickel, chromium and vanadium.

Had not an early determined effort been made towards conserving these critical alloying elements, there would actually have been an insufficient quantity available for the manufacture of the required quantities of armor alone. In this connection, the Tank and Combat Vehicle Division compiled the compositions used by the various manufacturers and decided that some reduction in alloy content could be made without impairment of ballistic quality.

Early this year the Steel Branch of the War Production Board was alert to the terrific drain upon our supplies of alloying elements demanded by scheduled armor tonnage. Upon their advice the Tank and Combat Vehicle Division established temporary maximum limits, based upon their earlier surveys of all types of armor. But since the minimum percentages of critical alloys which could be used without affecting ballistic characteristics was uncertain, a development program was inaugurated through the cooperation of the sub-committee of the Ferrous Metallurgical Advisory Board.

This program consisted, first of all, in the selection of the various armor steel analyses for investigation, together

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Balanced Heaters, Fans, Ducts

"You've wondered", he said, "how Despatch furnaces and ovens manage to have so much oomph. How it is that they are so flexible and speedy—how overshoot and temperature lag are eliminated. How they can process with such exceptional uniformity and operate so efficiently and economically".

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"Well, the answer is this: Every single Despatch furnace or oven is engineered. This means that our big, tough, high-velocity fans, our oversized heaters, our adjustable ports in the recirculating duct system are balanced carefully and to the most delicate degree by Despatch engineers who know heat dynamics and can apply their knowledge to fit every furnace or oven because they have had 40 years of practical experience."

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In reviewing Despatch's accomplishments, Torrid laid emphasis on heat treating furnaces for aluminum and magnesium castings, forgings, billets, sheets and shapes for aircraft parts, engine parts, for tanks, etc., furnaces for shell cases that are accomplishing wonders with steel and brass. Also tempering and hardening furnaces, stress relief furnaces and armor plate heat treating furnaces, as well as ovens for speedy and precision core baking, mold drying.

Stop in at the Despatch Booth No. A-415 at the National Metal Congress, and let's get acquainted. I will be flanked by photo murals of Despatch furnaces and ovens where I am now working producing more and better war materials.

After the congress adjourns, you will find me working wherever you see a Despatch foundry oven or furnace.

A special invitation is extended to everyone unable to attend our show this year to call or write Despatch for interesting and helpful bulletins and engineering services.

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DESPATCH
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Fig. 6—Light rolled armor plate forms body of this half-trac scout car seen here towing a 37-millimeter gun

with a determination of their sources and physical characters. This was followed by a discussion of the manufacturing and heat-treating processes used by the manufacturers and a comparison of these methods with the techniques developed by the Ordnance Department. Thereafter decisions were reached as to the quantity of each analysis to be produced and the variations of heat treatments to be used with each analysis. The nature of the necessary ballistic tests was then determined.

Ordinarily these tests consist in mounting the plate under test in a rigid frame and firing from 100 yards, the powder charge being adjusted to secure the desired impact velocities. Against 0.375 inch plate, .30 caliber armor-piercing ammunition is used, full automatic in a burst of 25 rounds. Above 0.375 inch and including 0.625 inch plate, .50 caliber armor-piercing bullets are employed; while plates up to and including 1 inch are struck with armor-piercing solid shot at points not less than 6 inches nor more than 15 inches apart.

In all cases, the development of cracks at the time of the test or within 24 hours, or any evidence of lack of ductility indicated by spalling or crumbling or the absence of a smooth entrance and exit hole will cause rejection. Resistance to penetration is similarly determined with thicker plates, failure occurring if the bullet passes through the plate or makes a hole deep enough to admit light.

Perhaps the most spectacular results of this conservation work have been achieved in the case of cast armor, from which it has been found possible to eliminate vanadium completely and to reduce the nickel and chromium contents to an extremely low percentage. Tests on rolled homogeneous armor plate are near completion and it already is evident that nearly as great a reduction of critical alloying element percentages can be made in this case. Rolled face-hardened armor, however, requires additional development and tests, and it is considered likely that a somewhat richer alloy containing especially nickel and vanadium will be necessary. *However, there are rather definite indications that savings of more than 50 per cent of the amounts of these elements formerly thought necessary may be made.*

Although the work of development in all three classes of armor is not complete, the total savings based on the Army supply program of April 6, 1942, will amount to:

37,000,000 pounds nickel
21,000,000 pounds chromium and
1,250,000 pounds vanadium

Should it be found possible to reduce alloy content still further, additional substantial economies will be effected.

As far as nickel is concerned, our domestic production includes only minor quantities of secondary metals recovered from scrap nickel anodes, nickel-silver, and copper-nickel alloys (including Monel metal) together with small quantities of primary metal recovered in copper refining. Our output on both counts is very small, the former rising from 1965 tons in 1936 to 2920 tons in 1940, the last year for which figures are given. Our production of primary nickel in that year amounted to but 554 tons, while our net imports were in the neighborhood of 80,000

As early as 1940, despite our record imports, a tight situation had developed as a result partly of a tendency on the part of domestic consumers to acquire unnecessarily large stocks, but also on account of increased production of nickel products.

Fortunately for us the principal source of the world's nickel supply is Canada, her production in 1939 being 105,286 tons of a world total of 127,000 (the last year for which this figure was available). The only other producing countries of any importance were Burma (959 tons), Greece (1207 tons), New Caledonia (11,700 tons) and Norway (1245 tons).

The chief ores of nickel are the silicate ores of New Caledonia (garnierite) and the magnetic pyrites containing nickel and copper found in Ontario. The silicate ores can be treated by direct reduction, while the magnetic pyrite ores are first smelted to form matte. In the Orford process used by the International Nickel Company of Canada, Ltd., the ore is ground fine, then classified and roasted in Herreshoff roasters. Smelting in reverberatory furnaces follows, the resulting matte being charged into converters with a silicious flux in order to produce a liquid slag which carries off the iron.

The bessemer matte thus produced is fused with sodium sulphide or sodium sulphate and coke. Solidification takes place in two layers, the upper containing copper and iron sulphides and the lower nickel sulphide. Resmelting of these "tops" and "bottoms" progressively purifies the product, the sodium sulphide being recovered from the tops in refining the copper.

This latter is blown to blister in basic lined converters

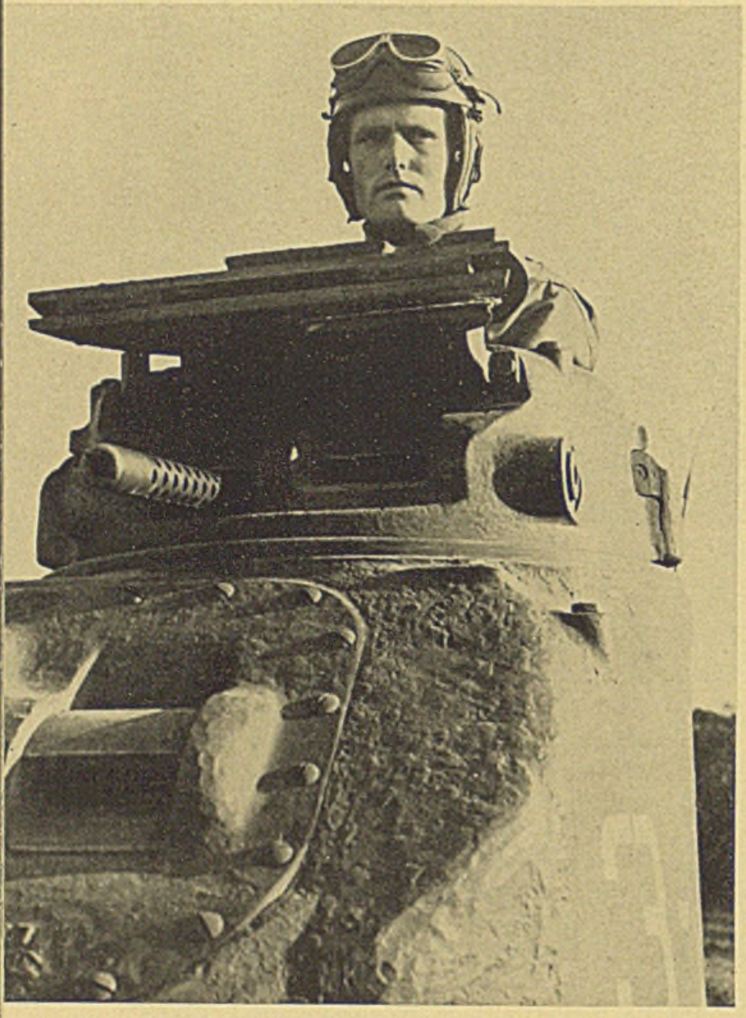


Fig. 7—Closeup of M-3 tank showing portions of cast armor forming the hull and turret. Certain sections such as gun mounts and shields are bolted in place for quick replacement in the field. Figs. 6, 7 and 8 from United States Signal Corps

and then refined electrolytically; while the bottoms, containing nickel sulphide and a small percentage of copper are washed to remove the mechanically enclosed sodium salts and roasted to remove the sulphur. The oxide is reduced to metal in reverberatory furnaces and cast into anodes for electrolytic refining.

Cast armor manufacturers have used as much as 2.5 per cent of nickel in various combinations in the past. In homogeneous rolled armor, percentages up to 4.5 have been employed. Other alloying elements include chromium, molybdenum, vanadium and, in the case of cast armor, copper. While these elements were plentiful, it was obviously better for the manufacturer to err on the safe side than have his product rejected, nickel having the effect of raising the elastic limit of steel with but little decrease in the ductility. Nickel, apparently, has the ability to dissolve in all proportions in alpha iron and render the ferrite tougher and more shock resistant. It may also be present to some extent in the carbides.

When chromium is also present, the resulting alloy possesses the valuable qualities of both nickel and chromium steels, the addition of chromium increasing the hardness and depth of the hardened layer after quenching. As much as 3 per cent has been used by cast armor manufacturers before the necessity of conservation forced a large immediate reduction and eliminated vanadium altogether. It has been claimed that the presence of a small amount (0.15 per cent) of vanadium increases the soundness of castings and tends to free them from occluded gases. It is also believed to refine the grain and accentuate the desirable effects of nickel and chromium.

In this mighty struggle of the mechanized powers for mineral self-sufficiency, the need for chromium plays an important part. With the sole exception of Russia, all the "great powers" must look elsewhere than their immediate national territories. In years gone by, our principal source of chromite ($FeO\ Cr_2O_3$) has been Southern Rhodesia; but we have also drawn upon India, South Africa, New Caledonia, Cuba and Europe.

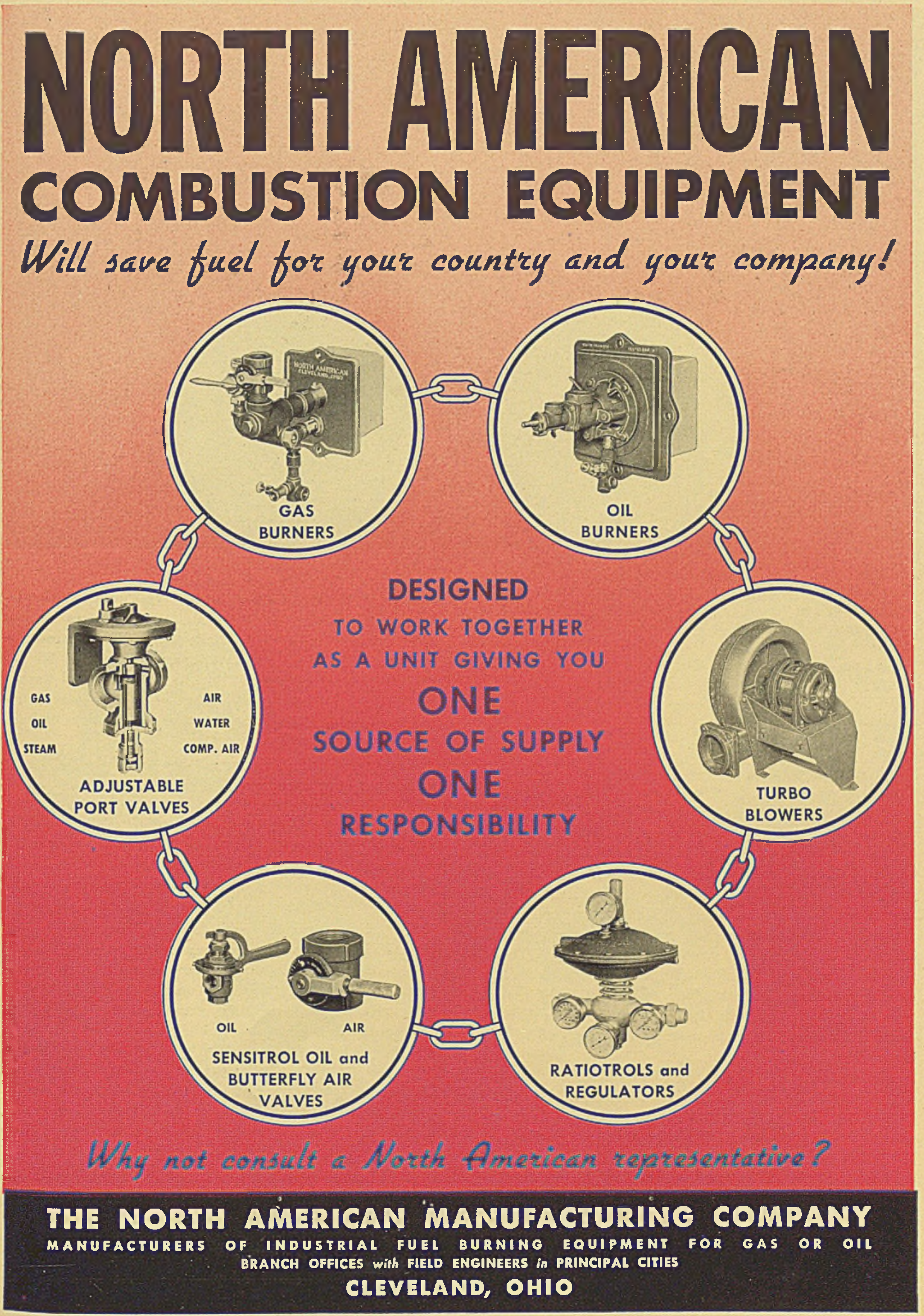
High grade ores, the only ones normally of value commercially, have a chromic oxide content of some 48 to 55 per cent, the proportion of iron being about 2½ to 1. Such domestic ores as we possess contain on the average only about 40 per cent of chromic oxide and have a relatively high iron content, rendering them less valuable from a metallurgical standpoint.

For addition to steel, the ore is converted to ferrochromium, generally containing about 60 per cent chromium and 30 per cent iron, the remainder being principally silicon and carbon. It is added to the molten steel in the furnace in the proper proportions to give the desired chromium content. Since it is easier to manufacture ferrochromium with high carbon content, that grade is used which gives the required chromium content without raising the carbon percentage above the prescribed maximum.

As far as vanadium is concerned, there would seem less reason for economy, since American interests normally control around 76 per cent of the world's output, some 60 per cent of our needs being supplied by Peru and the rest emanating from domestic sources. In recent years attention has been devoted to the recovery of vanadium from other sources than the ore, however. Germany, for example, is reported to be obtaining vanadium from blast furnace slag in large enough quantities to render herself virtually independent of imports; and in Italy vanadium oxide has been successfully recovered from the caustic soda solution employed in the Bayer process of refining bauxite and from naphtha soot collected from the smoke stacks of ships and industrial plants. Here in America we have reports of the accumulation of considerable quantities of flue dust containing from 20 to 40 per cent V_2O_5 from the boilers of ships burning Venezuelan fuel oil. Vanadium ores of American origin are found in Arizona, Colorado, New Mexico and Utah.

The results to date of the work of the Cast Armor subcommittee have enabled us to produce armor which meets the required ballistic tests and which contains low percentages of chromium, nickel, molybdenum and, in a few cases, copper. Since we hear of the progressive use of molybdenum as a replacement alloying element for others which are more critical, it may be of interest to note that both nickel and chromium contents may be reduced in the presence of this element without lowering the physical standards.

In a recent visit to a plant engaged in the heat treatment and shaping of rolled tank armor, the writer was informed that these changes in specifications necessitated a more rapid transfer of the plate from the furnace to the quenching tank. While the practice had been to lower the armor plate into the bath, arrangements were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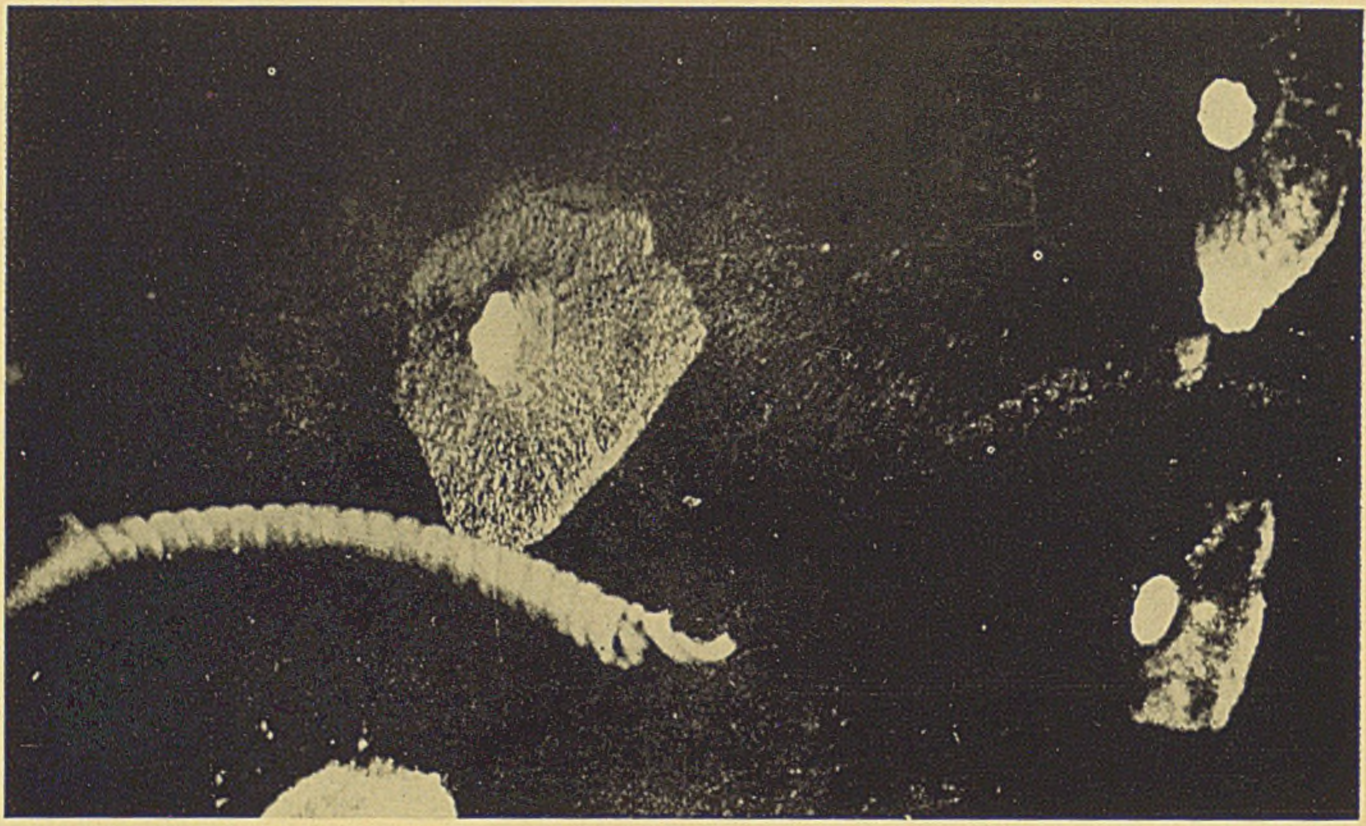

Fig. 8—Here's what happens when certain types of armor plate are penetrated by shell fire. Note how the metal has spalled away on the inside and imagine the deadly result to the occupants. Size of hole can be judged from section of armored cable seen nearby. Many photos such as this have come from the Libyan campaign where some high velocity anti-tank guns are in action

being made to provide water sprays which would impinge upon the entire surface—both front and back—at the same instant. In this way it was hoped, warping of the plate would also be diminished.

If any additional evidence were needed that these United States are the pot of mineral wealth at the end of the Axis rainbow, our supplies of molybdenum provide it. In 1938—the last year in which figures on world production were generally available—we produced 15,103 metric tons (2204 pounds) of the world total of 18,387, Italy the only other important producer was responsible for 1560 tons. Prior to the war, at least, the Climax Molybdenum Co. of Climax, Colo., was the world's largest producer with an output which rose from 4600 metric tons in 1935 to 10,380 in 1940, our total domestic production rising in that year to an all time high of 15,570 metric tons.

The metal, molybdenum, has had rather an interesting history. It was first separated from molybdenite (MoS_2) in 1782 and was produced in appreciable quantities some 20 years later. However it was not until about 1880 that iron-rich molybdenum alloys made their appearance. From this time we hear of its application on increasingly numerous occasions, the World War I giving large impetus to its use. Since then its commercial use has grown rapidly.

When pure, molybdenum is a soft ductile metal not unlike platinum in color. It is introduced into the steel bath in the form of a salt such as calcium molybdate or calcium molybdenum silicate or as ferromolybdenum. Molybdenite is extracted from its usual low grade ores by fine grinding and flotation concentration. The concentrate containing some 50 per cent molybdenum and 35 per cent sulphur is calcined to remove the latter and the resultant molybdic acid (MoO_3) utilized as the base material from which the various compounds and alloys of commerce are produced.

The reduction in the percentages of alloying elements which has been found practical in the case of cast armor and rolled homogeneous plate is greater than the savings possible with face-hardened rolled armor. This type differs materially from the former in composition, heat treatment and ballistic properties, but the relatively small amount of thin section required makes percentage savings of smaller consequence.

The hard facing is accomplished by one or other of several nitriding or carburizing processes or by the use of composite plate. The outside surface must be extremely hard, this demanding a drastic quench in the heat-treating cycle. At the same time, warpage has to be held to a minimum in the interest of ease of assembly. In addition to possessing the maximum power to resist penetration, the same requirements prevail as to absence of spalling and shattering resulting from projectile impact as apply to other types of light armor. Fig. 8 shows result of projectile velocity sufficient to cause penetration and spalling.

Nickel contents as high as 5 per cent have been used, but a lower temporary maximum has been imposed, effecting a saving of some 1500 tons of nickel in this one application alone. This maximum content may be further reduced with increased experience with these declining percentages of alloying elements in this vital material.

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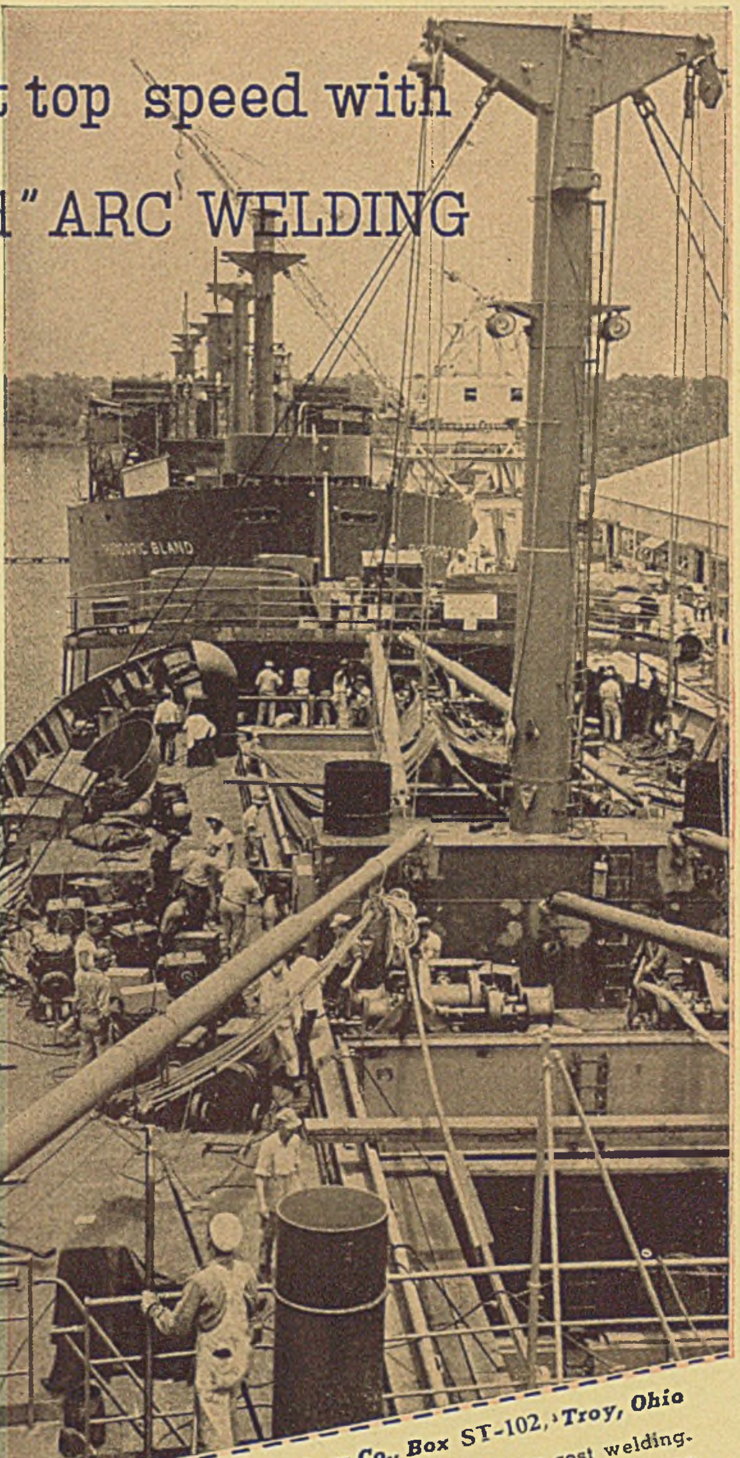

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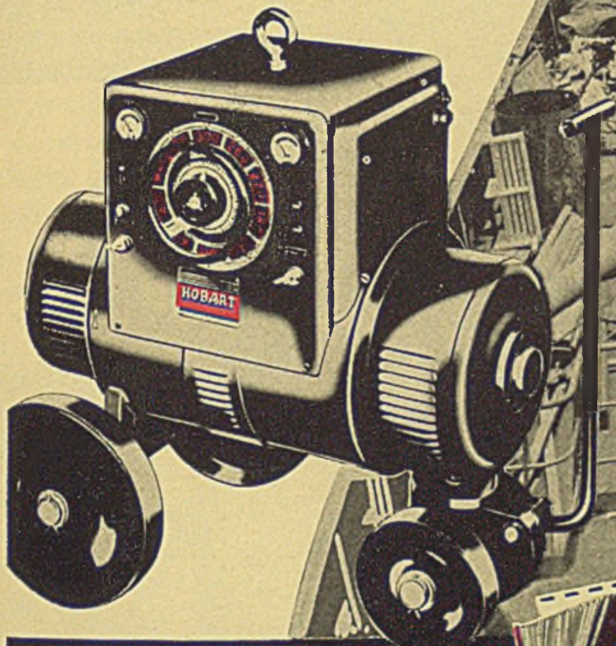

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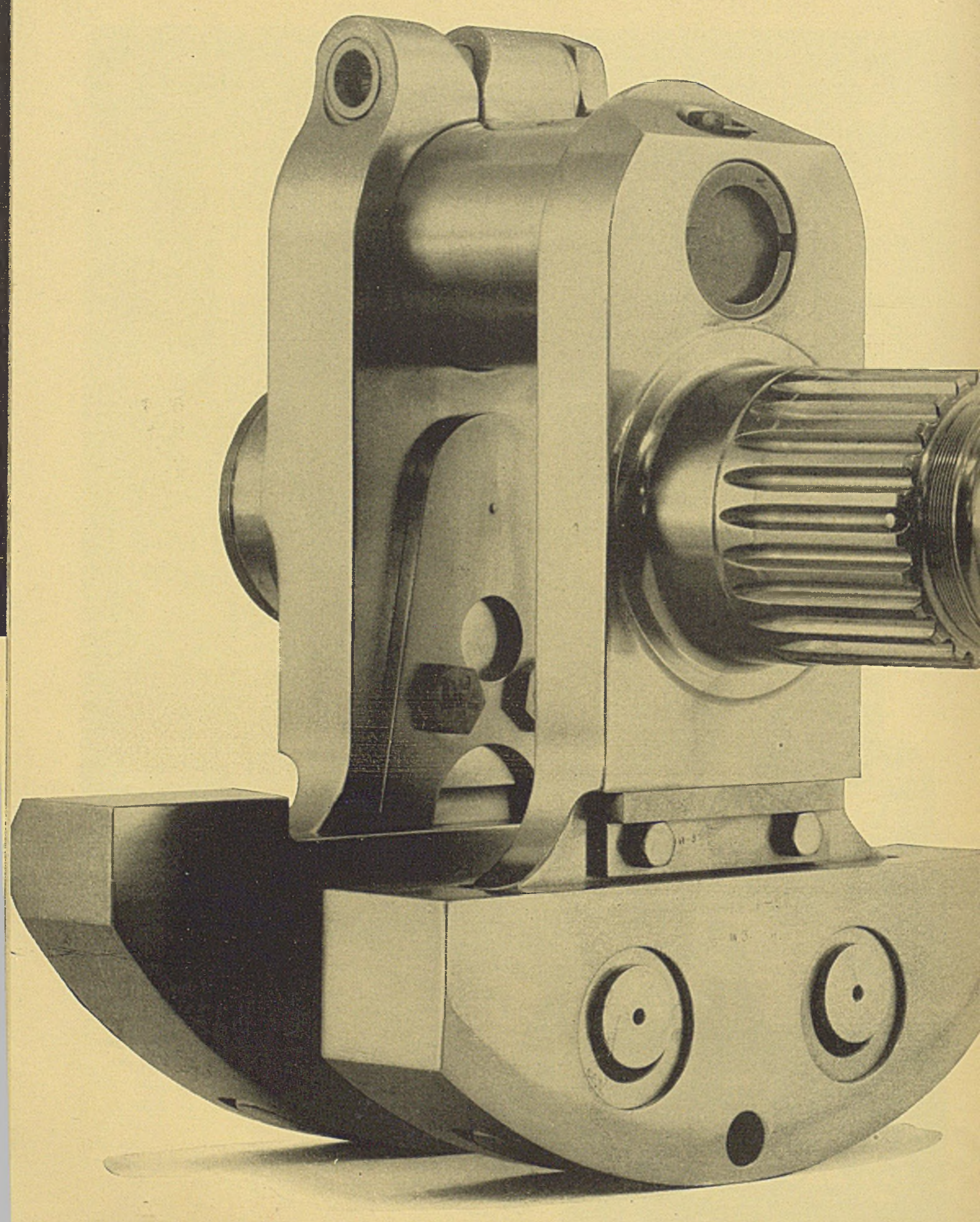
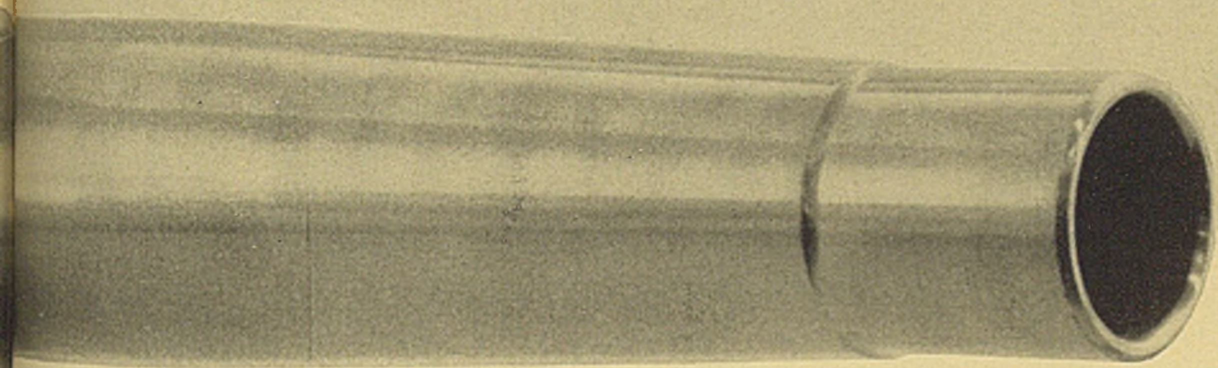


What's the most important half second in the life of a crankshaft?



YOU'RE looking at one of the sweetest pieces of precision engineering that ever stirred a craftsman's heart. Accurate as the balance wheel of your watch, this airplane engine crankshaft will soon be helping some pilot show the enemy what American men and machines can do.

However, in the split-second in which the final grinding operation on the shaft was completed, had the operator taken off just 0.001 inch more than the minimum diameter specified for the bearing, for instance, the shaft would never have seen action at all. Its value would have been reduced to scrap. And the staggering total of man and machine hours which had gone into it up to that point would have been worth absolutely nothing.

Can you find a single operation in war production where so much is at stake as in the final grinding process? Because of the key role it plays in war output, the grinding operation is one of the first places to check for ways to conserve materials, effort and time.

Make certain that your grinding machines are being operated with the utmost possible care. Make certain too that you are using the right grinding wheel for the particular job at hand. It is a *Weapon of Production* and should be properly used for maximum effectiveness.

Manufacturer's recommendations should be carefully followed on wheel speed, work speed, rate of infeed, wheel traverse, proper coolant and wheel grading (grit, grade and bond). Only the correct balance of these several factors will insure maximum production.

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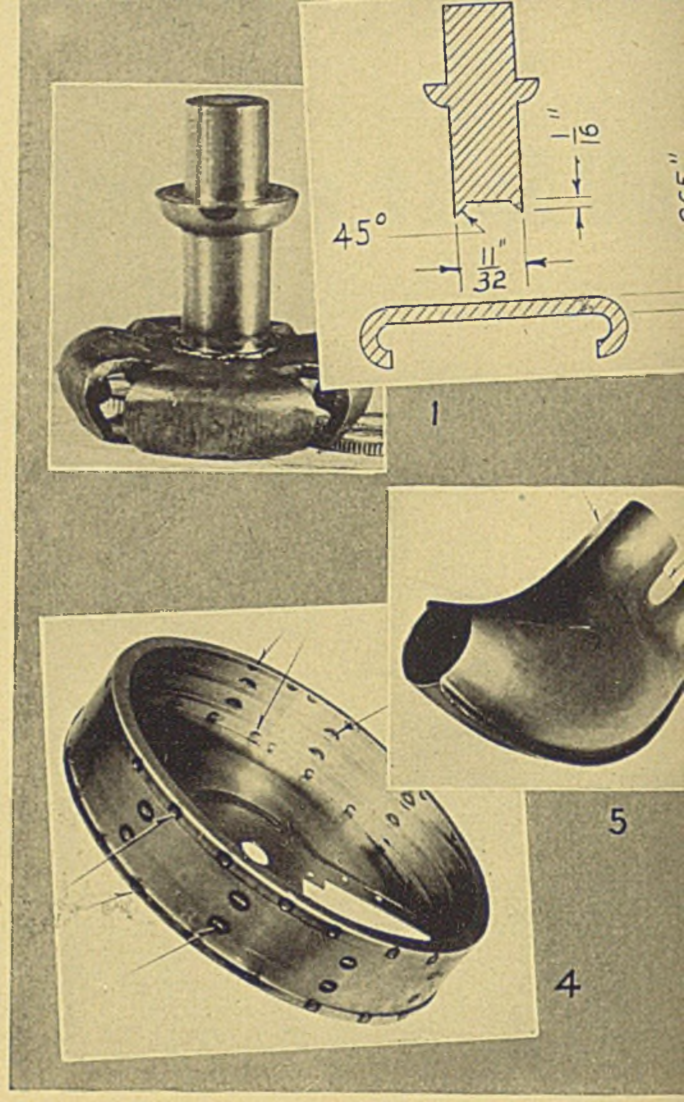
(Section III in a Series on Conservation and Substitution in Ordnance Work)



RESISTANCE WELDING In War Production

By B. L. WISE
Chief Electrical Engineer
Federal Machine & Welder Co.
Warren, O.

WAR REQUIRES use of those fabrication processes that will do the job more quickly, better, or with the fewest man-hours and the least skilled help. Resistance welding is one of these processes.

In discussing applications of the various forms of resistance welding to different types of war jobs, their general nature will be outlined briefly without revealing any restricted military information. Obviously some of the most important and the most interesting applications cannot even be mentioned. Of the resistance welding processes which are being used in our war program, the flash-butt welding process has promising possibilities, particularly in the field of heavy armament such as tanks, gun carriages, etc.

About ten years ago, a special flash-butt welder was developed for high-production welding of the longitudinal seam in the cylindrical portion of a barrel. An ordinary steel sheet, cut to size and preformed into a cylindrical shape with an open longitudinal seam, is welded to form a leakproof joint. This process came into considerable prominence during the early days of lend-lease aid to our allies. Exceptional production of these steel barrels was required for the transportation of oil, high-test aviation gasoline, petroleum products, alcohol, lacquers, chemicals, etc.

Flash Welding: Now this same type of machine is being used to produce ammunition boxes, depth bombs, chemical bombs, service containers, serial bombs and medium pressure vessels. In addition, many special welding machines have been designed to accommodate different shapes and sizes of cylinders, having a more concentrated cross-sectional area. The limiting factor in the welding of any closed shape by this method is the ratio existing between the various dimensions. The thicker the plate, or the longer the cylindrical portion of the part, the larger the diameter must be to accommodate the necessary clamp furnishing the clamping pressure. Powder drum rings, turret rings and many circular shapes formed from bar or plate stock are welded on machines of this nature.

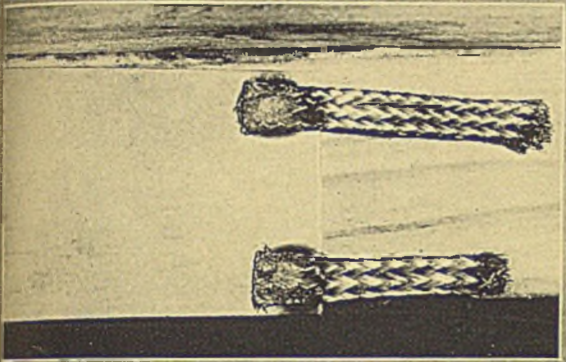
In the field of general flash welding, the number of the various devices fabricated by this means is almost too great to mention. Examples in this group are distinguished from those in the previous group by the fact that the parts to be welded are two separate and distinct pieces, *whereas the previous examples were concerned with the welding together of the two opposite ends of the same piece of material.*

There are two fundamental results from utilization of flash welding which may, in a large measure, determine the importance of this process. First: Savings in strategic and critical materials, accomplished by welding smaller pieces of a material to larger pieces of a less critical material. Second: Use of this process to conserve manpower and equipment.

In the savings of strategic material, the flash welding of low-alloy drill shanks and drill extensions to ordinary and special twist drills—particularly highspeed drills—has accomplished savings of considerable consequence in the materials and in the cost of the fabricated assembly. Welding of high-heat resisting valve heads to the valve stems of internal combustion engines has likewise con-

(Please turn to Page 186)

Based on a paper presented before the Cleveland chapter, American Welding Society, May 8, 1942.



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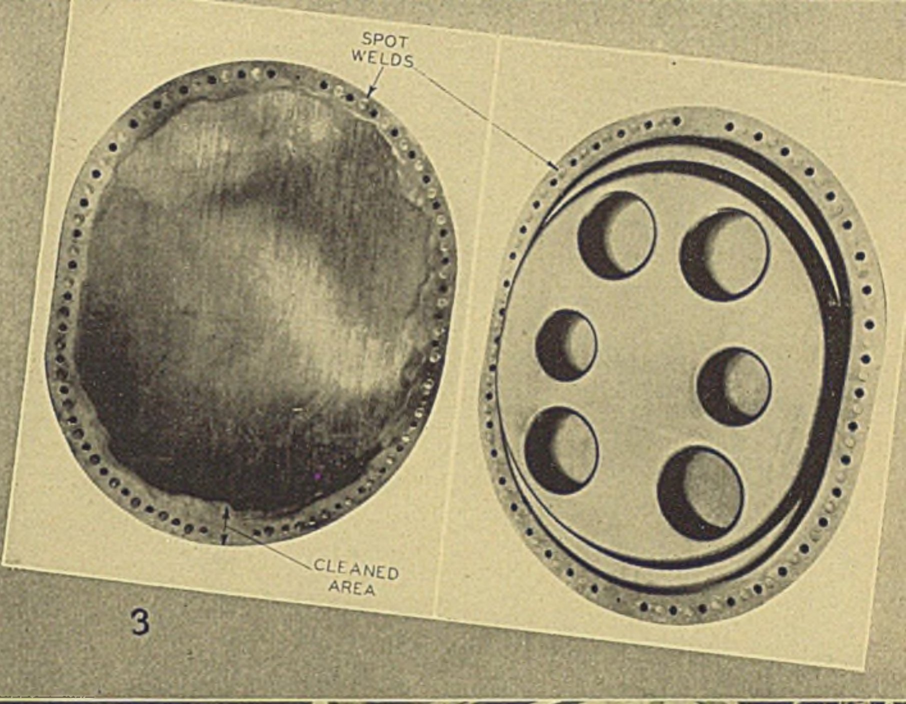

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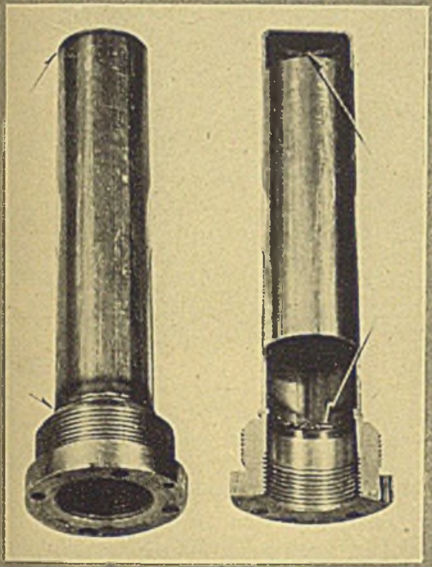

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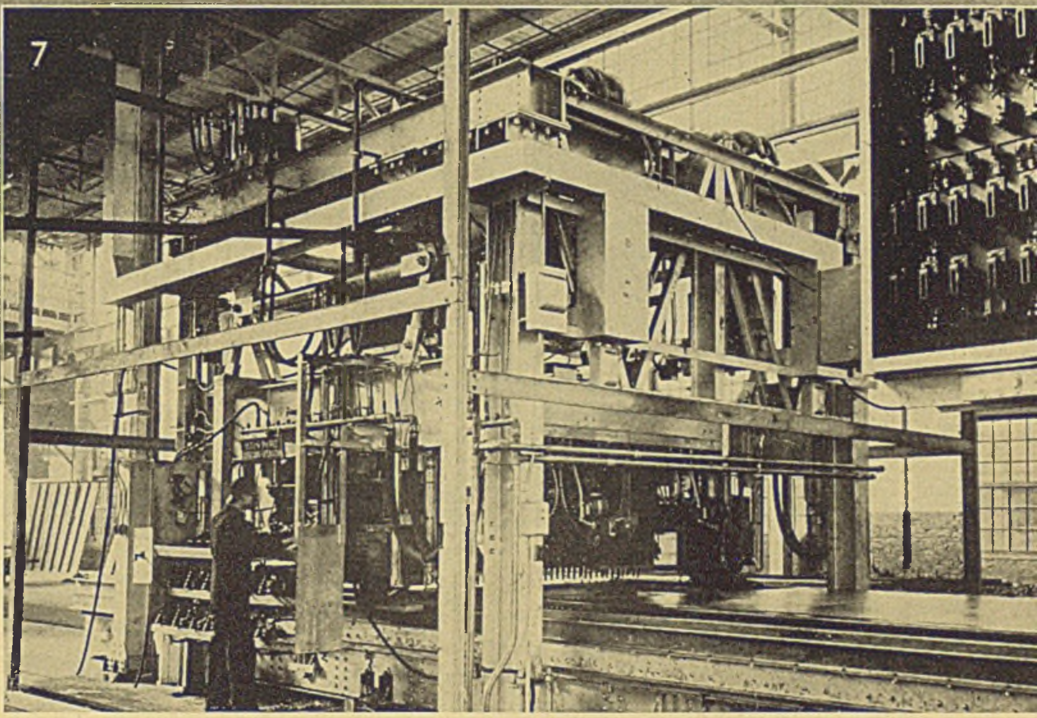


Fig. 1—This application of ring projection welding affords some idea of the savings that can be made in the fabrication of unusual parts. It would be extremely difficult to duplicate this small assembly by any other method at anywhere near the same cost. A 11/32-inch round is welded to 0.065-inch mild steel plate. Cross section of weld is 0.1 square inch; secondary current, 20,200 amperes; pressure, 625 pounds; time, 3 cycles; production, 1200 per hour

Fig. 2—Spot welding of tin-coated copper braid to cadmium plated steel is not a particularly easy welding job but is entirely feasible for production work. This job was developed to conserve tin by eliminating soldering and also to eliminate the severe breakage encountered in the flexible braids resulting from runback of solder on the braid. Weld area, 0.07 square inch; secondary current, 23,000 amperes; pressure, 575 pounds; time, 6 cycles; production, 1000 units per hour—2000 welds per hour

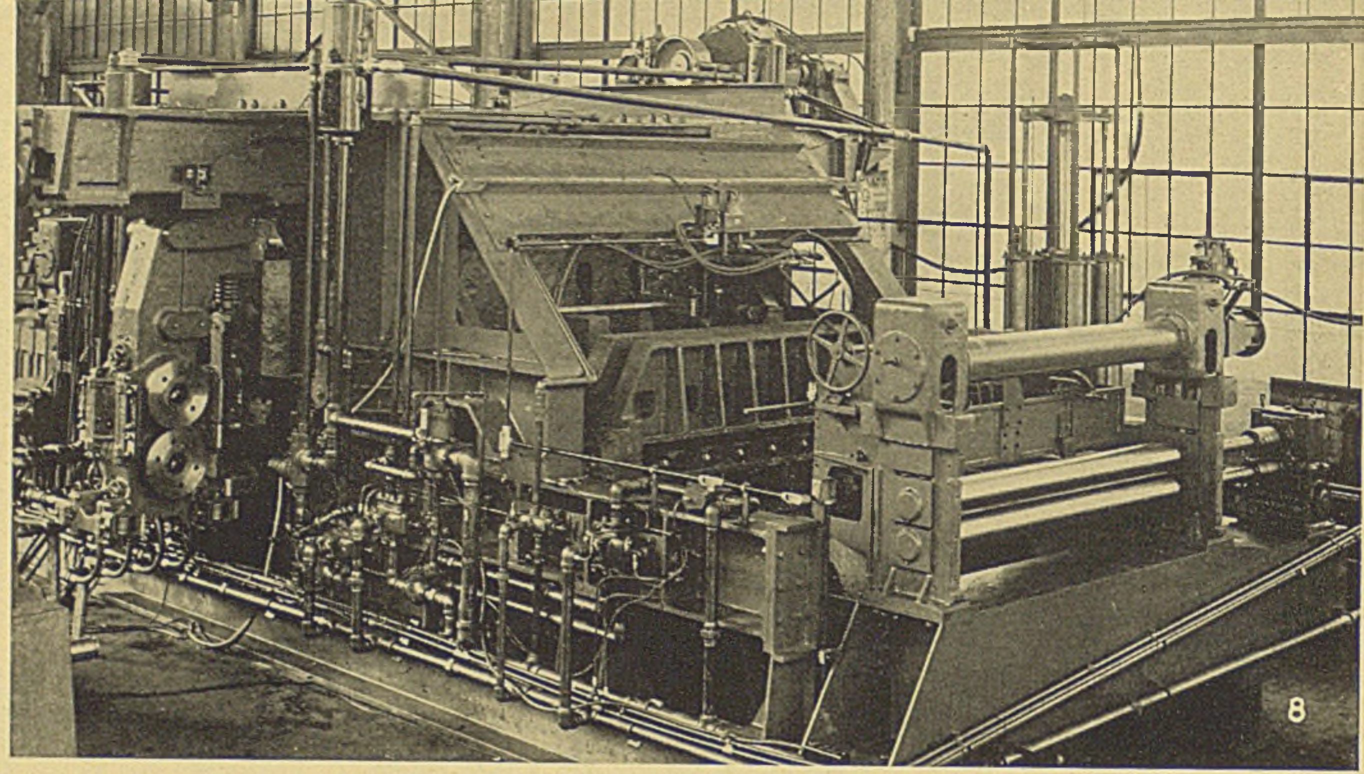
Fig. 3—Front and rear view of aircraft subassembly where spot welding fastens together outside flat sheet and inner reinforcing sheet to form access door, bolted to main aircraft structure by mounting holes. All areas welded are cleaned to remove aluminum oxide, using a rotating wire brush. Other cleaning methods include use of steel wool, chemical dips and etches. Assembly shown was welded at machine speed of 80 spots per minute

Fig. 4—Part of machine-gun magazine fabricated entirely from sheet steel stampings by hot riveting and spot welding. Lugs on side of spiral guide inserted on inside wall of part extended through wall and are hot riveted by spot welding machine which heats lugs and flattens them—an unusual application of resistance welding that has important possibilities

Fig. 5—Stainless steel exhaust stack for aircraft engine is formed entirely from two stampings. The flanged edges are welded together. Junction between the two parts is spot welded

Fig. 6—Bomb burster casing shown was expensive to make before application of resistance welding and required a tremendous amount of machine shop facilities to produce the quantities desired. Now the design requires only a simple metal stamping for the top cap, a piece of resistance welded or seamless tubing for the body and a relatively simple screw machine part for the mounting cap

Fig. 7—This huge machine is a specially constructed multipoint spot welder. It produces a complete freight car side by making a large number of spot welds in rapid succession. Work travels underneath electrodes on carriage that enables the completed car side to be removed and a new one put in place while a third is being welded



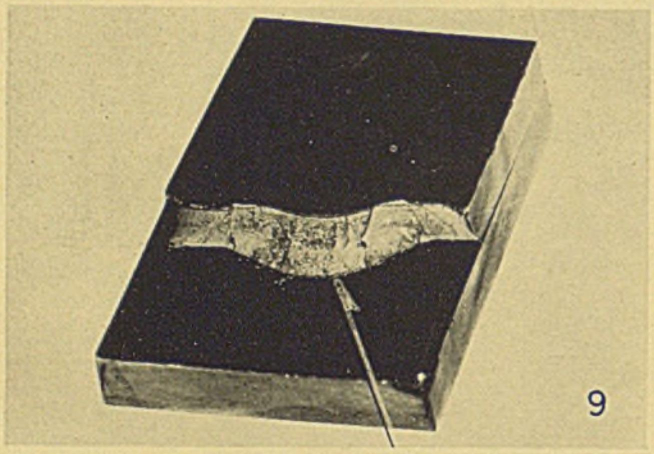


Fig. 8—This large flash welder shows the size to which such resistance welding equipment is built. This unit is capable of welding a joint 96 inches long in material ¼-inch thick in a single quick operation. Upset metal is trimmed from the weld while in the machine which can be set up as part of a continuous production line. Weld can subsequently be rolled, formed or otherwise fabricated as an integral part of the material itself

Fig. 9—These specimens show the spot welding of medium size armor plate. Several processes have been developed for spot welding plate up to 1 inch in thickness, some work on even heavier plate. Most combine a forging action with the welding cycle

served strategic materials and has resulted in a valve assembly that is both better and cheaper than the previous assembly. This process had been developed and used to a limited extent before the present emergency but is now of much greater importance.

The welding of stainless steel to mild steel has enabled the designers of many war items to retain the advantages of the stainless steel in their design, with the use of only one-fourth to one-half of the stainless previously used.

Tank Armor Flash Welded: It is also possible to flash weld large sections of armor plate without the use of stainless steel welding rod and skilled operators. Ballistic tests on flash-welded armor indicate such a superior performance that a tank arsenal is now in the process of construction for the complete flash welding of tank hulls. The saving in time by this process, particularly in man-hours, is of considerable consequence on 1 and 1½-inch thick armor plate.

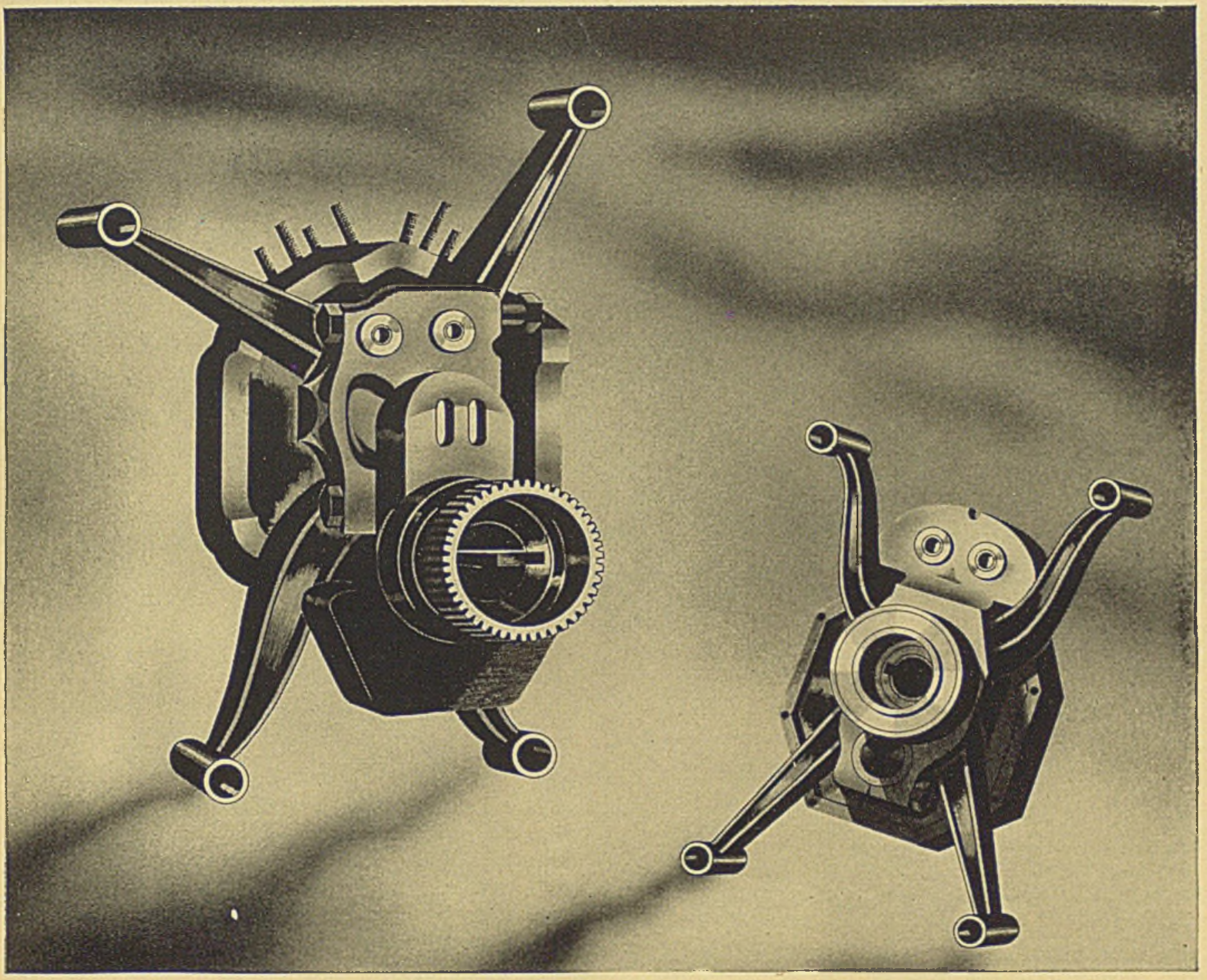
In Fig. 10 is shown a close-up view of the clamping dies for a machine used in flash welding the trailing edge of one sheet to the leading edge of the next from a 96-inch strip mill. Trimming cutters, shown in the retracted position, mill the edges of the sheets square with each other. After welding, the flash is trimmed in the machine and the sheet continues as an integral part of the strip.

Welding strip material end to end to produce a continuous strip permits the use of continuous processes without necessitating re-threading. See Fig. 8. In many cases it is not necessary to give any further consideration to the weld, and the welded portion goes through all of the subsequent processing operations as an integral part of the sheet or strip. This is true even though the subsequent operations may involve some rather deep-drawing.

Shortage of wide sheet and plate material has seriously threatened some large forming and stamping operations. By flash welding two or more smaller sheets or plates together it is possible to continue these processes with no increase in cost, because of the elimination of the higher premium charge for the larger widths.

Flash welding is widely used in joining simple parts to produce complicated assemblies. These may involve simple castings, forgings, stampings, or screw machine parts. The resulting savings in material and labor constitute a recognizable factor in speeding production. The parts themselves follow no standard pattern, and the variations and applications of the assemblies beggar description.

Spot and Seam Welding Used Extensively: In the more usual forms of resistance welding—spot, seam and projection—it is even more difficult to give a representa-



why TUESDAY couldn't marry THURSDAY

It happened in an airplane factory.

When brought together on the assembly line, some close-tolerance motor parts did not fit. Yet each part had been made correctly.

One part had been made on Tuesday—accurately. The other part had been made on Thursday—also accurately.

But Thursday was a warmer day than Tuesday. Uncontrolled expansion, due to the difference in temperature, upset the microscopically close tolerances of the two parts . . . thus preventing an accurate fit.

To eliminate the resulting waste and delay . . . air conditioning was installed to keep temperatures *under control.* It had to be extremely efficient air conditioning—with more *exact* temperature and humidity. *Precision* air conditioning—the kind General Electric is installing in many war production plants.

Today, air conditioning is making enormous, revolutionary advances in meeting stringent wartime requirements. After the war, the lessons learned in making fighting equipment will be applied to bring many new and interesting benefits to the general public.

More people will enjoy air conditioning . . . in homes . . . in cars . . . and in ever-increasing numbers of stores, offices and factories. It will be vastly improved air conditioning . . . in many ways. Temperature *and humidity* will be maintained more exactly than ever before. Equipment will be compact . . . flexible . . . economical.

Today, hundreds of wartime industrial users are turning to General Electric for reliable equipment. In the future, G-E air conditioning will fill the needs of all kinds of users.

Air Conditioning and Commercial Refrigeration Department, Division 423, General Electric Co., Bloomfield, N. J.

Air Conditioning by

GENERAL ELECTRIC

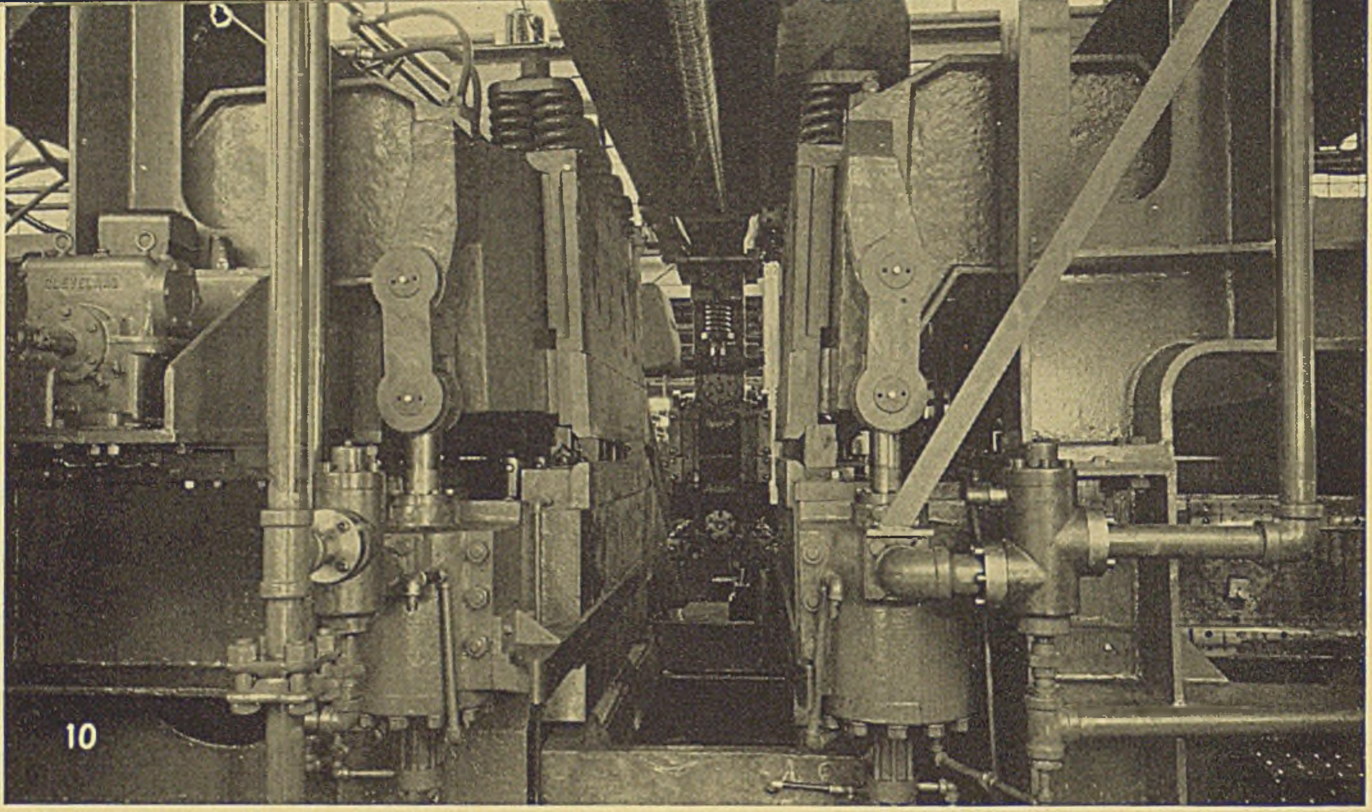


Fig. 10—Closeup of clamping dies on same large flash welder as shown in Fig. 8. The trimming cutters used to prepare the edge of the work square with one another for welding are shown in the retracted position

tive cross section of the war articles involved. To cover the war materials fabricated by the use of these methods would almost require a complete list of war *materiel*.

Both the Army and Navy were quick to recognize the value of these production tools before the advent of the war in Europe. Even at that early date resistance welding manufacturers were performing considerable experimental and research work in co-operation with the various branch of the armed services and in conjunction with the military commissions of the allies. This foresight on the part of the services can be recognized by the fact that resistance welding was incorporated in a large portion of the designs for armament from the outset of our war effort.

A few applications of spot, seam and projection welding will suffice to indicate the extent of utilization. Most of the following assemblies use at least two of these processes, many of them use all three and some include flash welding: Round bombs, anti-tank mines, parachute flares, chemical bombs, incendiary bombs, demolition bombs, trench mortar bombs, practice bombs and tailfin assemblies for almost all types of bombs.

Small bomb tail-fin assemblies shown in Fig. 12 are produced in large quantities on specially designed automatic welding machines. The two shown at the right have the tail fin spot welded to the base plug while the one on the left has the fins attached to the plug by projection welding. Of particular note is the fact that the projection-welded design produces a cleaner assembly. Excessive heat marks are visible on the spot-welded assemblies, especially the center one.

In Fig. 13 are larger units employing a somewhat different design. The fins are almost entirely sheet metal stampings and are in the major part spot welded together. The welding of the fins themselves to the base cap is accomplished by either spot or projection welds.

Another interesting application requiring high production and close tolerances involves a combination of hot riveting with spot welding and is illustrated in Fig. 4. This is a part of a machine gun magazine entirely fabricated from sheet steel stampings. In this case the spot-welding machine is utilized for performing the hot riveting operations.

Spot Weld Aircraft Assembly: As an indication of uses in aircraft a subassembly is shown in Fig. 3. Spot welding fastens an outside flat sheet to an inner reinforcing formed sheet. This particular unit is an access door which is bolted to the main structure by mounting holes. All welded areas had been cleaned prior to welding to remove aluminum oxide. In this particular assembly the oxide was removed with a rotating wire brush. Wire brushing, steel wool and chemical dips and etches are the prevailing methods for cleaning this type of alloy. The assembly shown was welded at a machine speed of approximately eighty spots per minute.

Seemingly insignificant is the application in Fig. 2.

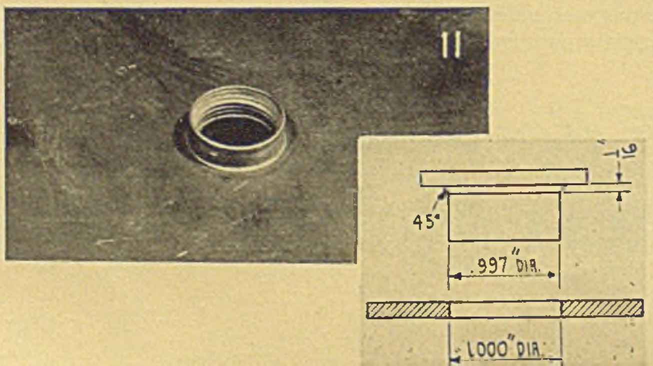


Fig. 11—General method for installing bungs in barrels. Similar process is used to install spuds in hot water tanks and medium pressure vessels. Most so-called glass-lined tanks must have the pipe connection reinforcements welded in this manner to permit the porcelain enamel to flow over the welded region and completely seal the metal from action of the tank contents. Also this method is used to weld small lugs onto relatively thin gage material. Such lugs can be drilled and reamed after welding to receive a bushing for a small bearing

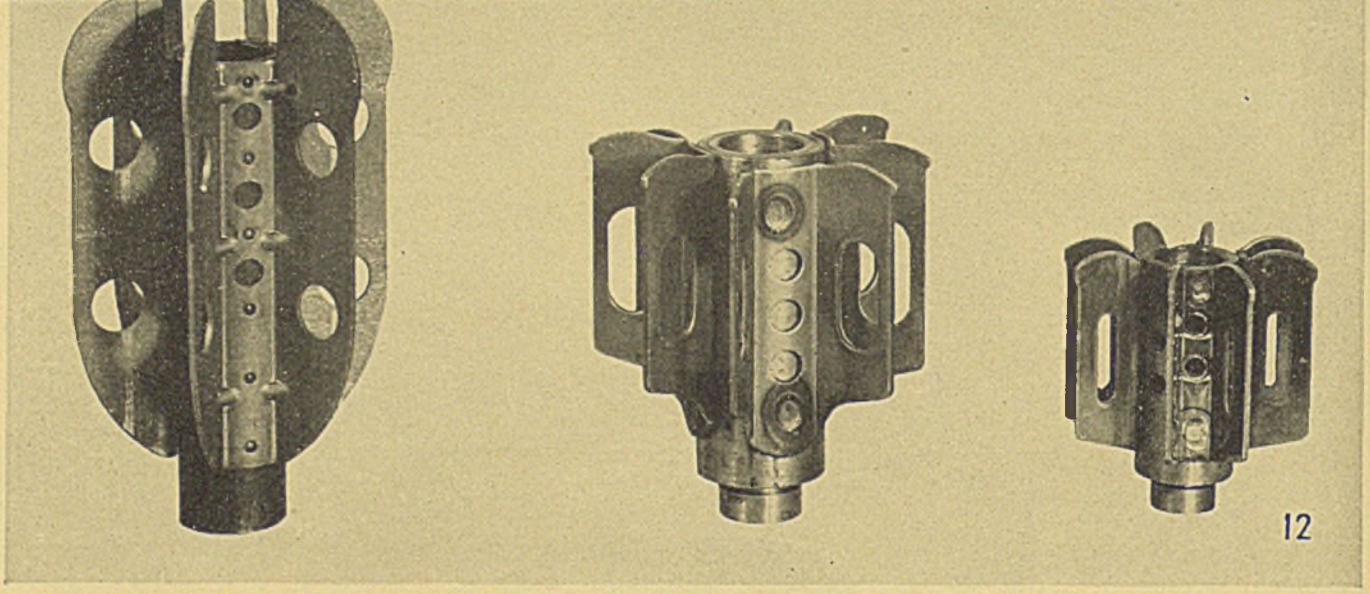


Fig. 12—*Group of small bomb tail-fin assemblies produced in large quantities on specially designed automatic resistance welders. The two on right have tail fin spot welded onto the base plug. Assembly at left has fins attached to base plug by projection welding*

Spot welding of the tin-coated copper braid, however, is not an easy job but is entirely feasible for production.

Welding of armor plate is usually considered difficult. Fig. 9 shows test specimens of successful spot welds.

Formed entirely from two stainless steel stampings is the aircraft engine exhaust stack in Fig. 5. The flanged edges are seam welded and the junction between the two ports is secured by spot welding.

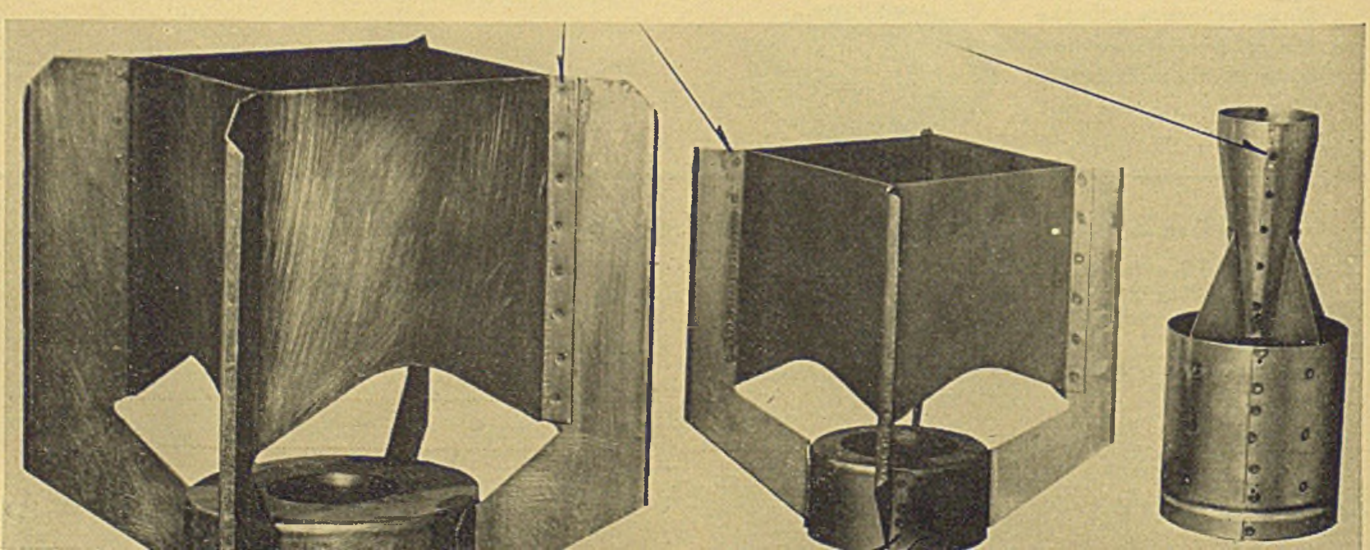
Ring Projection is Useful: Ring projection welding has many useful applications such as shown in Figs. 1 and 11. Fig. 11 illustrates the general method for installing bungs. A similar process is employed for spuds in medium pressure vessels. In fact, most of the porcelain-lined units must have pipe connection reinforcements welded in this manner to permit the flow of porcelain enamel over the welded region and completely seal the metal. Also, in this manner, small lugs are welded to relatively thin-gage material and are drilled and reamed after welding to support bushings for small bearings.

The insert in Fig. 11 is welded to 18-gage sheet steel and has 0.14-square-inch weld area. A current of 50,000 secondary amperes is required for the weld with 2500 pounds pressure; welding time, 35 cycles. Production is 750 per hour.

An idea of the savings that can be effected by ring-projection welding for the fabrication of unusual parts is indicated in Fig. 1. It would be difficulty to duplicate this small assembly by any other manufacturing method at anywhere near the same cost. The drawing of this part shows the method used to reduce the projection area. In this way the welding current used and the resulting strength of the joint are easily controlled. Round stock is welded to flat stock with a weld area of 0.1-square inch, requiring 20,200 secondary amperes and a pressure of 625 pounds.

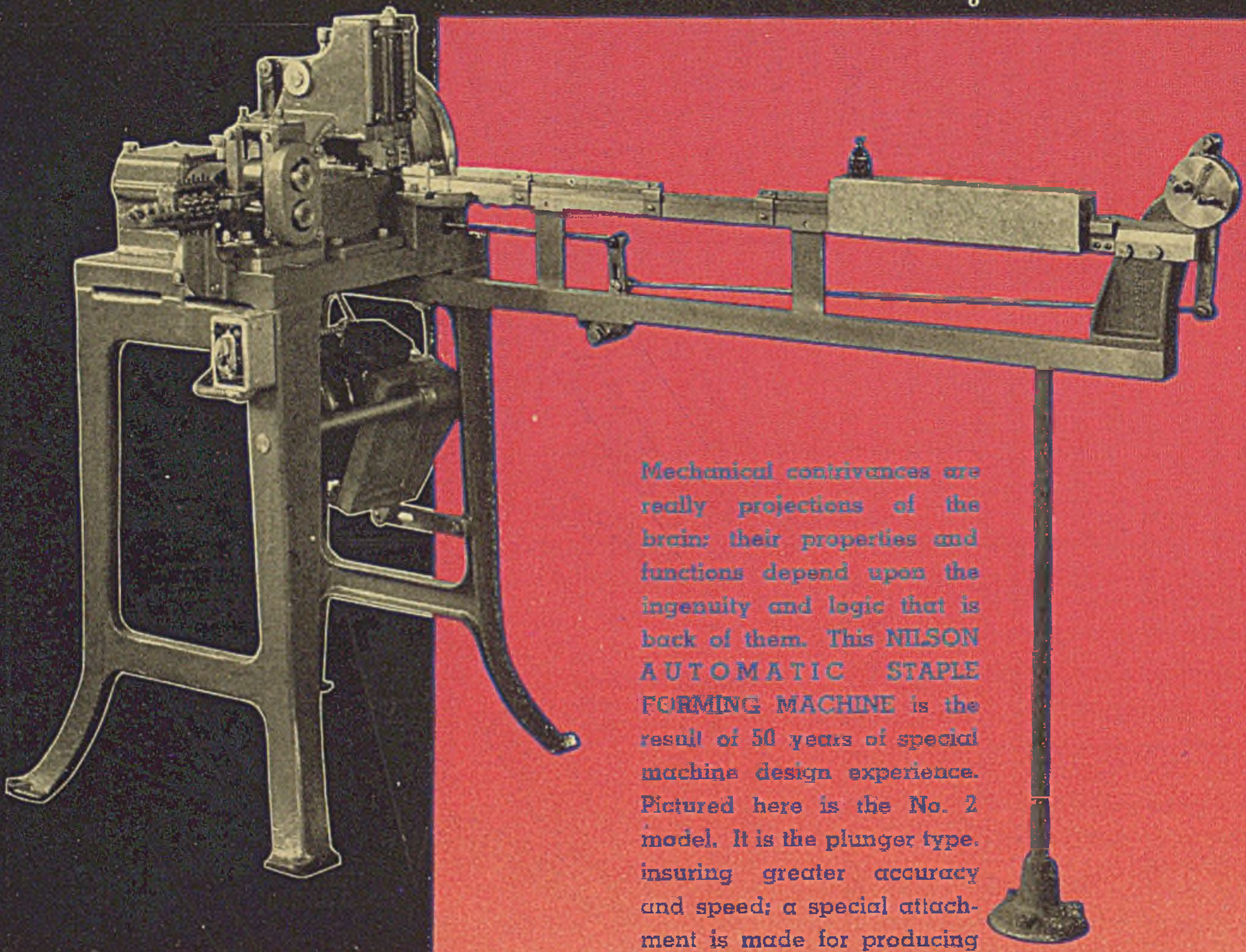
Obviates Extensive Machining: Another utilization of projection welding is seen in Fig. 6. Previously, bomb burster casings were expensive to produce and required a tremendous amount of machine shop facilities to produce the quantities desired. This design, however, involves only a simple sheet metal stamping for the top cap, a piece of seamless steel tubing or resistance welded tubing for the body and a relatively simple screw machine part for the mounting cap. Of particular importance is the small sheet metal cap. To eliminate an expensive machining operation it is desirable to weld the cap with minimum distortion and flash from the weld itself. To accomplish this, a weld of short timing is required which in turn requires considerably more power to weld the small cap to the top of the tube than is required to weld the large screw machine part to the bottom of the tube.

Fig. 13—*These bomb tail-fin assemblies are much larger than those in Fig. 12 and employ a different design. They consist almost entirely of sheet metal stampings, spot welded to-almost entirely of sheet metal stampings*



If machines are fingers of the brain

THE NILSON AUTOMATIC STAPLE FORMING MACHINE



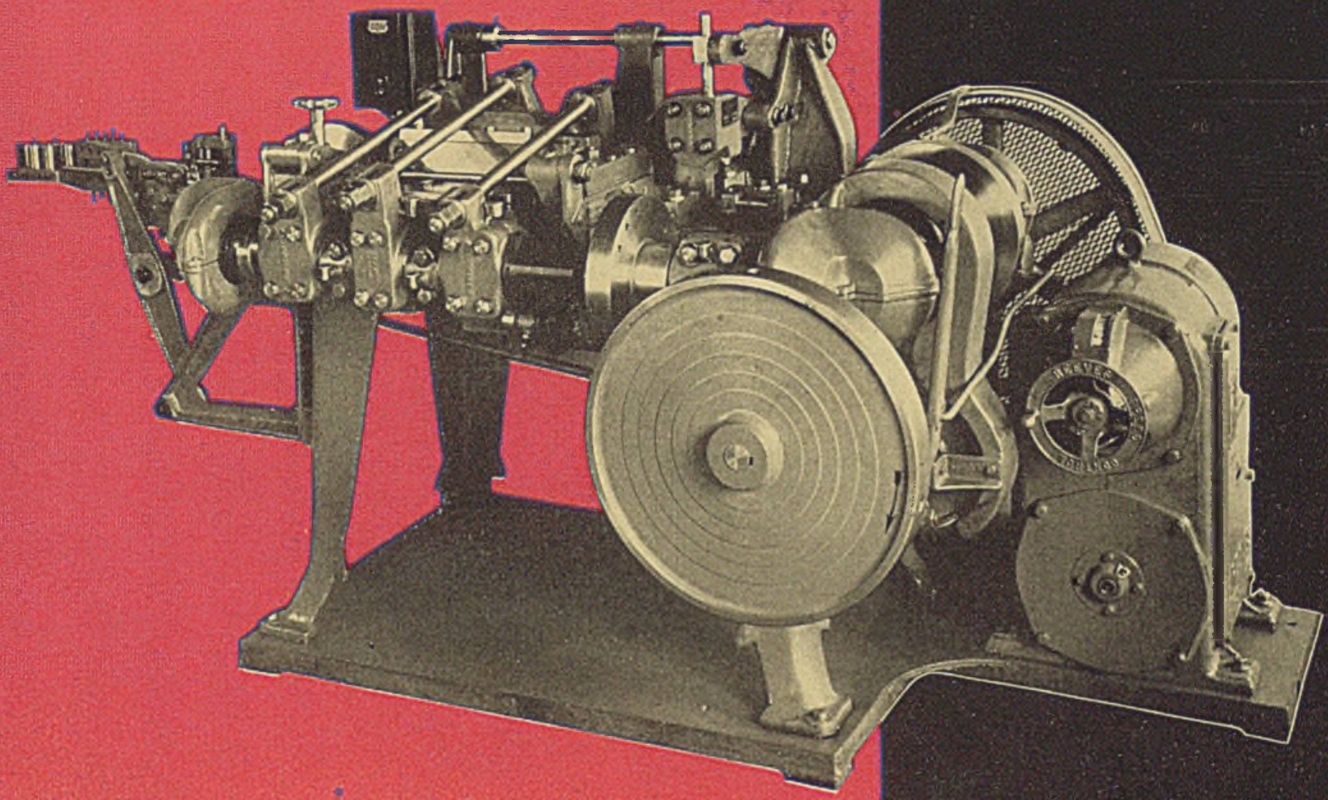
Mechanical contrivances are really projections of the brain; their properties and functions depend upon the ingenuity and logic that is back of them. This NILSON AUTOMATIC STAPLE FORMING MACHINE is the result of 50 years of special machine design experience. Pictured here is the No. 2 model. It is the plunger type, insuring greater accuracy and speed; a special attachment is made for producing chisel-point staples. Because improvements are added only when experiment and test prove them practical, we never depend upon our clients for market reaction; we "iron out the bugs" in advance. That is why NILSON machines give you the best in low production cost equipment for the manufacture of staples.

The A.H. NILSON

BRIDGEPORT

then here is mechanical intelligence:

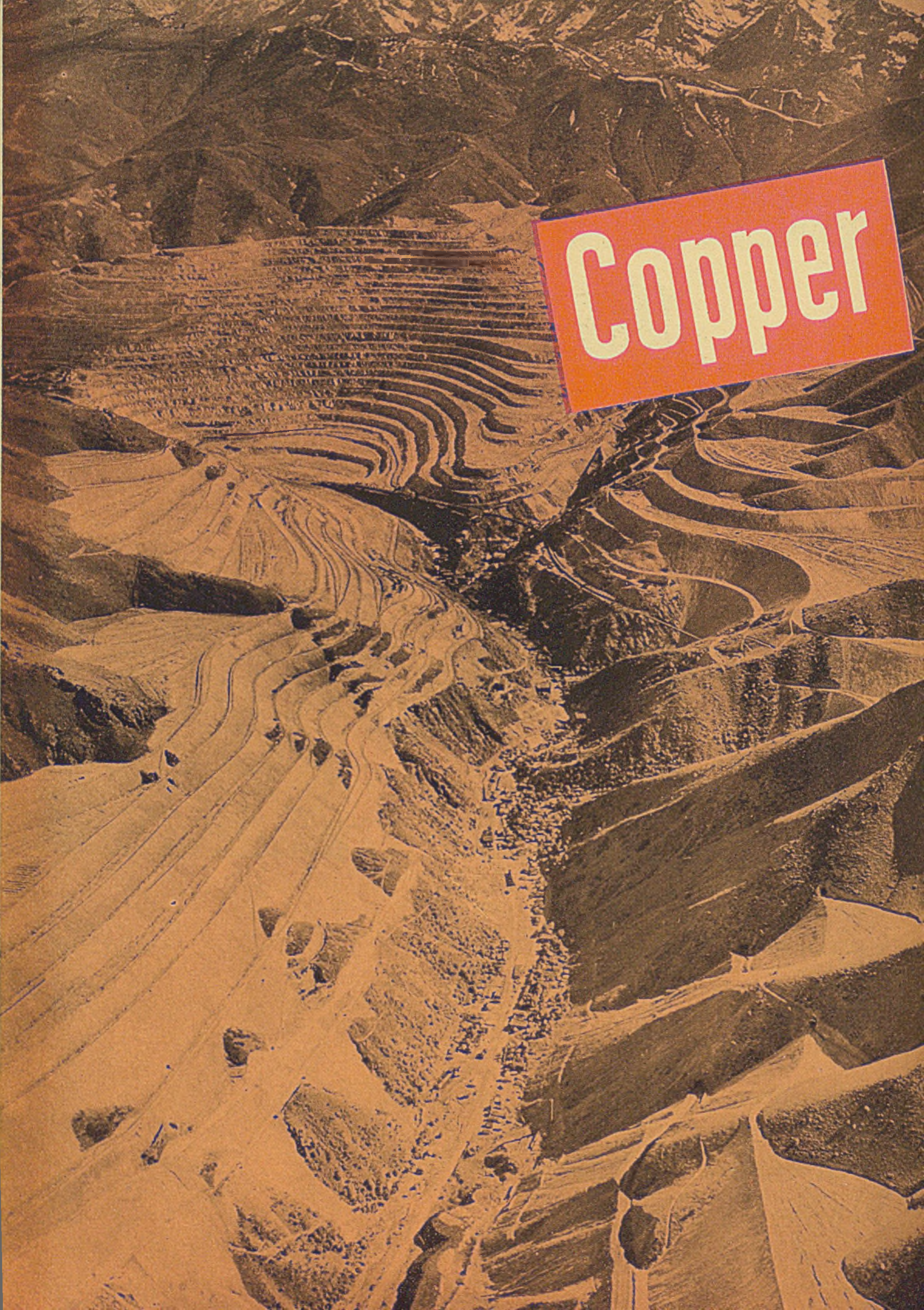
THE NILSON AUTOMATIC METAL WIRE FORMING MACHINE



Persistent efforts to produce a highly efficient and practical machine for forming wire and punching patterns from ribbon stock have resulted in the NILSON four-slide forming machine. To a layman, this is an ingenious contrivance; to a manufacturer, it is the answer to demands for increased speed and uniformity of products. Various patented features and extra attachments make it a necessary factor in reducing the manufacturing cost of your product. Skilled labor and perfect workmanship insure long life and freedom from repairs and replacements.

MACHINE CO.

CONN., U.S.A.


Copper

. . . . our sources of copper, supplies at hand and available, stockpiling, the world copper situation, production methods, conservation in ordnance work, substitution of steel for brass in cartridge cases, other important substitutions

(Section IV in a Series on Conservation and Substitution of Critical Materials in Ordnance Work)

By ARTHUR F. MACCONOCHIE
Head, Department of Mechanical Engineering
University of Virginia
University Station, Va.
And
Contributing Editor, STEEL

POSSIBLY no nonferrous metal among the many required for the manufacture of war equipment is of greater importance than copper. The readiness with which it alloys with other metals, particularly tin and zinc; the ease with which it can be drawn and pressed, whether in its native state or as an alloy; and the valuable physical properties it possesses, including its resistance to corrosion and its high conductivity for heat and electricity, render it invaluable for a wide variety of applications.

Perhaps the earliest metal to be used by man, it has woven itself into the fabric of human society for thousands of years. In the form of bronze, it has given its name to one of the great ages of mankind. Now in time of war it not only is an essential part of our shield and buckler but it also plays an important part in the spearhead of attack.

Any discussion of the proper allocation of available supplies should doubtless be prefaced by some account of nature and extent of our resources and the efforts which have been made and are even now in progress to extend them. To the layman, aware that nonessential use of the metal has virtually ceased and that large deposits of copper ores together with extensive mining and processing facilities exist within our borders, the knowledge that we are being forced to abandon brass cartridge manufacture and to conserve copper in many other ways which will be discussed comes as something of a shock, especially if he is familiar with our incomparably superior situation in relation to our enemies, particularly Germany, who has been able to maintain the world's greatest fighting machine in action over a period of three years.

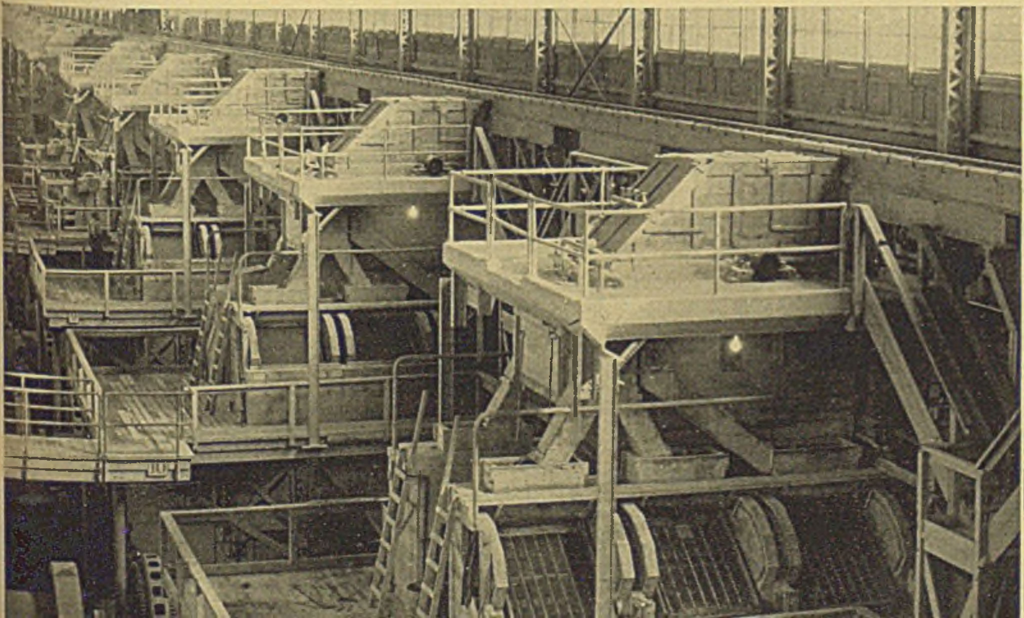
By way of lending exact emphasis to these remarks, Fig. 7, taken from an excellent little book by Brooks Emeny entitled *The Strategy of Raw Materials* (to which I cordially recommend the reader), exhibits on the vertical scale the ratio between domestic production and apparent consumption of essential raw materials, including copper; and on the horizontal scale, the apparent consumption by countries expressed as a percentage of the largest national consumption—in this case, our own. This chart, of course, gives the peacetime situation of the great powers and takes no account of the absorption of unwilling vassals by the armies of conquering nations. Even so, Germany's situation has scarcely been improved as far as copper is concerned for it differs but little from the indications of the chart.

With a realism which has been absent from the approach of the United Nations until recently, and with a

Fig. 1. (Opposite page)—Utah Copper Co.'s open-cut copper mine at Bingham Canyon, Utah. Close examination will show town of Bingham in valley. From Mining & Metallurgy, *New York*

Fig. 2. (Left, below)—Battery of huge electric vibrating screens at Magna plant of Utah Copper Co. From Mining & Metallurgy, *New York*

Fig. 3. (Right)—Gold mining in northwestern states. In a world at war, gold is of little value. Gold mining operations should cease as the workmen are badly needed in the production of other metals such as copper. Federal Works Agency photo



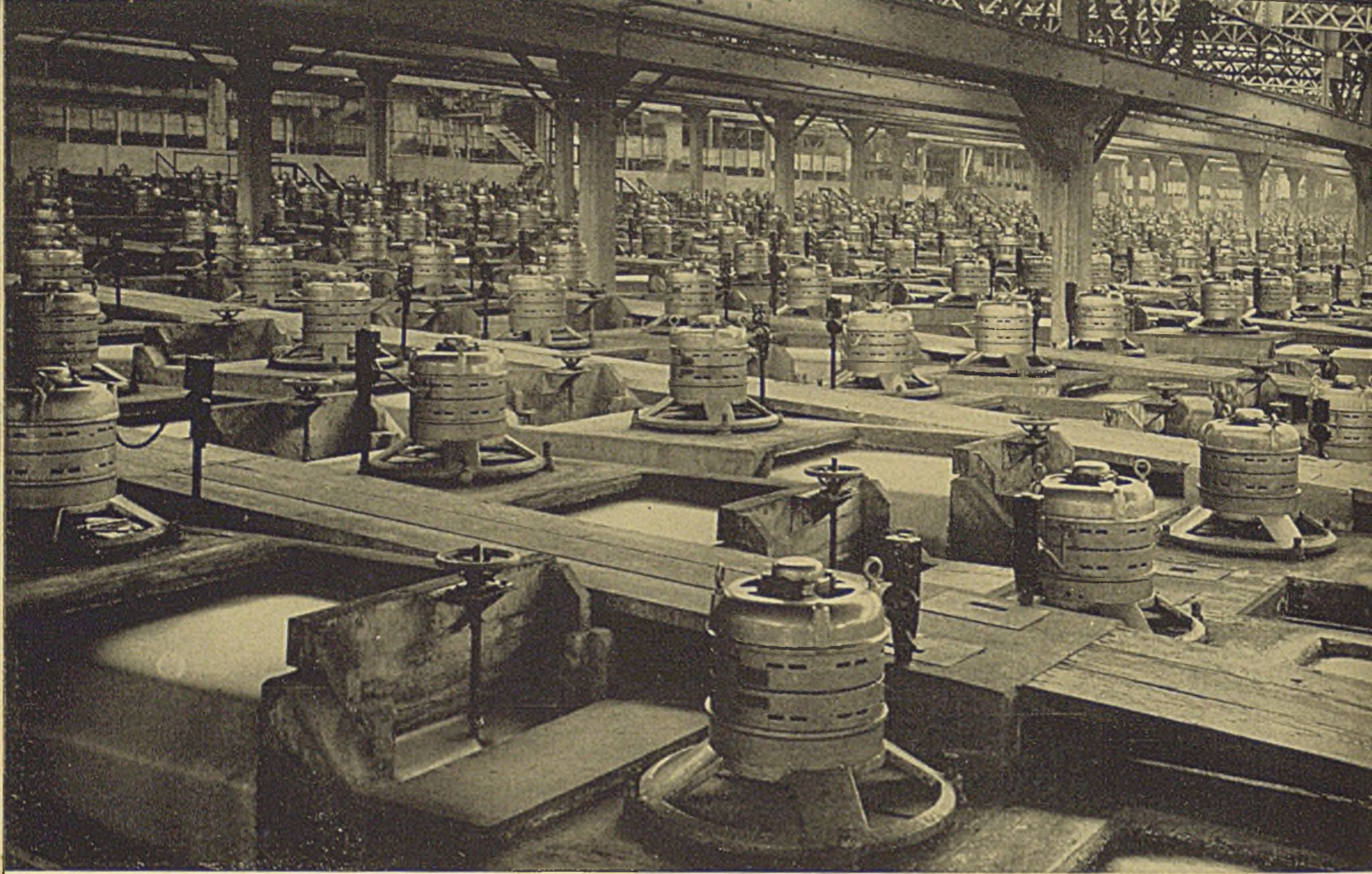


Fig. 4—Flotation section, Utah Copper Co. plant, employs literally hundreds of electric motors on individual agitator drives. Flotation permits working ores containing only 1 per cent of copper. This has added many million tons to national ore reserves. From Mining & Metallurgy, *New York*

single-minded end in view, Germany first proceeded to develop her low-grade deposits, especially of iron and copper, building up her mineral production without regard to cost. Examples of this are the pig iron production of the Herman Goering Works at Salzgitter and the increased production of copper at the Mansfield mines, at a cost estimated to be more than double the world price. But this expansion has been worth every penny to the Nazis.

Further, since 1933, Germany has bartered with the Balkan states for most of their mineral output and has built up large stocks by imports from the Western hemisphere. At the same time, our mines, especially copper, were languishing in the depths of the depression of the thirties. Even now, in our anxieties over inflation and our political weakness which prevent the firm application of wage ceilings as well as price ceilings, men are leaving the copper mines to seek better paid work elsewhere. And gold mining, Fig. 3—a most useless effort at present—still continues to employ men who are badly needed in the copper mining industry.

The latest figures on copper production that can be published include February of this year. In that month, estimates indicate a total of 83,484 for domestic mines, including Alaska. This represented a decrease of 2733 short tons from that of January, but since February is a short month, the actual daily production rose from 2781 to 2982. The overall picture of copper production from domestic ores as reported by smelters during recent years may best be seen in the following table:

	Short Tons
1941	979,500
1940	909,084
1939	712,675
1938	562,328
1937	834,661
1934	232,522
1931	524,552
1928	934,496

If our January production rate be maintained throughout this year, production will top *a million tons.* Coupled with this, at the end of 1941 we had on hand 77,500 tons of refined copper and 239,500 tons of blister and materials in solution. From these figures some idea of the extent of our own needs, together with lend-lease commitments, can be gained if we remember that brass cartridge cases—the largest single use—must be abandoned.

During the years 1932 to 1938 German imports of copper metal rose from 152,200 short tons to over 300,000; and her imports of copper ore from 262,000 to 720,000 tons. Unhampered by the democratic philosophy of holding the carrot in front of the donkey, Germany applied the stick in the shape of government control of all labor unions, whose members as early as 1936 were obliged to work 60 hours a week, any who resisted being sent to a concentration camp. Milder forms of obstruction, of the ca' canny variety, were controlled through reduction in food rations allowed the workman and his family.

This is not intended as an incitement toward the adoption of totalitarian methods since the right of free men to work where, as, and if they please is something we hope to preserve. However, it may well be questioned whether the compromise policy of establishing a 12-cent ceiling for electrolytic copper and 17 cents for

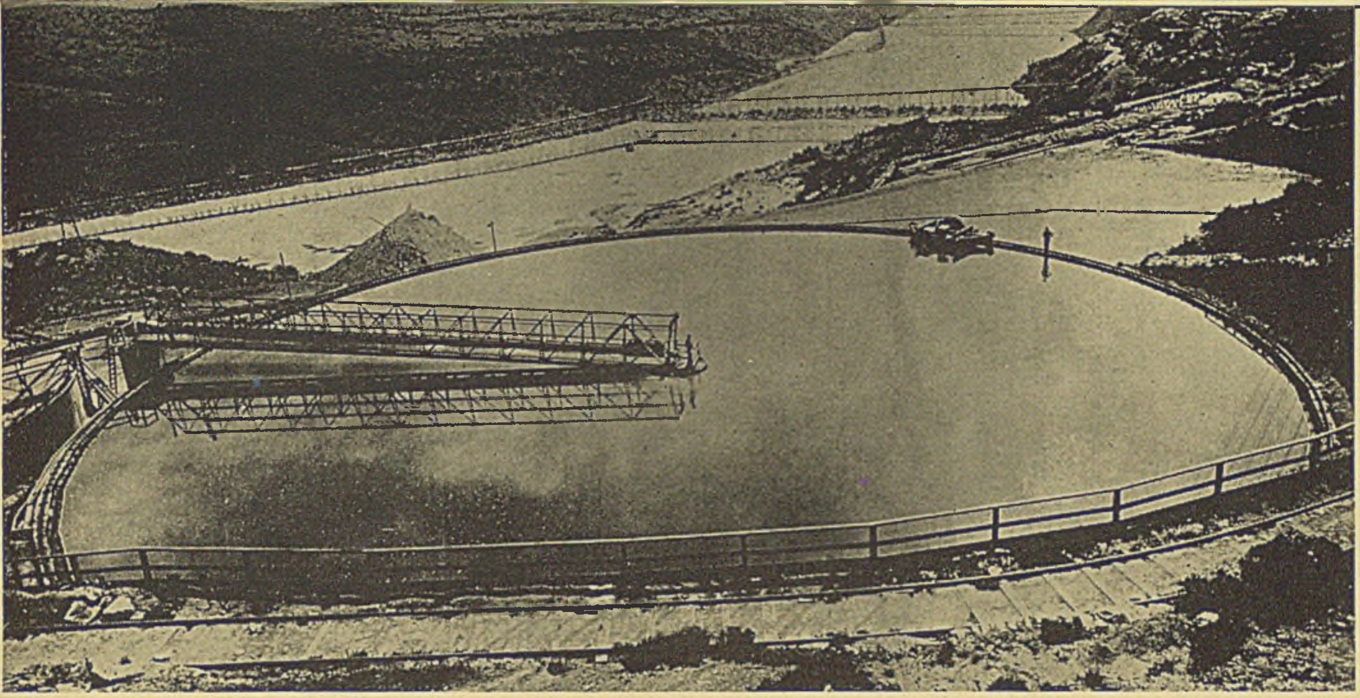


Fig. 5—Some idea of the size of this huge 200-foot diameter thickener tank for de-watering flotation tailings at Miami, Ariz., can be had by looking for the men standing at the center and at the far right rim. Bureau of Mines, Department of Interior photo

over-quota output will produce as much copper from a boomer industry as we might get if economic forces were allowed a little more free play.

By way of contrast with the effective policy of our enemies, the principle of stockpiling, *considered by the War Department since* 1927, was only established by our government during the fiscal year 1937-1938, in which Congress allotted a small sum for the purchase of strategic materials to be stored for emergency use by the Navy. The Strategic Minerals act, which became law in June, 1939, finally established a sound basis for action. This bill authorized the expenditure of $100,000,000 over a period of four years for stockpiling purposes and in addition provided funds for an investigation of domestic resources of strategic minerals and for developing methods of treatment for low and off-grade ores.

Later, the money available for the purchase of strategic materials was increased by the creation of the Metals Reserve Co., an organization with $5,000,000 capital, to which the Reconstruction Finance Corp. authorized loans of an additional $100,000,000 for the purchase of tin, manganese and other metals; but there is no reference to copper from domestic sources.

When it became apparent, in the last quarter of 1940, that production in the United States was insufficient to meet the demands of industry, the Metals Reserve Co. began making arrangements to buy Latin American copper. Receipts were to form a buffer stock pile, and manufacturers who were unable to obtain their copper requirements from domestic refiners were to be permitted to draw from government stocks. Deliveries from the stock pile to domestic consumers were begun in March, 1941.

Before turning from this statistical stocktaking of our resources to a discussion of the contributions of the United States Geological Survey and the Bureau of Mines toward their expansion, a glance at the world copper situation as it existed in the early stages of the present war in Europe and immediately preceding its outbreak gives some comfort. Coupled with our million-ton volume in prospect for this year, Canada had expanded her 1939 output of close to a quarter of a million tons by 14 per cent in 1940 to well over a third of a million tons. While no information is available concerning prospects for 1942, it may be assumed that forward steps have been taken in both 1941 and 1942. If we add up our own estimated production for this year and those of Canada, Cuba and Mexico, the gross for the North American continent cannot be far from *one and a half million tons.*

The rest of the world's total, as can be observed from Table I (*Bureau of Mines Yearbook* for 1940) (see page 204) is largely in the hands of the United Nations. The entire output of Europe, excluding the U.S.S.R. and the United Kingdom, was just over a quarter of a million short tons in 1938, while that of Asia—or rather that part of it now under Japanese control—was less than half of this amount. Granted that expansion has taken place and that Germany acquired large stocks of copper in France, Belgium and Holland, the Axis will still be hard put to it to match our armament production in the long pull if copper is any index.

While copper occurs in the native state and also as an oxide, a carbonate and a silicate, most of the world's copper comes from the sulphides, of which chalcopyrite ($CuFeS_2$) is the most common; and, in North America at least, the most important commercially. When pure it has a copper content of 34.5 per cent. Chalcocite (Cu_2S) is second to chalcopyrite and up to about 30 years ago was the source of more than half the copper produced. It has a much higher copper content—some 79.8 per cent —when in the pure state. Bornite, another copper-iron sulphide with about 55.6 per cent copper, is important in a few districts; while enargite ($3Cu_2SAs_2S_5$), with 48.3 per cent copper, is one of the important ore minerals at Butte, Mont. Malachite (a carbonate) and chrysocolla (a silicate) are mined in the oxidized zones of copper deposits and are the principal sources of copper at the Inspiration and Miami mines. Native copper is the only copper mineral mined in the Lake Superior district of Michigan.

As a characteristic illustration of open-cut mining operations, Fig. 1 is a view of the Utah Copper Co.'s open-cut mine at Bingham Canyon, Utah. Note the tiny

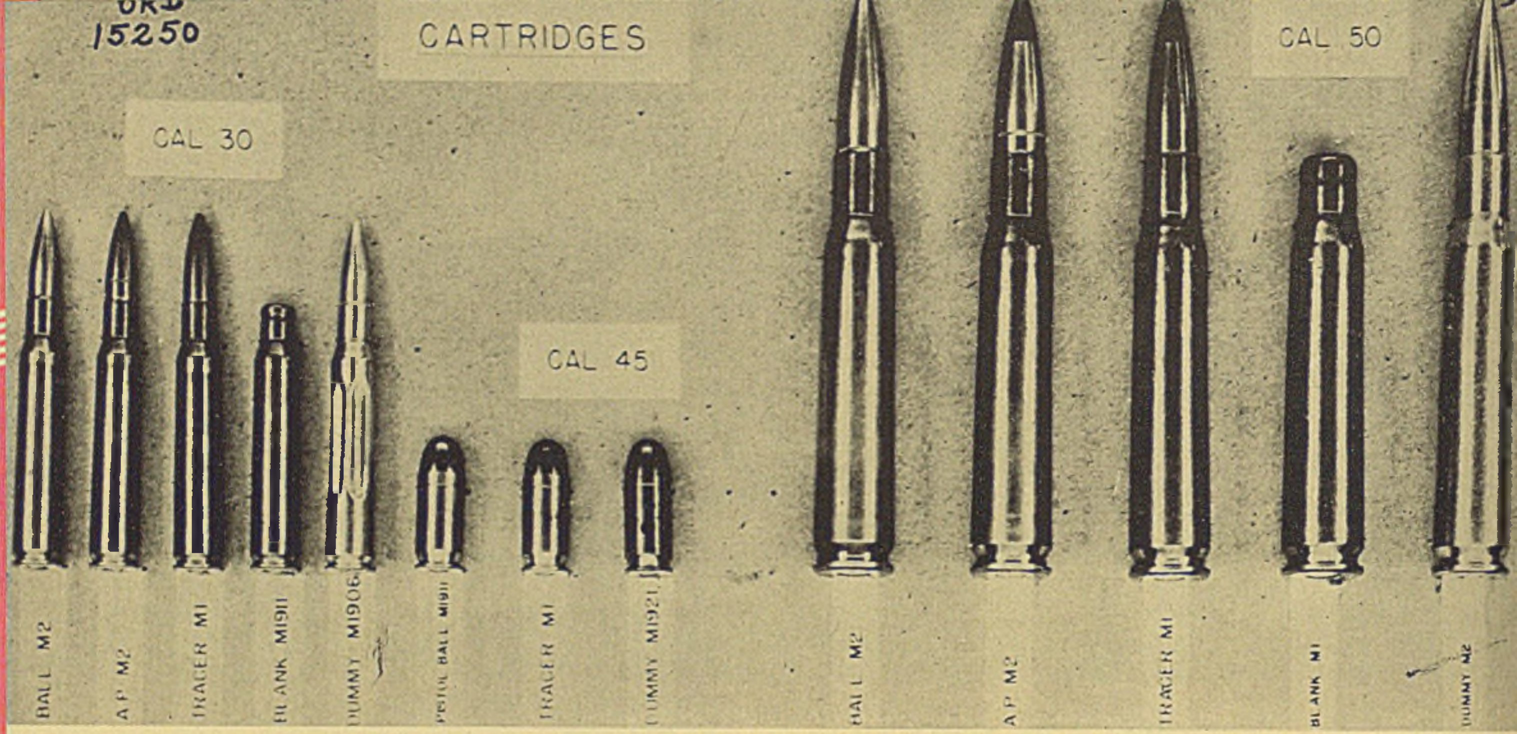


Fig. 6—While the problem of substituting steel for brass as a material for cartridge cases has been solved for artillery ammunition, small arms cartridge cases are still made of brass. However, since the largest tonnage of brass is in artillery cases, that change has already made important savings

buildings that represent the town of Bingham at the bottom of the valley—almost lost in the huge expanse. The Utah copper ore body has an overall length on its long axis of about 6000 feet, a maximum width of 4000 feet and a vertical depth of around 2000 feet. An average of some 115 feet of capping or completely leached porphyry originally covered the ore; but by the end of 1934 about 121,000,000 cubic yards had been removed. This is one of the largest reserves of developed ore in the country.

The invention of flotation is one of the most important developments in metal mining for it makes practicable the working of extremely low-grade ores. Not long ago 2 per cent ore had no value. Today some of the most profitable mines work ores of 1 to 1.3 per cent. In 1930, over 44 per cent of copper output came from deposits considered worthless in 1900.

In concentration by flotation, the ore is ground wet to the desired degree of fineness, a certain amount of conditioning, frothing, depressing and collecting reagent added and the mixture violently stirred. Air is introduced by agitators or by forcing it into the mixture under pressure, forming vast numbers of air bubbles to which the water-repellent ore-mineral particles attach themselves to be carried to the surface by reason of their enhanced buoyancy.

Meanwhile, the particles of gangue, which are readily wetted by water, do not collect air bubbles and so remain at lower levels. In this way a separation of ore-mineral

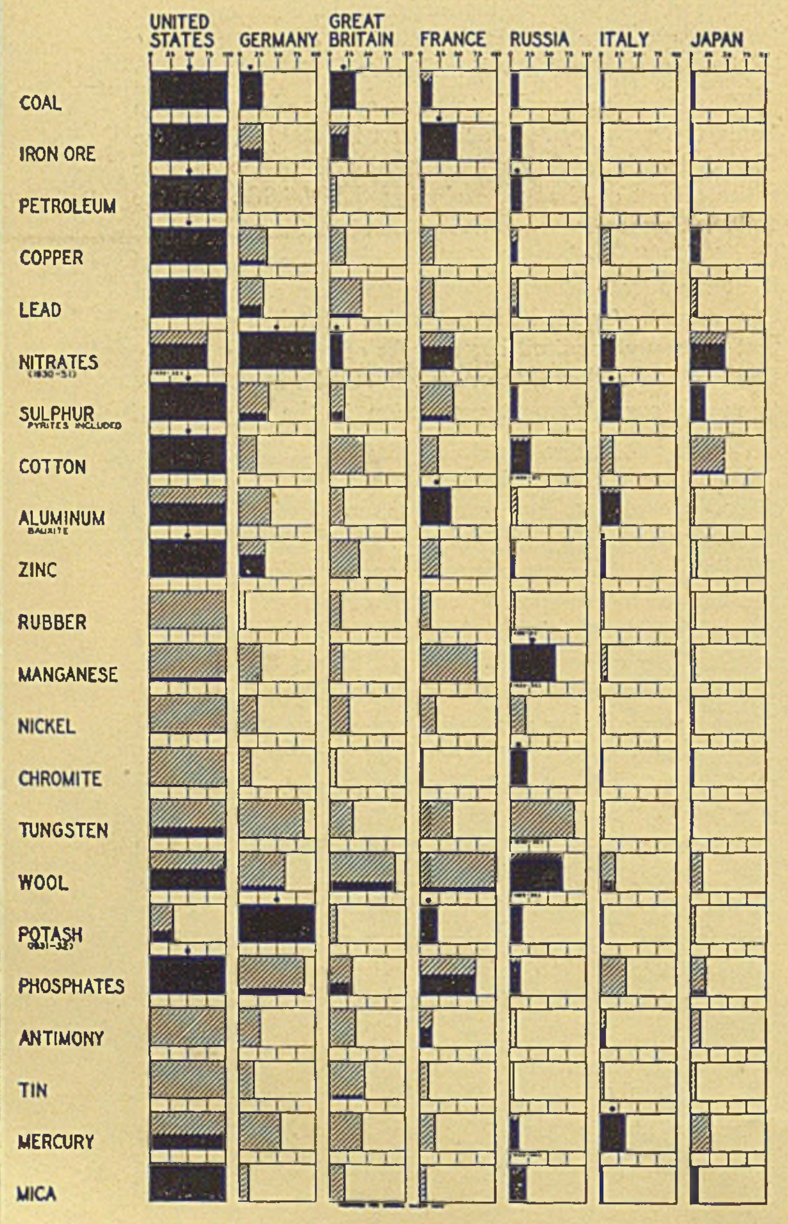


Fig. 7—Situation of the "great powers" reveals extent of national self-sufficiency in essential raw materials in terms of comparative consumption demand. Vertical scale: Domestic production and net imports, expressed as percentages of apparent consumption of product indicated with black section indicating domestic production, shaded area denoting net imports. Horizontal scale: Apparent consumption of product indicated expressed as percentage of the largest annual national consumption. The black dot over a section indicates net exports were larger than 2 per cent of total apparent consumption of the seven powers. Unless otherwise noted, percentages are yearly averages for 1925-29 inclusive, except Russia 1929-32. From Brooks Emeny's The Strategy of Raw Materials *published by Macmillan Co.*

IS PAVED WITH SCRAP

This is a *must* . . . the urgent problem is more and still MORE scrap iron. Steel plants need MORE—because manufacturing plants need MORE steel—because the armed forces need MORE weapons to speed Axis surrender. ¶The situation is critical, the time is now. It calls for America's top resourcefulness, energy and executive skill. It takes cooperation from every industrial worker, every industrial plant, every civilian. ¶Your nearest salvage collector will buy your scrap iron and move it to the steel mills. Every pound will help secure the homes, lives, and future of all of us. Every pound will bring the Nazi-Nippon "Kamerad" nearer!

THE OHIO SEAMLESS TUBE COMPANY SHELBY OSTUCO OHIO

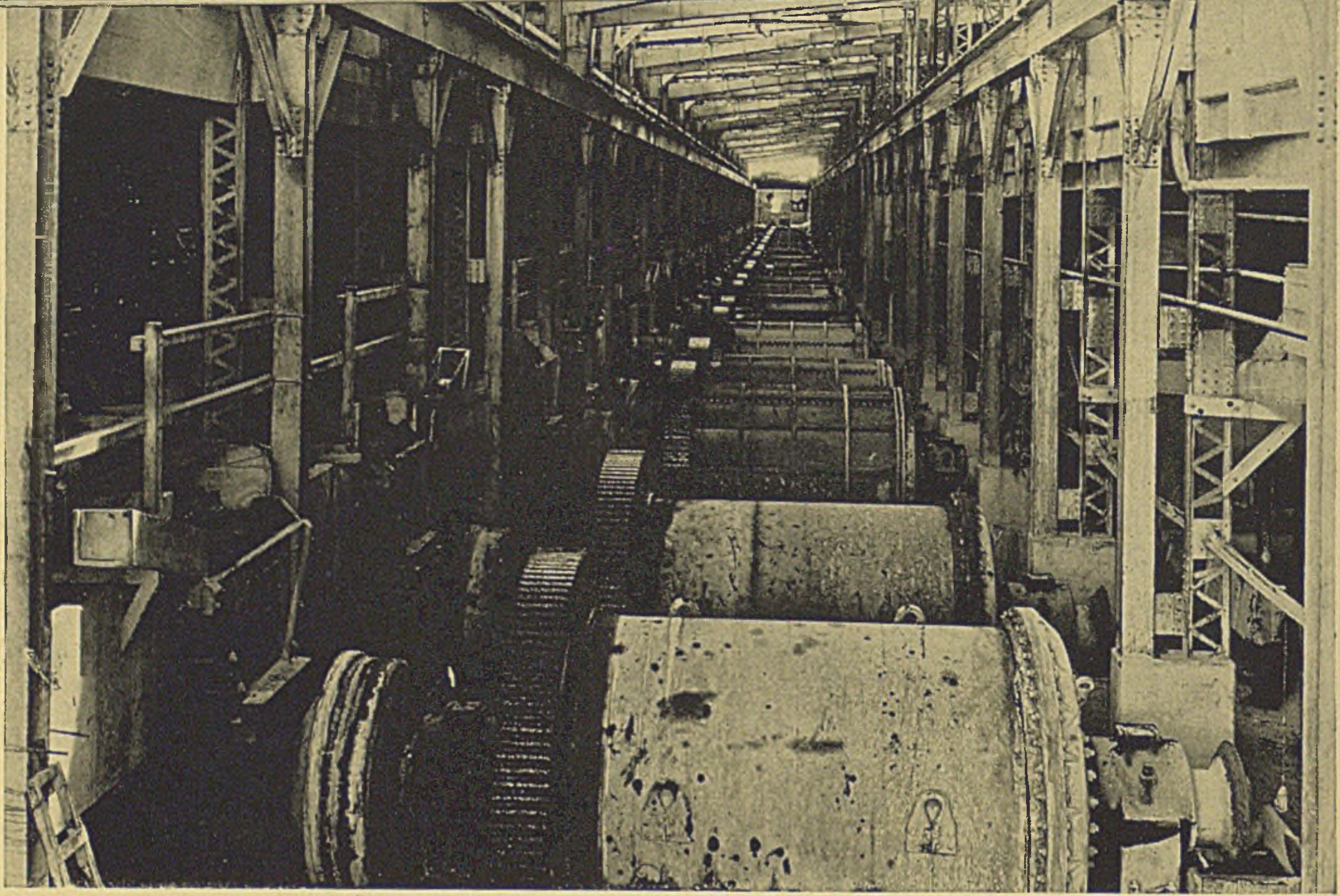


Fig. 8—Ball mill section, Utah Copper Co. plant. From Mining & Metallurgy, *New York*

and gangue particles is made, the efficiency of the operation depending both on the character of the ore and the effectiveness of the action. A typical flotation section at Utah Copper Co. plant is shown in Fig. 4. Note that literally hundreds of vertical electric motors are used on individual agitator drives.

In the extraction of copper from its various ores, two methods are in general use. The first, known as the dry method, involves smelting in a reverberatory furnace, followed by the bessemerizing of the copper matte in a converter. The second consists of a leaching process (with or without a preliminary roast) and subsequent precipitation of the copper from solution. The reason for roasting copper ores arises from the greater affinity of copper for sulphur than any of the other familiar metals. Thus when copper ore containing sulphur is fused, Cu_2S is formed. Any excess sulphur forms sulphides of other metals, known as matte. If the sulphur is too high, the losses of copper in the waste slag increase. Roasting thus helps remove the undesired sulphur.

The blister copper from the converter is porous and brittle and must be refined to get rid of impurities, irons, etc., and to recover any precious metals that may be present in quantity. Since the latter is generally the case, the electrolytic method of refining has superseded the older process of fire refining in which a reverberatory type furnace was used and the cuprous oxide reduced by "poling" or forcing poles of green timber, butt end first, into the mass of molten copper.

Mention has already been made of the highly successful results attending our efforts to use steel for cartridge cases, successful firings having now been conducted in four calibers of artillery ammunition. A major problem was successful obturation (contraction of the case after firing to permit extraction from the gun), but this appears to have been satisfactorily overcome.

Another is the loss of shape after the first firing, necessitating re-shaping if the case is to be used again. Brass artillery cartridge cases have been used as many as eight times before finally relegating them to the scrap pile, thus conserving production capacity.

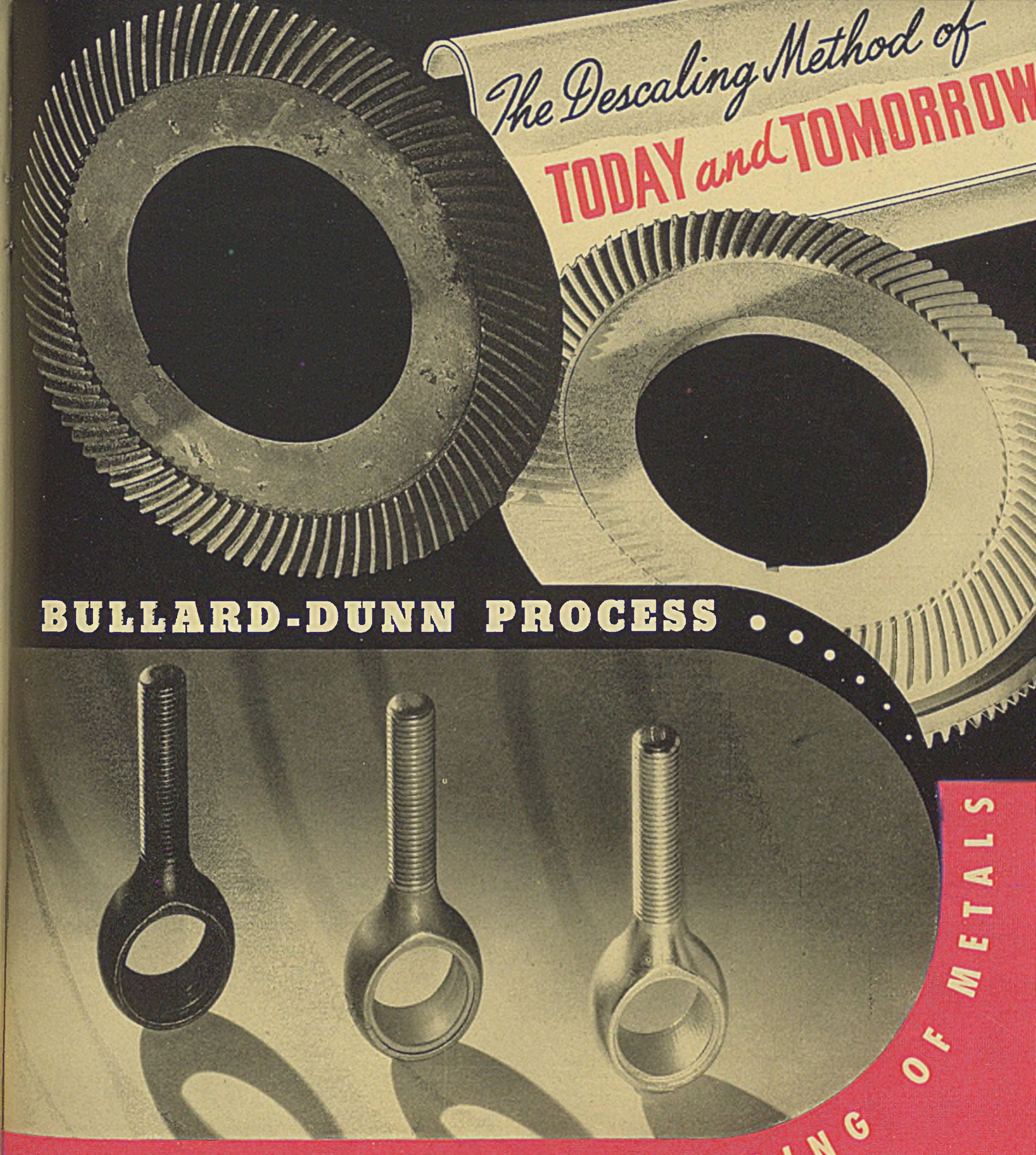
Then there is the matter of corrosion of steel cartridge cases, both external and internal—a problem which has been successfully solved. Savings of copper by use of steel in artillery ammunition alone will reach 30,500 tons this year and 295,500 tons in 1943—no insignificant proportion of our total output.

The use of steel for cartridge cases for small arms ammunition—especially 0.30 and 0.50-caliber—has not yet progressed to a stage where any definite statements regarding its successful application can be made. Experimental work gives much promise of our ability to manufacture on existing production lines. It should be pointed out that while the total number of small arms ammunition rounds required is of considerable proportions, the weight of each individual cartridge case is small.

The copper alloy band surrounding the shell body or projectile near the base functions as a gas check and imparts rotary motion to the projectile by engaging the rifling grooves of the gun as it is fired. This band has also been the subject of study. Several projects now under way are aimed at reducing the amount of copper required. These include the use of powdered metals such as copper itself, gilding metal, soft steel and also copper bands formed by electrodeposition.

A serious drawback to some of these proposals lies in the coppering of the barrel caused by using pure copper instead of gilding metal. Perhaps powdered copper alloys are the most hopeful, embrittlement tests at low temperatures being under way.

Boosters and primers for artillery ammunition are among the smaller items in which copper can be saved.


The Descaling Method of
TODAY and TOMORROW
BULLARD-DUNN PROCESS

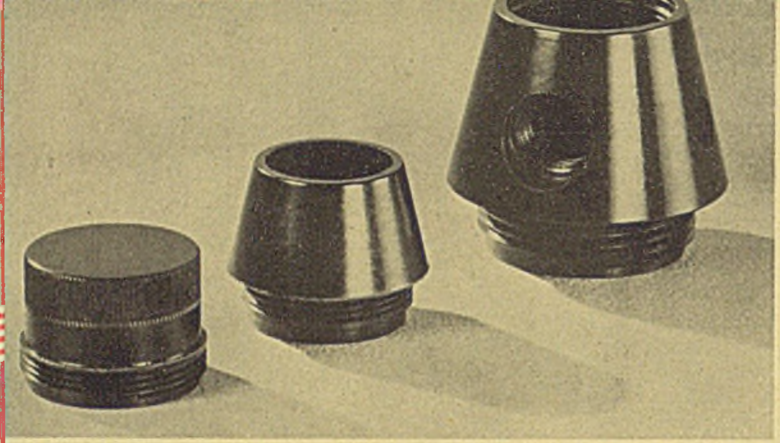


Fig. 9—These fuze parts for trench mortar shell are now made from plastics to save critical materials, especially copper. Many similar substitutions are being made in other important ordnance items. In none, however, is quality permitted to be sacrificed—the substitute must serve equally as well or better than the original material

Most booster parts can be produced from other materials on the same machines that now make the brass parts; but primers of aluminum, copper and steel have slightly different weights from the present standards and have an appreciable effect on ballistics.

No repercussions, however, appear to have resulted from the use of steel bullet jackets, clad outside and in with gilding metal. This procedure saves about 80 per cent of the gilding metal—or rather would save this amount if the scrap losses were not higher than with cupro-nickel envelopes. At present, the saving in gilding metal is only about 60 per cent, but it will take us some considerable time to change over.

Copper-plated steel jackets are proving effective for 0.45-caliber ammunition apparently, but possibly trouble may occur from coppering of the barrel in this case also.

The complexity of the conservation problem is well illustrated by the fact that while we use our utmost endeavors to limit use of copper in the ways indicated above and in a wide variety of other items, including parts of combat vehicles and artillery material, the demand for copper in steel castings is rising because of its substitution for nickel, which is more critical. Then, too, the high coefficient of heat transmission of copper and its alloys, particularly cupro-nickel, renders substitution difficult in such assemblies as oil cooler systems.

However, good results have been obtained in the substitution of bearing materials other than bronze. For instance, the central bronze hemisphere bearing of a certain type of antiaircraft gun is being made successfully from a copper-molybdenum cast iron.

So we might proceed, citing illustration after illustration of gray or cast iron substituted for bronze in fuse-setters; lead-base antimonial metal for bronze name plates; bronze-faced glands instead of solid bronze; and compression rings with bronze only where they fit.

The suggestion has been made that we are possibly piling up too much war material; but being in the defensive we are obliged to accumulate stocks over a vast area of the earth's surface. Further, as compared with Germany, who is able to salvage much material as she advances, and to add captured supplies, we must make good the losses of the United Nations, especially Russia.

Whereas in Germany and the occupied countries civilian use is down to the bone, we are still getting as much copper for civilian use as in the days of the depression—but the indications are that we shall get less and less.

✦

TABLE I—World Mine and Smelter Production of Copper from 1938 to 1940 in Metric Tons

Country	Mine			Smelter		
	1938	1939	1940	1938	1939	1940
North America:						
Canada	259,113	275,829	(1)	[2] 215,732	[2] 229,370	(1)
Cuba	14,431	9,064	10,500			
Mexico	41,851	44,390	37,602	37,100	44,300	34,400
Newfoundland	8,056	10,341	9,426			
United States	505,991	660,717	796,582	[3] 570,773	[3] 698,323	[3] 922,369
	829,442	1,001,241	(1)	823,605	971,093	(1)
South America:						
Bolivia	[4] 2,885	[4] 4,056	[4] 6,660			
Brazil	15	14	(1)			
Chile	351,443	339,170	352,439	337,508	324,591	337,021
Peru	37,529	38,170	37,686	35,741	34,115	33,584
	391,872	381,410	397,000	373,249	358,706	370,605
Europe:						
Belgium				[5] 81,460	(1)	(1)
Bulgaria	64	320	(1)			
Finland	12,232	11,797	(1)	11,824	13,246	(1)
France	[6] 600	(1)	(1)	(1)	(1)	(1)
Germany Austria	30,000	30,000	(1)	[7] 70,000	[7] 66,000	(1)
Hungary	336	(1)	(1)			
Italy	[6] 1,000	(1)	(1)	2,963	(1)	(1)
Norway	21,619	19,436	(1)	10,517	10,515	(1)
Portugal	4,884	(1)	(1)			
Rumania	[8] 580	(1)	(1)	580	(1)	(1)
Spain	[6] 30,000	(1)	(1)	[6] 11,000	[6] 7,300	(1)
Sweden	9,289	9,610	(1)	10,668	11,076	(1)
U. S. S. R.[9]	[10] 114,552	[10] 144,000	(1)	114,552	144,000	(1)
United Kingdom	37	(1)	(1)	7,200	(1)	(1)
Yugoslavia	49,500	64,200	(1)	41,093	41,658	42,951
	275,000	(1)	(1)	363,000	(1)	(1)
Asia:						
Burma	[6] 3,600	(1)	(1)			
China [11]	240	1	(12)	240	1	(12)
Cyprus	29,780	24,384	(4)			
India, British	[6] 5,600	(1)	(1)	5,416	6,800	(1)
Japan:						
Japan Proper	[10] 102,000	[10] 104,000	(1)	102,000	104,000	(1)
Taiwan	[6] 4,000	[6] 4,000	[6] 4,000			
Netherlands Indies	93	94	(1)			
Philippine Islands	3,528	7,496	9,259			
Turkey	[10] 2,488	[10] 5,917	(1)	2,488	5,917	(1)
U. S. S. R.	(9)	(9)	(9)	(9)	(9)	(9)
	[9] 151,000	(1)	(1)	[9] 110,144	[9] 116,718	(1)
Africa:						
Algeria	22	(1)	(1)			
Belgian Congo	[10] 123,943	[10] 122,649	(1)	123,943	122,649	(1)
Rhodesia:						
Northern	254,904	(1)	(1)	216,450	215,065	(1)
Southern	5	(1)	(1)			
South-West Africa	4,828	3,530	1,485			
Union of South Africa	11,305	10,998	(1)	13,468	14,089	(1)
	395,007	(1)	(1)	353,861	351,803	(1)
Oceania: Australia	10,758	19,800	(1)	17,372	20,219	(1)
	2,062,000	(1)	(1)	2,041,000	[13] 2,216,000	(1)

[1] Data not available.
[2] Copper content of blister produced.
[3] Smelter output from domestic and foreign ores, exclusive of scrap. The production from domestic ores only, exclusive of scrap, was as follows: 1938, 510,133 tons; 1939, 646,524 tons; 1940, 824,703 tons.
[4] Copper content of exports.
[5] Figures represent blister copper only. In addition to blister copper, Belgium reports a large output of refined copper which is not included above as it is believed produced principally from crude copper from the Belgian Congo and would therefore duplicate output reported under the latter country.
[6] Approximate production.
[7] Exclusive of material from scrap.
[8] Smelter output from ores.
[9] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[10] Smelter product.
[11] Exports of ingots and slabs.
[12] Less than 1 ton.
[13] Approximate production based upon output of countries shown, which in 1938 contributed about 95 percent of total world output.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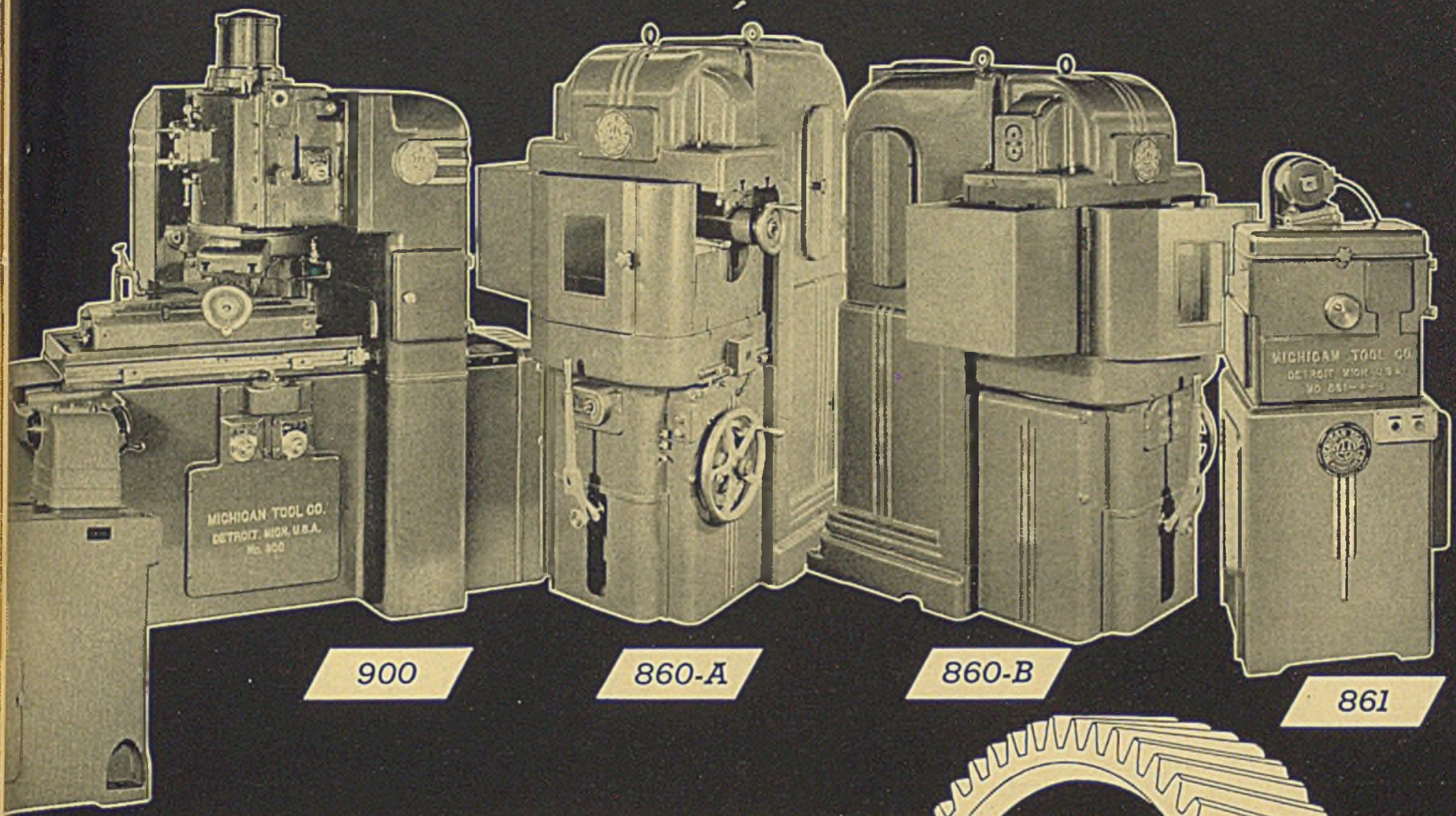

MACHINE MODEL NO.	GEAR CAPACITY (diameter)
861-4B (Light Duty)	¼″ to 4″
900 (Rack Type)	1″ to 8″
860-(A or B)-8	1″ to 8″
860-(A or B)-12	1″ to 12″
860-(A or B)-16	1″ to 16″
862-18 (Heavy Duty)	2¼″ to 18″
862-24 (Heavy Duty)	2¼″ to 24″
865-36 (Heavy Duty)	4″ to 36″
865-48 (Heavy Duty)	4″ to 48″
865- ? ? ? (Heavy Duty)	for larger gear sizes up to 16 feet diameter (on special order)

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WAR PRODUCTION GROUP MEETINGS

. . . . on war production problems, conservation and substitution, sponsored by American Society for Metals and held in conjunction with the 1942 National Metal Congress and Exposition at Public Hall, Cleveland, Oct. 12 to 16, inclusive

Monday, Oct. 12

2:00 P.M.

"Metallurgical Aspects of the National Emergency Steels"
"Aluminum"

4:00 P.M.

"Employe Training in Metalworking Departments"

8:00 P.M.

"Doing More with What Alloys We Have by Using National Emergency Steels"
"Manufacture and Heat Treatment of Magnesium Castings"
"Salvage of Broken Tools and Maintenance of Equipment"

Tuesday, Oct. 13

2:00 P.M.

"Doing More with Available Tool Steels"
"Speeding Production by Improved Metal Cutting Practice (Part I)"

4:00 P.M.

"Interpretation of Magnaflux and Other Surface Inspection Tests"

8:00 P.M.

"Selecting the Proper Die Steels for Mass Production"
"Use and Interpretation of Radiography As an Inspection Method"
"Speeding Production by Improved Metal Cutting Practice (Part II)"

Wednesday, Oct. 14

2:00 P.M.

"Making More Steel in Open-Hearth Plants"
"Problems Associated with the Large Expansion of the Steel Foundry Industry"

4:00 P.M.

"Use of Powdered Metals in War Production and Tools"

Bradley Stoughton

President, American Society for Metals; Dean of Engineering, Lehigh university, Bethlehem, Pa.

8:00 P.M.

"Increasing Yields of Electric Furnaces (Electric Steel Manufacture)"
"Doing More with Low-Alloy and Carbon Steels by Use of Special Additions in Steel Manufacture (Intensifiers)"
"Recruiting, Training and Handling Inspectors of Metallurgical Material"

Thursday, Oct. 15

2:00 P.M.

"Speeding the Job by Better Production Heating for Softening"
"Better Use of Secondary Metals"

4:00 P.M.

"Programs for Segregation, Collection and Reclamation of Metal Scrap"

7:00 P.M.—HOTEL STATLER BALLROOM

Annual Banquet of the American Society for Metals

Friday, Oct. 16

2:00 P.M.

"Speeding the Job by Better and Faster Production Hardening"
"Getting By with Low-Tin Alloys"

4:00 P.M.

"Methods and Materials for Surface Protection"

TECHNICAL PROGRAM

Headquarters—Hotel Statler

Monday, Oct. 12

9:30 A.M.—Lattice Room

"Effect of Elements in Solid Solution on Hardness and Response to Heat Treatment of Iron Binary Alloys", by C. R. Austin, Pennsylvania State college, State College, Pa.

"Third Element Effects on Hardenability of a Pure Hyper-Eutectoid Iron-Carbon Alloy", by C. R. Austin and T. A. Prater, Pennsylvania State college, State College, Pa., and W. G. Van Note, North Carolina State college, Raleigh, N. C.

"The Ar^3 Range in Some Iron-Cobalt-Tungsten Alloys", by W. P. Sykes, General Electric Co., Schenectady, N. Y.

9:30 A.M.—Parlors 1, 2 and 3

"The Effect of Hardness on the Machinability of Six Alloy Steels", by O. W. Boston and L. V. Colwell, University of Michigan, Ann Arbor, Mich.

"Carburizing Characteristics of 0.20 Per Cent Carbon Alloy and Plain Carbon Steels", by G. K. Manning, Republic Steel Corp., Cleveland.

"The Metallography of Galvanized Sheet Steel Using a Specially Prepared Polishing Medium with Controlled pH", by D. H. Rowland and O. E. Romig, Carnegie-Illinois Steel Corp., Pittsburgh.

9:30 A.M.—Grand Ballroom

"Bursting Tests on Notched Alloy Steel Tubing", by G. Sachs and J. D. Lubahn, Case School of Applied Science, Cleveland.

"Notched Bar Tensile Tests on Heat Treated Low Alloy Steels", by G. Sachs and J. D. Lubahn, Case School of Applied Science, Cleveland.

"Stress-Strain Measurements in the Drawing of Cylindrical Cups", by E. L. Bartholomew Jr., Massachusetts Institute of Technology, Cambridge, Mass.

"Fatigue Strength of Normalized and Tempered Versus As-Forged Full Size Railroad Car Axles", by O. J. Horger and T. V. Buckwalter, Timken Roller Bearing Co., Canton, O.

5:00 P.M.—Public Auditorium

Educational Course

"Tool Steels", by J. P. Gill, Vanadium-Alloys Steel Co., Latrobe, Pa.

Tuesday, Oct. 13

9:30 A.M.—Lattice Room

"The End-Quench Test: Reproducibility", by Morse Hill, Wright Field, Dayton, O.

"The End-Quench Test: Hardenability of Aircraft Steels and Its Representation", by Morse Hill, Wright Field, Dayton, O.

"Hardenability Control of a One Per Cent Carbon Steel", by G. R. Barrow and Gilbert Soler, Timken Roller Bearing Co., Canton, O.

9:30 A.M.—Grand Ballroom

"The Alpha Iron Lattice Parameter as Affected by Molybdenum, and an Introduction to the Problem of the Partition of Molybdenum in Steel", by F. E. Bowman, R. M. Parke and A. J. Herzig, Climax Molybdenum Co., New York.

John Chipman

Edward De Mille Campbell Memorial Lecturer for 1942; Massachusetts Institute of Technology, Cambridge, Mass.

"The Effect of Molybdenum on the Isothermal, Subcritical Transformation of Austenite in Eutectoid and Hyper-Eutectoid Steels", by J. R. Blanchard, R. M. Parke and A. J. Herzig, Climax Molybdenum Co., New York.

"The Effect of Molybdenum on the Rate of Diffusion of Carbon in Austenite", by J. L. Ham, R. M. Parke and A. J. Herzig, Climax Molybdenum Co., New York.

9:30 A.M.—Parlors 1, 2 and 3

"The Method of Thin Films for the Study of Intermetallic Diffusion and Chemical Reactions at Metallic Surfaces", by H. S. Coleman and H. L. Yeagley, Pennsylvania State college, State College, Pa.

"On the Location of Flaws by Stereo-Radiography", by James Rigbey, Ford Motor Co. of Canada, Windsor, Ont.

"The Fluorescent Penetrant Method of Detecting Discontinuities", by Taber de Forest, Magnaflux Corp., Chicago.

5:00 P.M.—Public Auditorium

Educational Course

"Tool Steels", by J. P. Gill, Vanadium-Alloys Steel Co., Latrobe, Pa.

Wednesday, Oct. 14

9:00 A.M. Grand Ballroom

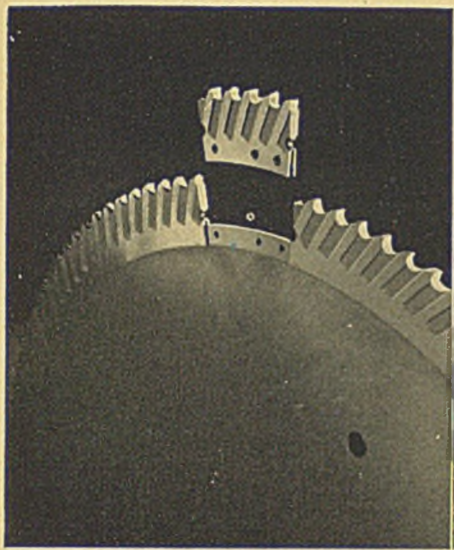
Business Meeting

1942 Edward De Mille Campbell Memorial Lecture, by John Chipman, Massachusetts Institute of Technology, Cambridge, Mass.

5:00 P.M.—Public Auditorium

Educational Course

"Tool Steels", by J. P. Gill, Vanadium-Alloys Steel Co., Latrobe, Pa.



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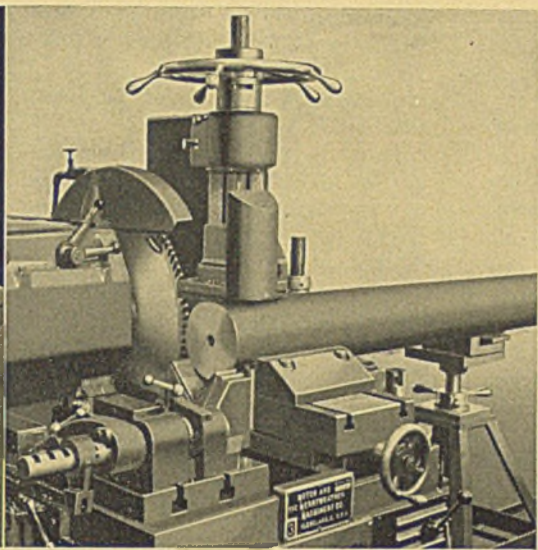

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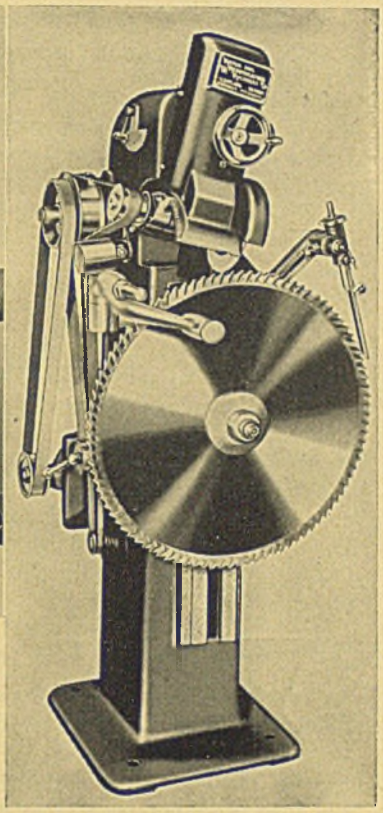

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Thursday, Oct. 15

9:30 A.M.—Grand Ballroom

"A Metallographic Study of the Formation of Austenite from Aggregates of Ferrite and Cementite in an Iron-Carbon Alloy of 0.5 Per Cent Carbon", by T. G. Digges and S. J. Rosenberg, National Bureau of Standards, Washington.

"Influence of Initial Structure and Rate of Heating on the Austenitic Grain Size of 0.5 Per Cent Carbon Steels and Iron-Carbon Alloy", by T. G. Digges and S. J. Rosenberg, National Bureau of Standards, Washington.

"The Mechanism and the Rate of Formation of Austenite from Ferrite-Cementite Aggregates", by G. A. Roberts, Vanadium-Alloys Steel Co., Latrobe, Pa., and R. F. Mehl, Carnegie Institute of Technology, Pittsburgh.

9:30 A.M.—Parlors 1, 2 and 3

"The Tantalum-Carbon System", by F. H. Ellinger, General Electric Co., Schenectady, N. Y.

"Influence of Strain Rate on Strength and Type of Failure of Carbon-Molybdenum Steel at 850, 1000 and 1100 Degrees Fahr.", by R. F. Miller and G. V. Smith, United States Steel Corp., New York, and G. L. Kehl, Columbia university, New York.

"Rupture Tests at 200 Degrees Cent. on Some Copper Alloys", by E. R. Parker and C. Ferguson, General Electric Co., Schenectady, N. Y.

9:30 A.M.—Lattice Room

"Corrosion of Water Pipes in a Steel Mill", by C. L. Clark, Timken Roller Bearing Co., Canton, O., and W. J. Nungester, University of Michigan, Ann Arbor, Mich.

"A Study of the Iron-Rich Iron-Manganese Alloys", by A. R. Troiano and F. T. McGuire, University of Notre Dame, Notre Dame, Ind.

"The Induction Furnace as a High-Temperature Calorimeter and the Heat of Solution of Silicon in Liquid Iron", by John Chipman and N. J. Grant, Massachusetts Institute of Technology, Cambridge, Mass.

5:00 P.M.—Public Auditorium

Educational Course

"Tool Steels", by J. P. Gill, Vanadium-Alloys Steel Co., Latrobe, Pa.

7:00 P.M.—Ballroom, Hotel Statler

Annual Banquet

Friday, Oct. 16

9:30 A.M.—Grand Ballroom

"The Hardening of Tool Steels", by Peter Payson and J. L. Klein, Crucible Steel Co. of America, New York.

"The Kinetics of Austenite Decomposition in High Speed Steel", by Paul Gordon and Morris Cohen, Massachusetts Institute of Technology, Cambridge, Mass., and R. S. Rose, Vanadium-Alloys Steel Co., Latrobe, Pa.

"The Tempering of Two High-Carbon High-Chromium Steels", by Otto Zmeskal, Illinois Institute of Technology, Chicago, and Morris Cohen, Massachusetts Institute of Technology, Cambridge, Mass.

9:30 A.M.—Parlors 1, 2 and 3

"Some Aspects of Strain Hardenability of Austenitic Manganese Steel", by D. Niconoff, Republic Steel Corp., Cleveland.

"The Precipitation Reaction in Aged Cold-Rolled One Per Cent Cd-Cu: Its Effects on Hardness, Conductivity and Tensile Properties", by R. H. Harrington and L. E. Cole, General Electric Co., Schenectady, N. Y.

"The Effect of Moderate Cold Rolling on the Hardness of the Surface Layer of 0.34 Per Cent Carbon Steel Plates", by Harry K. Herschman, National Bureau of Standards, Washington.

9:30 A.M.—Lattice Room

"The Metallography of Commercial Magnesium Alloys", by J. B. Hess and P. F. George, Dow Chemical Co., Midland, Mich.

"Study of Inverse Segregation Suggests New Method of Making Certain Alloys", by M. L. Samuels, A. R. Elsea and K. Grube, Battelle Memorial Institute, Columbus, O.

"Effects of Various Solute Elements on the Hardness and Rolling Texture of Copper", by R. M. Brick, Yale university, New Haven, Conn.; D. L. Martin, General Electric Co., Schenectady, N. Y.; and R. P. Angier, Handy & Harman, New York.

5:00 P.M.—Public Auditorium

Educational Course

"Tool Steels", by J. P. Gill, Vanadium-Alloys Steel Co., Latrobe, Pa.

TECHNICAL PROGRAM

Headquarters—Hotel Carter

Monday, Oct. 12

10:30 A.M.

Directors' Meeting

12 Noon

Program Committee Lunch

2:30 P.M.

H. H. Timbers, contract license manager, Western Electric Co., New York, Chairman.

Opening Address by Carl E. Johnson, president of the Wire Association.

"The Wire Industry's Part in Industrial Conservation", by Ivon B. Tilyou, assistant utility co-ordinator, Industrial Salvage Section, War Production Board, Washington.

"Mines Above Ground—Conservation of Scrap and Waste Material", motion picture by Western Electric Co., New York.

"Substitute Materials", by speaker from Bell Telephone Laboratories, New York.

Tuesday, Oct. 13

9:30 A.M.

Earle H. Thomas, superintendent, George W. Prentiss Co., Holyoke, Mass., Chairman.

"Reducing Accidents in Wire and Wire Products Operations", by R. H. Ferguson, manager of safety, Republic Steel Corp., Cleveland.

"Scheduling and Planning the Wire Mill for War Production", by L. D. Seymour, assistant works manager, Canada Works, Steel Co. of Canada Ltd., Hamilton, Ont., Canada.

1:00 P.M.

Annual Luncheon

Address by Dr. Charles Copeland Smith, National Association of Manufacturers, New York.

4:00 P.M.

Business Meeting

Carl E. Johnson, president, the Wire Association, Chairman.

Wednesday, Oct. 14

9:45 A.M.

W. H. Crawford, resident manager, Eaton Mfg. Co., Massillon, O., Chairman.

"Tungsten Carbide Applications", by A. MacKenzie, vice president in charge of manufacturing, Carboloy Co. Inc., Detroit.

Mordica Memorial Lecture

"Steel and Wire", by Louis H. Winkler, metallurgical engineer, Bethlehem Steel Co., Bethlehem, Pa.

2:00 P.M.

W. B. Farnsworth, chief metallurgist, Pittsburgh Steel Co., Monessen, Pa., Chairman.

"Trouble Shooting on Bronze and Steel Weaving Wire", by L. D. Granger, assistant to vice president, Wickwire Spencer Steel Co., New York.

"Welding Electrodes", by Dr. John W. Miller, metallurgist, Reid-Avery Co., Dundalk, Baltimore.

7:30 P.M.

Annual Dinner—Stag Smoker

Thursday, Oct. 15

9:45 A.M.

A. E. Glen, assistant general manager of sales, Carboloy Co. Inc., Detroit, Chairman.

"Pickling of Rod and Wire", by Walter G. See, sales and service manager, Submerged Combustion Co. of America, Hammond, Ind.

"Electric Patenting of Wire", by John P. Zur, metallurgical engineer, Trauwood Engineering Co., Cleveland.

1:30 P.M.

Plant Inspection—Electric Patenting of Wire.

7:00 P.M.—BALLROOM, HOTEL STATLER

American Society for Metals Dinner.

TECHNICAL PROGRAM

Headquarters—Hotel Statler

Monday, Oct. 12

Institute of Metals Division

AFTERNOON

Copper-Base Alloys

Carl E. Swartz and F. N. Rhines, Chairmen.

"Phase Diagram of the Copper-Iron-Silicon System From 90 Per Cent to 100 Per Cent Copper", by A. G. H. Andersen, metallurgical engineer, Oakdale, N. Y.; and W. A. Kingsbury, research metallurgist, Phelps Dodge Corp., New York.

"Internal Friction of an Alpha Brass Crystal", by Clarence Zener, associate professor of physics, Washington State College, Pullman, Wash.; now at Watertown Arsenal, Watertown, Mass.

"Note on Some Hardness Changes That Accompany the Ordering of Beta Brass", by Cyril Stanley Smith, research supervisor, War Metallurgy Committee, National Academy of Sciences, National Research Council.

Iron and Steel Division

AFTERNOON

Magnetite Reduction: Chromizing: Weldability

L. S. Bergen and A. B. Kinzel, Chairmen.

"A Study of Low-Temperature Gaseous Reduction of a Magnetite", by M. C. Udy and C. H. Lorig, Battelle Memorial Institute, Columbus, O.

"Chromizing of Steel", by I. R. Kramer and Robert H. Hafner, Division of Physical Metallurgy, Naval Research Laboratory, Anacostia station, Washington, D. C.

"Calculated Hardenability and Weldability of Carbon and Low-Alloy Steels", by C. E. Jackson and G. G. Luther, Division of Physical Metallurgy, Naval Research Laboratory, Anacostia station, Washington, D. C.

Tuesday, Oct. 13

Institute of Metals Division

MORNING AND AFTERNOON

Symposium on Rare and Precious Metals

W. P. Sykes and T. A. Wright, Chairmen (Morning).

E. M. Wise and C. B. Sawyer, Chairmen (Afternoon).

"Rare Metals and the War Effort", by W. P. Sykes, consultant, Conservation Division, War Production Board, Washington.

"The Rare Metals and Why They Are Rare", by R. S. Dean, assistant director, United States Bureau of Mines, Washington.

"The Use of Silver During the Emergency", by R. H. Leach, vice president, and John L. Christie, metallurgical manager, Handy & Harman, New York.

"The Effect of Certain Elements on the Rate of Tarnishing of Silver Alloys", by W. E. Campbell, research chemist, Bell Telephone Laboratories, New York.

"Bismuth Solders and Other New Applications of Bismuth", by A. J. Phillips, superintendent, Research Department, American Smelting & Refining Co., New York.

"Elements A La Carte: A Summary of the Status of Artificially Produced Elements and Some of Their Applications", by K. K. Darrow, physicist, Bell Telephone Laboratories, New York.

"Rare Elements in the Electrical Industry", by Porter H. Brace, consulting metallurgist, Research Laboratory, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

"Rare Elements in the Glass Industry", by M. B. Vilensky, chief metallurgist, Owens-Corning Fiberglas Corp., Toledo, O.

"Notes on Refractory Metal-Base Compound Materials", by G. G. Goetzel,

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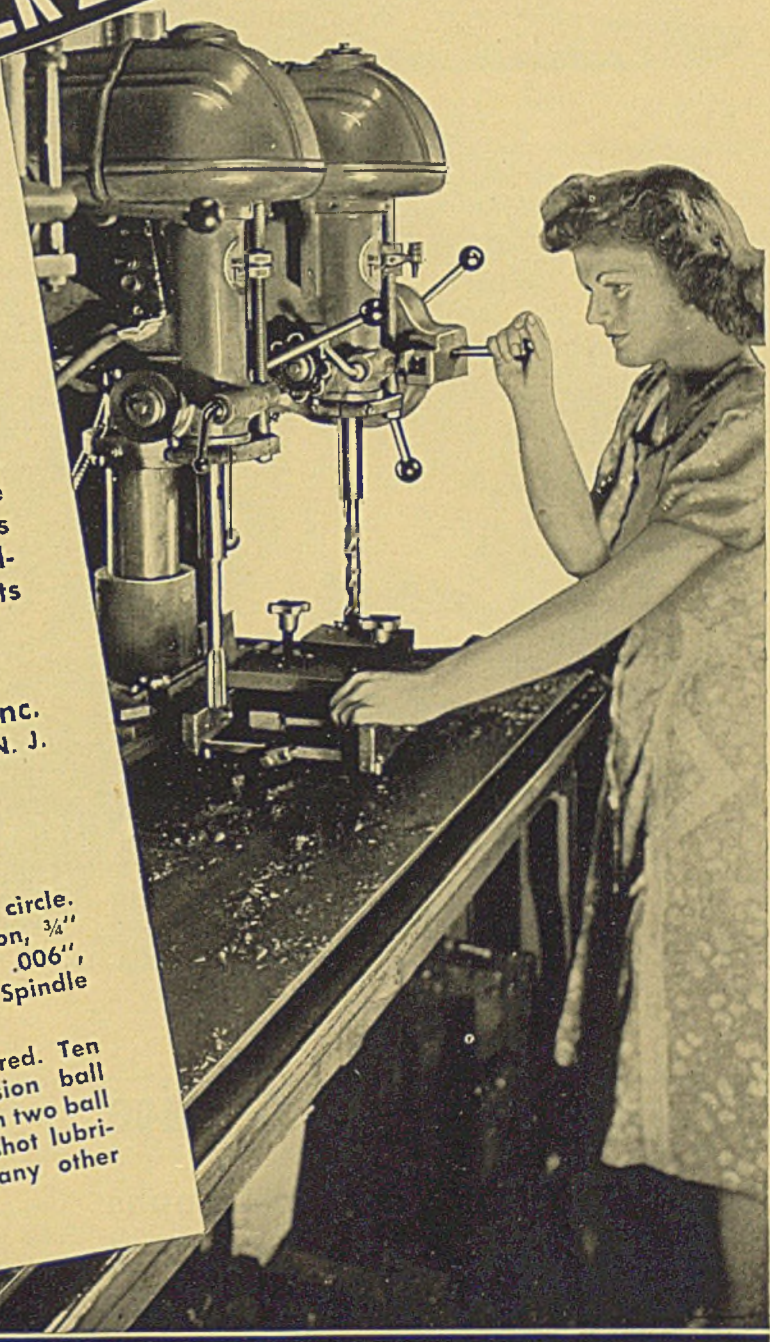

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"Time-To-Fracture Tests on Platinum, Platinum-Iridium, and Platinum-Rhodium Alloy", by H. E. Stauss, research physicist, Baker & Co. Inc., Newark, N. J.

Iron and Steel Division

MORNING

Tensile Properties and Hardenability

J. Hunter Nead and G. R. Brophy, Chairmen.

"True Stress-Strain Relations at High Temperatures by the Two-Load Method", by C. W. MacGregor, associate professor of applied mechanics, Massachusetts Institute of Technology, Cambridge, Mass.; and L. E. Welsh, engineer, Bakelite Corp., New York.

"The Calculation of the Tensile Strength of Normalized Steels from Chemical Composition", by F. M. Walters Jr., director of physical metallurgy, Naval Research Laboratory, Anacostia station, Washington, D. C.

"Effect of Silicon on Hardenability", by Walter Crafts and J. L. Lamont, Union Carbide & Carbon Research Laboratory Inc., Niagara Falls, N. Y.

NOON

Executive Committee Luncheon

AFTERNOON

Open Hearth Steel

Frank G. Norris and Gilbert Soler, Chairmen.

"Duplex Process for Manufacture of Basic Open-Hearth Steel", by H. B. Emerick and S. Feigenbaum, metallurgical department, Jones & Laughlin Steel Corp., Pittsburgh.

"The Effects of Tin on the Properties of Plain Carbon Steel", by J. W. Halley, metallurgist, Inland Steel Co., Chicago.

"Cause of Bleeding in Ferrous Castings", by C. A. Zappfe, research metallurgist, Battelle Memorial Institute, Columbus, O.

Metals Divisions

EVENING—EUCLID BALLROOM

Annual Dinner

Carl E. Swartz, chairman, Institute of Metals Division, Toastmaster.

Earle C. Smith, chairman, Iron and Steel Division, Speaker.

Wednesday, Oct. 14

Institute of Metals Division

NOON

Executive Committee Luncheon

AFTERNOON

Aluminum, Magnesium and Lead

E. E. Schumacher and Dana W. Smith, Chairmen.

"The Rate of Precipitation of Silicon from the Solid Solution of Silicon in Aluminum", by L. K. Jetter, Aluminum Research Laboratory, Aluminum Co. of America, Pittsburgh, and Robert F. Mehl, Department of Metallurgy, Carnegie Institute of Technology, Pittsburgh.

"Equilibrium Diagrams and Lattice Spacing Relationships in the Systems Magnesium - Tin and Magnesium-Lead", by Geoffrey V. Raynor, Inorganic Chemistry Laboratory, University Museum, Oxford, England.

"Constitution of Lead-Rich Lead-Antimony Alloys", by W. S. Pellini, research assistant, and F. N. Rhines, member of staff and assistant professor of Metallurgy, Metals Research Laboratory, Carnegie Institute of Technology, Pittsburgh.

Iron and Steel Division

AFTERNOON

Physical Chemistry of Steelmaking

Charles H. Herty Jr. and W. O. Philbrook, Chairmen.

"Silicon: Oxygen Equilibria in Liquid Iron", by C. A. Zappfe, research metallurgist, and C. E. Sims, supervising metallurgist, Battelle Memorial Institute, Columbus, O.

"Equilibria of Liquid Iron and Simple Basic and Acid Slags in a Rotary Induction Furnace", by C. R. Taylor, research engineer, American Rolling Mill Co., Middletown, O.; and John Chipman, professor of metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

Thursday, Oct. 15

Iron and Steel Division

NOON

Physical Chemistry of Steelmaking Committee Luncheon

TECHNICAL PROGRAM

Headquarters, Hotel Cleveland

Monday, Oct. 12

9:30 A.M.—BALLROOM

Opening Session

G. F. Jenks, president, American Welding Society, Chairman; E. V. David, chairman of Convention Committee, Vice Chairman.

Presentation of Medals and Prizes

10:15 A.M.—BALLROOM

Training of Welding Operators and Qualifications

K. L. Hansen, Harnischfeger Corp., Milwaukee, Chairman; E. T. Scott, Cleveland School of Welding, Cleveland, Vice Chairman.

"Training of Welding Foremen", by F. H. Achard, supervisor of training, Consolidated Edison Co. of New York Inc., New York.

"Instruction Methods in Welding Developed by United States Office of Education", by H. K. Hogan, United States Office of Education, Washington.

12:00 Noon

Opening Metals Exposition

2:00 P. M.—RED ROOM

Fatigue and Impact

A. E. Gibson, Wellman Engineering Co., Cleveland, Chairman; F. L. Plummer, Hammond Iron Works, Warren, Pa., Vice Chairman.

"Fatigue Strength of Metal Subjected to Combined Stresses", by L. H. Donnell, Illinois Institute of Technology, Chicago.

"Fatigue Strength of Commercial Butt Welds in Carbon Steel Plates", by W. M. Wilson, University of Illinois, Urbana, Ill.

"Fatigue Tests of Full Thickness Plates with and Without Butt Welds", by

E. C. Huge, Babcock & Wilcox Co., New York.

"Impact Strength of High Alloy Steel Welds", by E. C. Chapman, Combustion Engineering Co., Chattanooga, Tenn.

2:00 P.M.—Ballroom

War Production

R. J. Kriz, James H. Herron Co., Cleveland, Chairman; A. F. Davis, Lincoln Electric Co., Cleveland, Vice Chairman.

"Some Special Applications of Flame Hardening", by Stephen Smith, Air Reduction Sales Co., New York.

"High Quality Welding—Vertical and Overhead Positions with Alternating Current", by H. O. Westendarp, General Electric Co., Schenectady, N. Y.

"Conservation and Effective Use of Equipment and Supplies for Welding and Cutting", by H. Ullmer, The Linde Air Products Co., New York.

"Welding Gun Mounts", by W. B. Lair, York Safe & Lock Co., York, Pa.

6:30 P.M.—Rose Room

Industrial Research Dinner

7:30 P.M.—Red Room

Motion Picture Films

"The Inside of Welding", by General Electric Co., Schenectady, N. Y.

"The Welding of Aluminum", by Aluminum Co. of America, Pittsburgh.

"The Welding Technique", by Oklahoma Agricultural and Mechanical college, Stillwater, Okla.

Tuesday, Oct. 13

9:30 A.M.—Ballroom

Weldability of Steel

A. B. Kinzel, Union Carbide & Carbon Research Laboratories, New York, Chairman; A. E. Marble, Firestone Tire & Rubber Co., Akron, O., Vice Chairman.

"What Happens to Residual Stresses in Service", by J. T. Norton and D. Rosenthal, Massachusetts Institute of Technology, Cambridge, Mass.

"Effects of Cooling Rate on the Properties of Arc Welded Joints", by W. F. Hess, Rensselaer Polytechnic Institute, Troy, N. Y.

"Weld Quench Gradient Tests", by W. H. Bruckner, University of Illinois, Urbana, Ill.

9:30 A.M.—Red Room

Aircraft Welding (Fuselage)

P. H. Merriman, Glenn L. Martin Co., Baltimore, Chairman; J. F. Maine, Republic Structural Iron Works, Cleveland, Vice Chairman.

"Welding of Airplane Propeller Blades", by C. A. Liedholm, Curtiss-Wright Corp., New York.

"Welding of New Types of Alloy Steels for Aircraft Structures", by A. R. Lytle and K. H. Koopman, Union Carbide & Carbon Research Laboratories, New York.

"Effect of Current on the Welding of X4130 Sheet and Tubing", by W. T. Tiffin, University of Oklahoma, Norman, Okla.

2:00 P.M.—Ballroom

Weldability of Steel

C. H. Jennings, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Chairman; G. B. Carson, Case School of Applied Science, Cleveland, Vice Chairman.

"Weldability of Carbon-Manganese Steels", by O. E. Harder and C. B. Voldrich, Battelle Memorial Institute, Columbus, O.

"Weldability Tests of Carbon-Manganese Steels", by C. E. Jackson, M. A. Pugacz and G. G. Luther, Naval Research Laboratory, Anacostia Station, Washington, D. C.

"Jominy End Quench Hardenability Tests on Carbon-Manganese Steels", by G. A. Timmons, Climax Molybdenum Co., New York.

"Tee-Bend Tests on Carbon-Manganese Steels", by L. C. Bibber and J. Heuschkel, Carnegie-Illinois Steel Corp., Pittsburgh.

2:00 P.M.—Assembly Room B

Aircraft Welding (Sheet)

G. O. Hoglund, Aluminum Co. of America, New Kensington, Pa., Chairman; John D. Gordon, Taylor-Winfield Corp., Warren, O., Vice Chairman.

"Spot Welding in Aircraft Structures", by E. S. Jenkins, Curtiss-Wright Corp., New York.

"Standards and Recommended Practices and Procedures for Spot Welding Aluminum Alloys", by G. S. Mikhalapov, Taylor-Winfield Corp., Warren, O.; chairman of Aircraft Welding Standards Committee.

"Arc Welding of Magnesium Alloys", by W. S. Loose and A. R. Orban, Dow Chemical Co., Midland, Mich.

"Welding—Its Application to Aircraft", by Francis H. Stevenson, Vega Aircraft Corp., Glendale, Calif.

2:00 P.M.—Red Room

Gas Cutting

J. R. Dawson, Union Carbide & Carbon Research Laboratories, Niagara Falls, N. Y., Chairman; O. L. Smith, Weldit Acetylene Co., Detroit, Vice Chairman.

"Gas Cutting in Steel Mills", by S. D. Baumer, Air Reduction Sales Co., New York.

"Improved Methods of Machine Flame Cutting", by H. E. Rockefeller, The Linde Air Products Co., New York.

"Gas Cutting in Shipbuilding", by R. F. Helmkamp, Air Reduction Sales Co., New York.

7:30 P.M.—Red Room

Fundamental Research Conference

H. C. Boardman, Chicago Bridge & Iron Co., Chicago, Chairman.

Wednesday, Oct. 14

9:30 A.M.—Assembly Room B

Resistance Welding

G. N. Sieger, S-M-S Corp., Detroit, Chairman; B. L. Wise, Federal Machine & Welder Co., Warren, O., Vice Chairman.

"Refrigerant Cooled Spot Welding Electrodes", by F. R. Hensel, E. I. Larsen and E. F. Holt, P. R. Mallory & Co., Indianapolis.

"Spot Welding of 0.040-Inch Thickness SAE X4130 Steel", by W. F. Hess and D. C. Herrschaft, Rensselaer Polytechnic Institute, Troy, N. Y.

"Unusual Resistance Welding Developments and Operations", by R. T. Gillette, General Electric Co., Schenectady, N. Y.

"Resistance Welding Trench Mortar Fin Assembly", by J. H. Cooper, Taylor-Winfield Corp., Warren, O.

9:30 A.M.—Red Room

Production Welding

O. B. J. Fraser, International Nickel Co., New York, Chairman; D. H. Corey, Detroit Edison Co., Detroit, Vice Chairman.

"Welding with Aluminum Bronze", by Clinton E. Swift, Ampco Metal Inc., Milwaukee.

"Adapting Automatic Electric Welding to Routine Production", by J. M. Keir, The Linde Air Products Co., New York.

"Welded Steel Tube and Its Application in War Production", by H. S. Card, Formed Steel Tube Institute, New York.

2:00 P.M.—Assembly Room B

Resistance Welding

R. E. Powell, Western Electric Co., Kearny, N. J., Chairman; J. D. Tebben, P. R. Mallory & Co., Indianapolis, Vice Chairman.

"The Spot Welding of NAX High Tensile Steel", by C. R. Schroder, Great Lakes Steel Corp., Ecorse, Mich.

"Application of Copper Oxide Rectifiers for Resistance Welding", by R. L. Briggs, Thomson-Gibb Electric Welding Co., Lynn, Mass.

"The Effect of Weld Spacing on the Strength of Spot-Welded Joints", by

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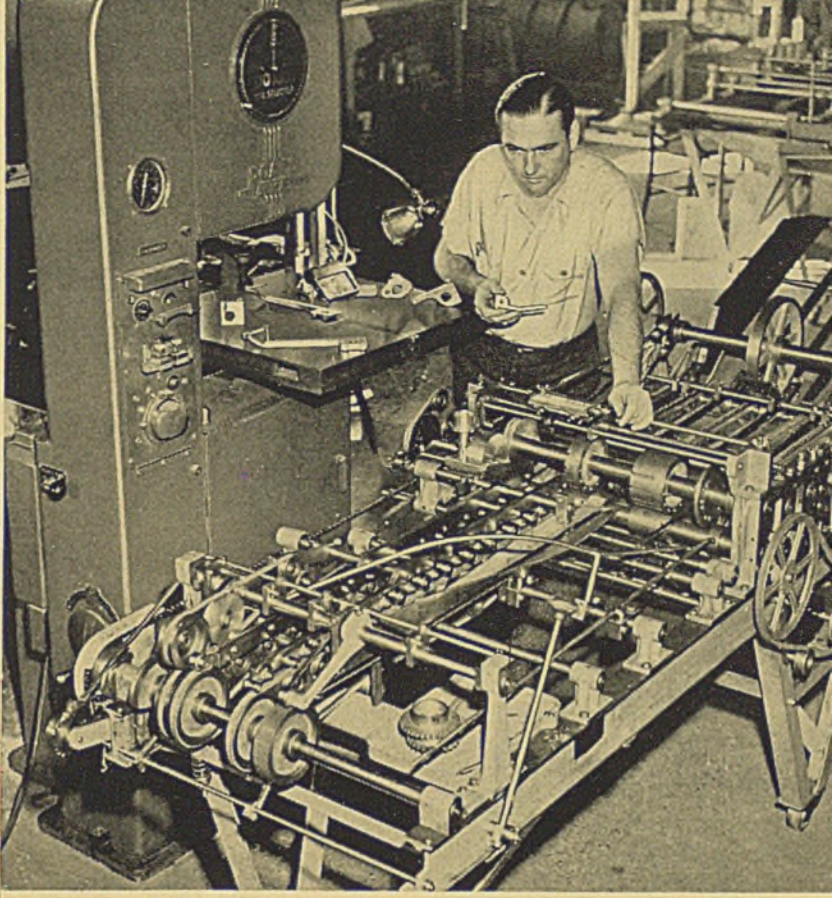

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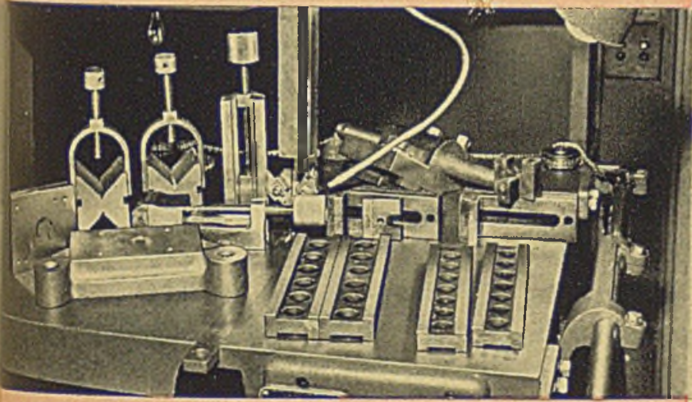

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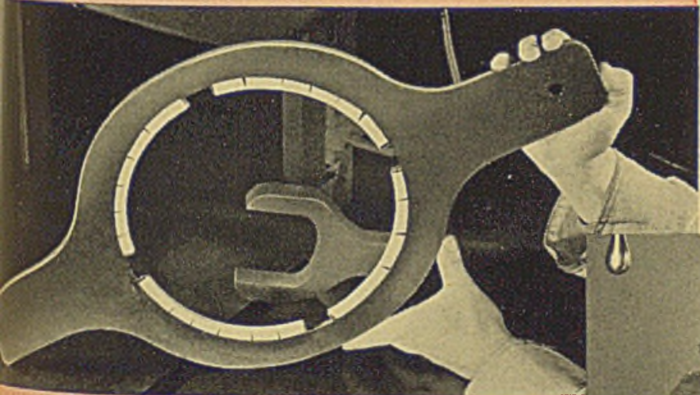

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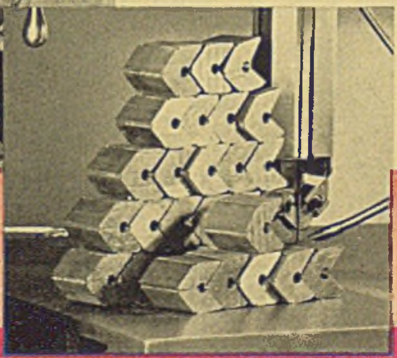

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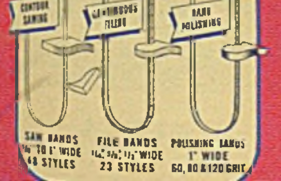

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STRIP-OUT CONTAINER

R. Della-Vedowa and M. M. Rockwell, Lockheed Aircraft Corp., Burbank, Calif.

"Preparation of Aluminum Alloy for Spot Welding", by T. E. Piper, Northrop Aircraft Inc., Hawthorne, Calif.

2:00 P.M.—BALLROOM

Welding and Cutting of Ordnance

H. L. R. Whitney, War Production Board, Washington, Chairman; H. C. Boardman, Chicago Brid_e & Iron Co., Chicago, Vice Chairman.

"Factors Affecting the Accuracy of Ordnance Machine Cutting", by Howard Hughey and H. A. Yoch, Air Reduction Sales Co., Philadelphia.

"Manual and Automatic Welding of Heavy Plate of Hardenable Alloys", by L. A. Danse, Cadillac Motor Car Division, Detroit.

"Developments in Cast Iron Welding Rods and Electrodes", by R. J. Franklin, Chicago Hardware Foundry Co., North Chicago, Ill.

"Electric Welding of Mobile Artillery Gun Carriages", by G. E. Campbell, Pettibone-Mulliken Corp., Chicago.

2:00 P.M.—RED ROOM

Shipbuilding

David Arnott, American Bureau of Shipping, New York, Chairman; A. L. Pfeil, Universal Power Corp., Cleveland, Vice Chairman.

"Suggested Methods Which Will Increase Welding Production and Decrease Welding Costs", by J. F. Lincoln, Lincoln Electric Co., Cleveland.

"Distortion and Shrinkage Problems in Ships and Other Large Structures", by LaMotte Grover, Air Reduction Co., New York.

"Motor Boat Construction and Small Ships", by W. E. Whitehouse, Defoe Shipbuilding Co., Bay City, Mich.

"Application of Welding in Submarine Construction", by E. H. Ewertz, Electric Boat Co., New York; and R. D. West, Manitowoc Shipbuilding Co., Manitowoc, Wis.

7:30 P.M.—ROSE ROOM

Section Officers' Dinner and Conference

Thursday, Oct. 15

9:30 A.M.—RED ROOM

Aircraft Welding

S. L. Hoyt, Battelle Memorial Institute, Columbus, O., Chairman; E. Vom Steeg, General Electric Co., New York, Vice Chairman.

"Utility Characteristics of Aircraft Electrodes", by C. B. Voldrich and R. D. Williams, Battelle Memorial Institute, Columbus, O.

"Results of Survey on Current Arc Welding Practice in Aircraft Industry", by Maurice Nelles, chairman, Western Aircraft Welding Committee.

"Copper Welding for Aircraft", by T. V. Buckwalter, Timken Roller Bearing Co., Canton, O.

9:30 A.M.—ASSEMBLY ROOM B

Non-Destructive Tests and Inspection

J. J. Crowe, Air Reduction Sales Co., New York, Chairman; O. R. Carpenter, Babcock & Wilcox Co., New York, Vice Chairman.

"Correlation of Metallographic and Radiographic Examinations of Spot Welds in Aluminum Alloys", by Dana W. Smith and Fred Keller, Aluminum Co. of America, Pittsburgh.

"The Magnetic Powder Method for Inspecting Weldments and Castings for Sub-Surface Defects", by Carleton Hastings, Watertown Arsenal, Watertown, Mass.

"Radiographic Inspection of Welded Armor Plates and Castings", by Don M. McCutcheon, Ford Motor Co., Dearborn, Mich.

"Visual Inspection of Arc Welds", by W. L. Warner, Watertown Arsenal, Watertown, Mass.

2:00 P.M.—ROSE ROOM

Business Meeting

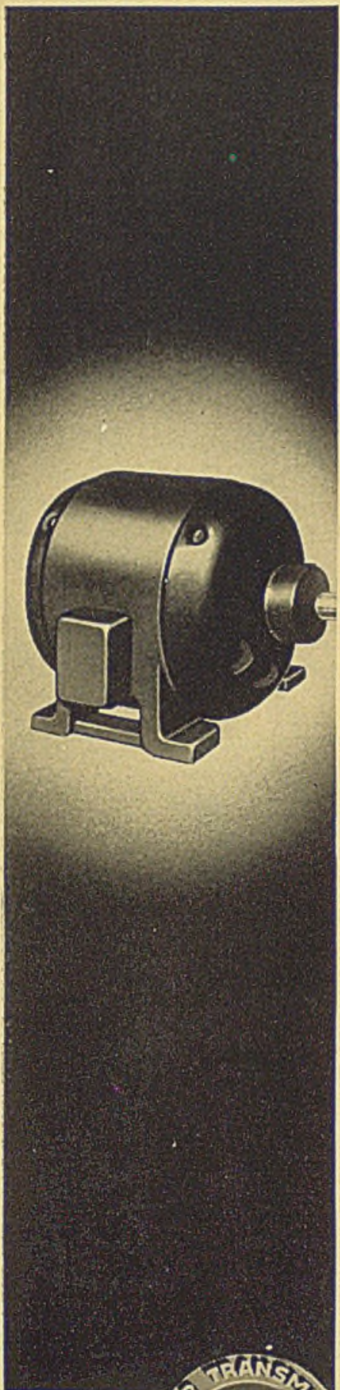
3:00 P.M.—ROOM 1

Board of Directors Meeting

Attempting to raid an R.A.F. desert camp in Libya, this Junkers 88 became a mass of wreckage when shot down by British night fighters. British official photo

In this vital gap . . .

between prime mover and the machine to be operated



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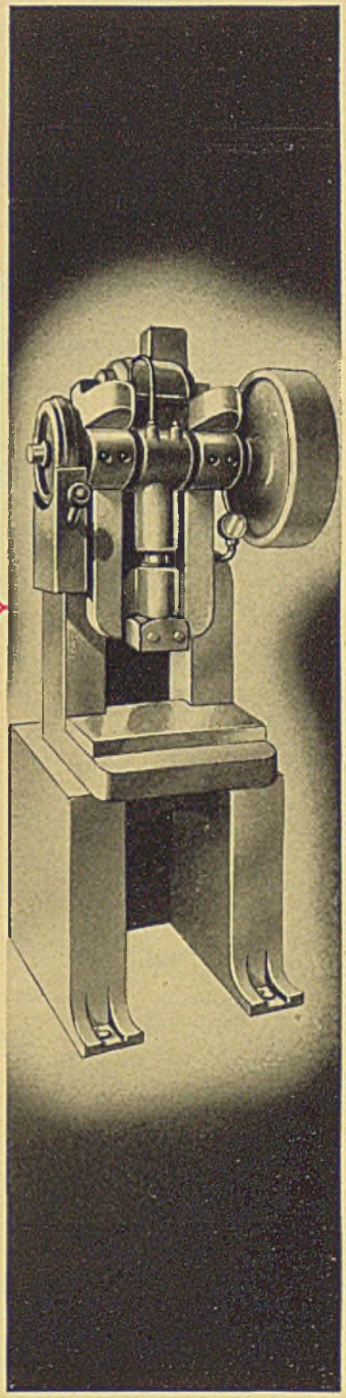

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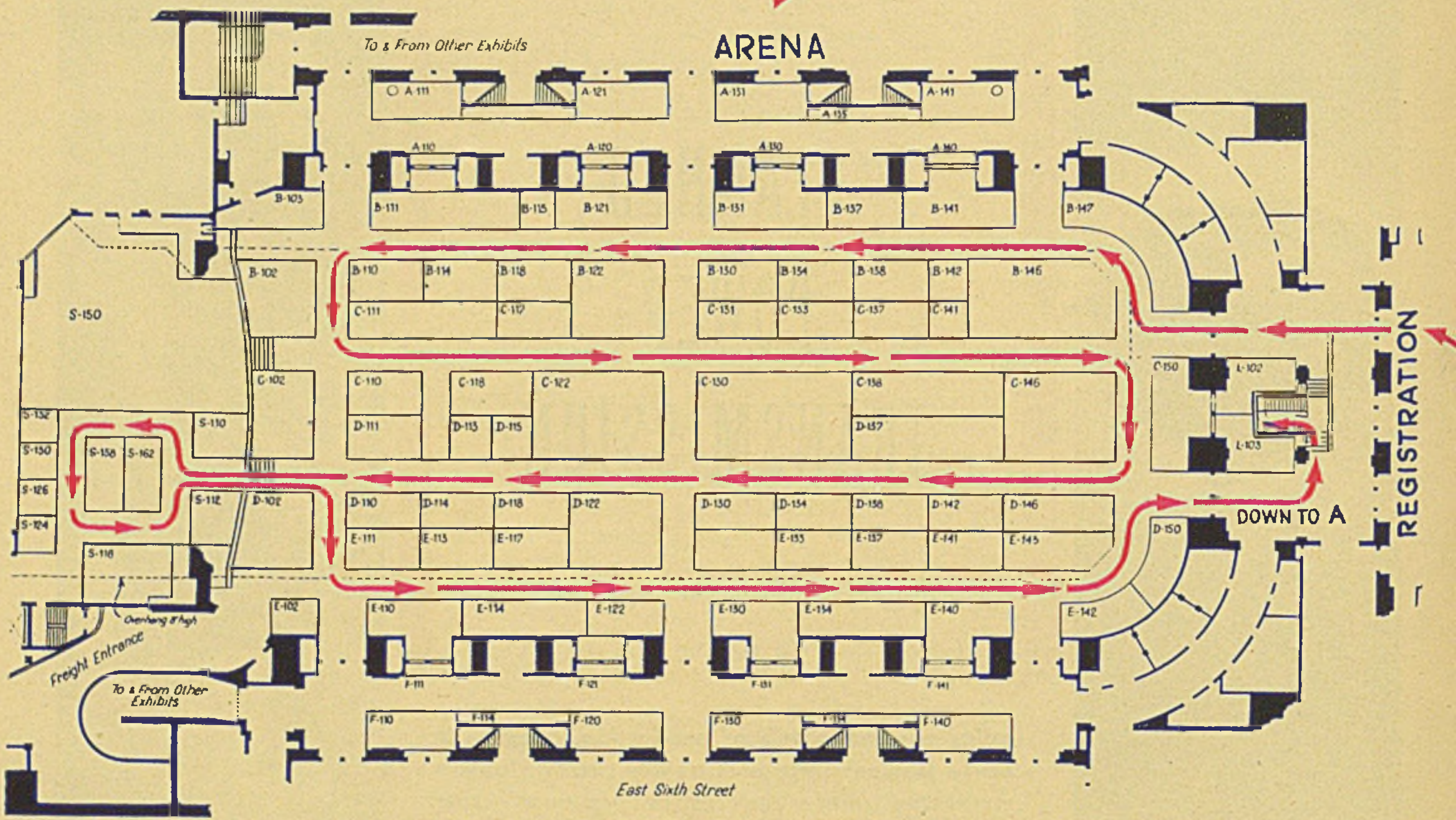
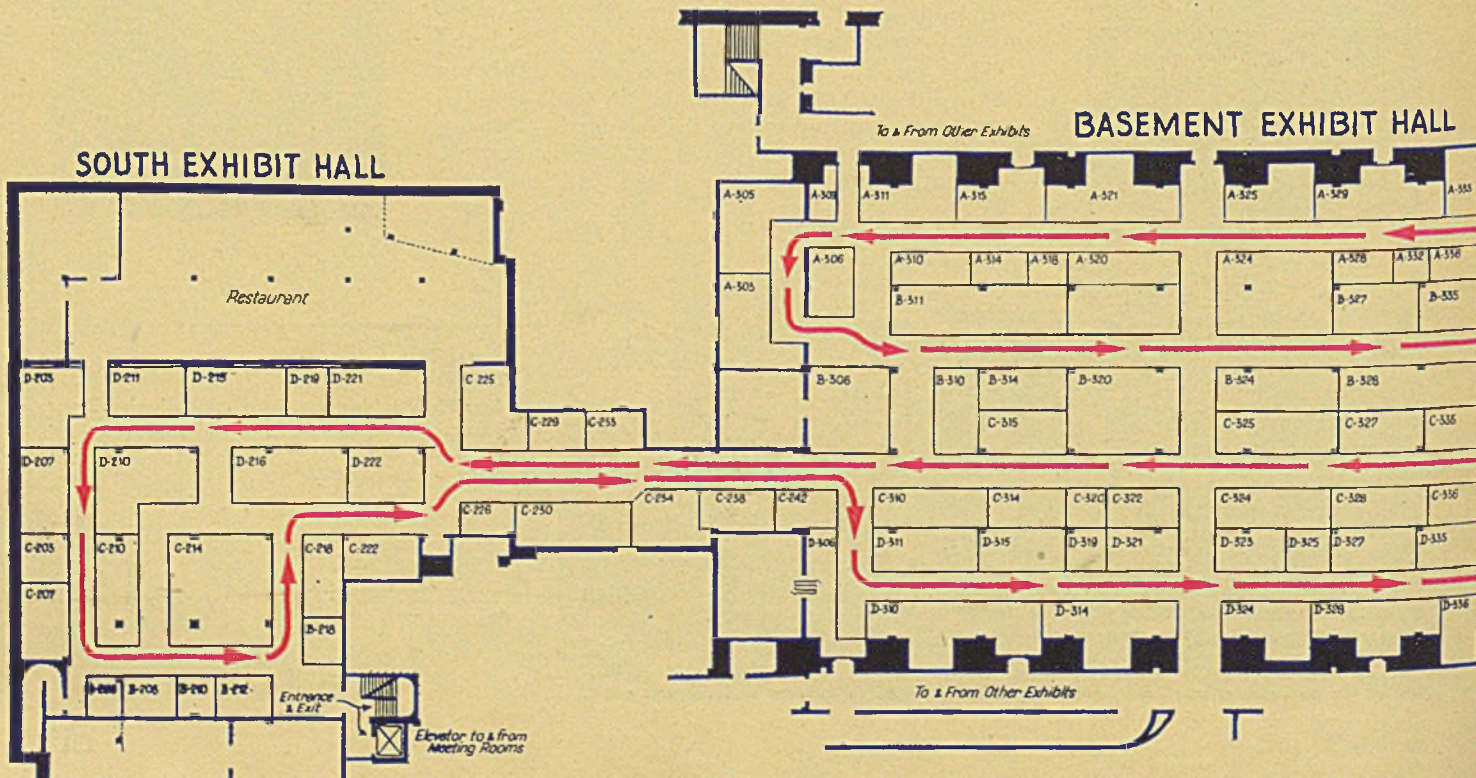


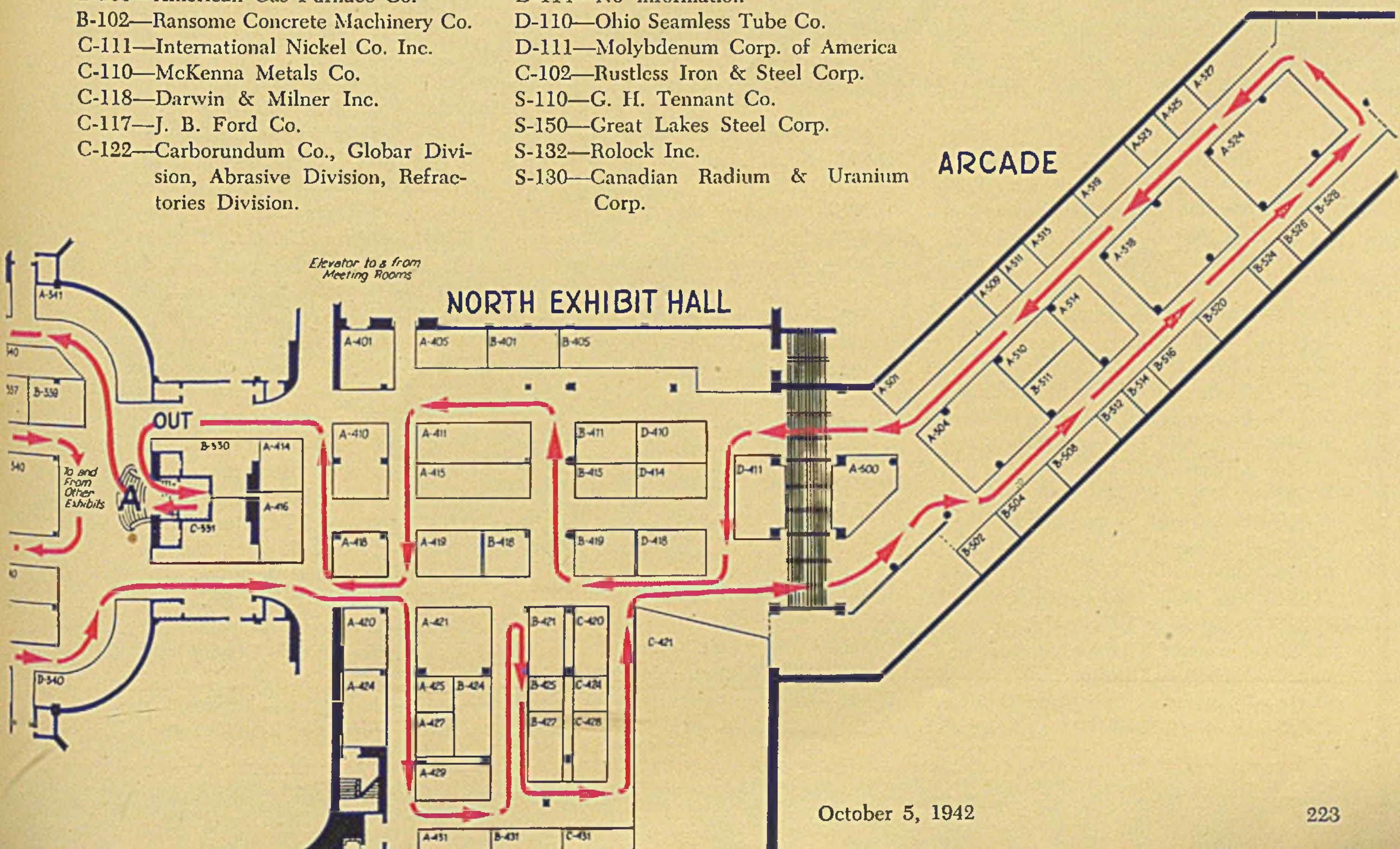


Metal Exposition

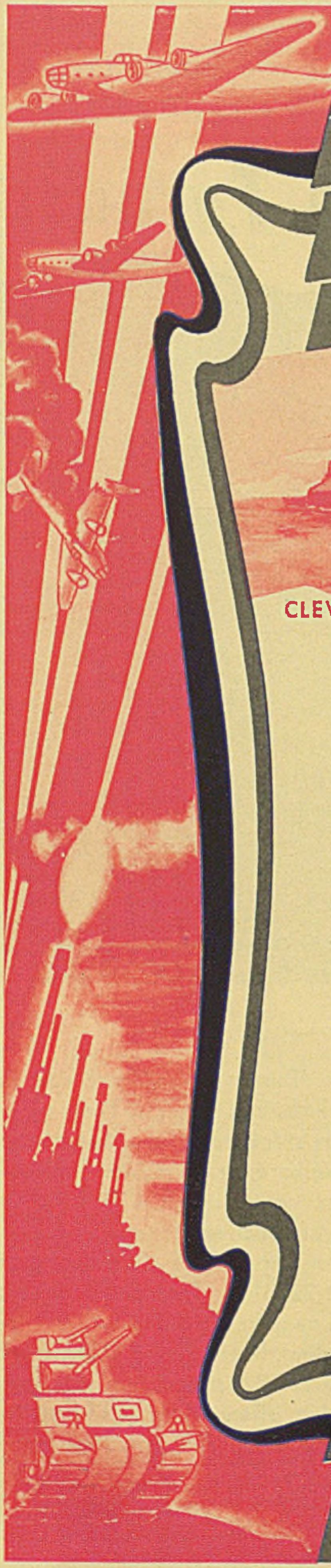
. . . . by taking this course through the exhibits. If you follow the arrows on the above floor plan, you will see the exhibits in the order given below. If you wish to find the location of some particular company's booth, you will find an alphabetical listing on page 227

Enter from Lakeside avenue. Register in lobby. Enter arena by righthand (western) door.

L-102—Chicago Steel Foundry Co.
C-150—Firth-Sterling Steel Co.
B-147—A. F. Holden Co.
B-146—Lindberg Engineering Co.
B-142—Brush Development Co.
B-141—Doall Cleveland Co. Inc.
B-137—Anderson & Brown Co.
B-138—Tempil Corp.
B-134—Parker-Kalon Corp.
B-130—National Machine Works
B-131—Ampco Metal Inc.
B-121—Chilton Co. Inc.
B-122—Picker X-Ray Corp.
B-118—Andrew King
B-115—Sterling Alloys Inc.
B-111—Dow Chemical Co.
B-114—Martindale Electric Co.
B-110—Duraloy Co.
B-103—American Gas Furnace Co.
B-102—Ransome Concrete Machinery Co.
C-111—International Nickel Co. Inc.
C-110—McKenna Metals Co.
C-118—Darwin & Milner Inc.
C-117—J. B. Ford Co.
C-122—Carborundum Co., Globar Division, Abrasive Division, Refractories Division.
C-130—Pangborn Corp.
C-131—Bastian-Blessing Co.
C-133—Continental Industrial Engineers Inc.
C-137—Wilson Mechanical Instrument Co. Inc.
C-141—Behr-Manning Corp.
C-138—Norton Co.
C-146—General Alloys Co.
D-146—Black Drill Co.
D-142—Hevi Duty Electric Co.
D-138—Armstrong Cork Co.
D-137—E. F. Houghton & Co.
D-134—E. I. du Pont de Nemours & Co.
D-130—No information
D-122—Hammond Machinery Builders Inc.
D-118—Surface Combustion Division, General Properties Co. Inc.
D-115—No information
D-113—Atlas Steels Ltd.
D-114—No information
D-110—Ohio Seamless Tube Co.
D-111—Molybdenum Corp. of America
C-102—Rustless Iron & Steel Corp.
S-110—G. H. Tennant Co.
S-150—Great Lakes Steel Corp.
S-132—Rolock Inc.
S-130—Canadian Radium & Uranium Corp.
S-126—C. J. Tagliabue Mfg. Co.
S-124—Gray Machine Co.
S-116—No information
S-158—Welding Engineer Publishing Co.
S-162—Alvey Ferguson Co.
S-112—Park Chemical Co.
D-102—Selas Co.
E-102—Claud S. Gordon Co. of Ohio
E-111—Adolph I. Buehler
E-110—George Scherr & Co.
E-113—Advance Polishing Wheels Inc., Matchless Metal Polish Co.
E-117—Automatic Temperature Control Co. Inc.
E-114—Chicago Flexible Shaft Co., Stewart Industrial Furnace Division,
Kelley-Koett Mfg. Co. Inc.
E-122—Industrial Press
E-130—Kold-Hold Mfg. Co.
E-134—Oakite Products Inc.
E-133—Illinois Testing Laboratories Inc.
E-137—McGraw Hill Publishing Co.
E-141—Spencer Turbine Co.
E-140—Eutectic Welding Alloys Co.
E-143—Penton Publishing Co., (STEEL,



THE FOUNDRY, MACHINE DESIGN, DAILY METAL TRADE, NEW EQUIPMENT DIGEST)
E-142—S. K. Wellman Co.
D-150—Bausch & Lomb Optical Co.
L-103—Conover-Mast Corp.
Go downstairs to underground exhibit hall.
B-339—Wall Colmonoy Corp.
A-341—Lester-Phoenix Inc.
A-340—Progressive Welder Co.
A-335—National Machinery Co.
A-336—Titanium Alloy Mfg. Co.
A-332—Heil & Co.
A-328—Victor Saw Works Inc.
A-329—Gulf Oil Corp., Gulf Refining Co.
A-325—Delaware Tool Steel Corp.
A-324—Ohio Crankshaft Co.
A-320—Magnaflux Corp.
A-321—American Brass Co.
A-318—Eastman Kodak Co.
A-314—Hitchcock Publishing Co.
A-315—Marquette Mfg. Co.
A-310—Crown Rheostat & Supply Co.
A-311—Precise Tool & Mfg. Co.
A-309—Cleveland Tapping Machine Co.
A-305—No information
A-303—No information
A-306—Sperry Products Inc.
B-311—N. Ransohoff Inc.
B-310—Wells Mfg. Corp.
B-314—American Car & Foundry Co.
B-320—Meehanite Research Institute of America (American Brake Shoe & Foundry, Atlas Foundry Co., Banner Iron Works, Barnett Foundry & Machine Co., H. W. Butterworth & Sons, Farrel-Birmingham Co., Florence Pipe Foundry & Machine Co., Fulton Foundry & Machine Co., General Foundry & Mfg. Co., Greenlee Foundry Co., Hamilton Foundry & Machine Co., Kanawha Mfg. Co., Kinney Iron Works, Koehring Co., Henry Perkins Co., Pohlman Foundry Co., Rosedale Foundry & Machine Co., Ross-Meehan Foundries, Stearns-Rogers Mfg. Co., Valley Iron Works, Vulcan Foundry Co., Warren Foundry & Pipe Corp.)
B-324—Carboloy Co. Inc.
B-328—No information
B-327—Chase Brass & Copper Co.
B-335—Globe Machine & Stamping Co.
B-337—Philips Metalix Corp.
B-340—Minnesota Mining & Mfg. Co.
C-340—Lukens Steel Co.
C-336—J. W. Kelley Co.
C-335—Instrument Specialties Co. Inc.
C-327—Phillips Mfg. Co.
C-328—Ohio Carbon Co.
C-324—Hild Floor Machine Co.
C-325—Babcock & Wilcox Co.
C-322—Cleveland Graphite Bronze Co.,
C-320—Nicholson File Co.
C-314—Independent Pneumatic Tool Co.
C-315—W. J. Holliday & Co., Monarch Steel Co.
C-310—D. A. Stuart Oil Co. Ltd.
B-306—Revere Copper & Brass Co.
C-233—Tel Autograph Corp.
C-229—Atlas Publishing Co.
C-225—No information
D-222—No information
D-221—No information
D-219—No information
D-216—No information
D-215—No information
D-211—No information
D-210—No information
D-203—No information
D-207—No information
C-203—Chilton Co. Inc.
C-210—No information
C-207—No information
B-206—No information
B-208—No information
B-210—Andresen Inc.
B-212—No information
C-214—No information
B-218—No information
C-218—No information
C-222—No information
C-226—Safety Socket Screw Corp.
C-230—No information
C-232—Detecto Scales Inc.
C-234—No information
C-238—General Aniline & Film Corp., Agfa Ansco Division
C-242—H & H Research Co.
D-306—No information
D-310—Triplex Machine Tool Corp.: City Engineering Co.; Hamilton Tool Co.; Ultrahap Machine Co.
D-311—Detroit Rex Products Co.
D-315—Electro Refractories & Alloys
D-314—Handy & Harman
D-319—American Metal Market Co.
D-321—Mall Tool Co.
D-323—Manhattan Rubber Mfg. Co.
D-324—Tide Water Associated Oil Co.
D-325—National Industrial Publishing Co.
D-327—Magnetic Analysis Corp.
D-328—Lepel High Frequency Laboratories
D-335—Machinery Mfg. Co.
D-336—Standard Oil Co. of Ohio
D-340—American Foundry Equipment Co.
C-331—No information
A-420—National Refining Co.
A-421—No information
A-424—Elastic Stop Nut Corp.
A-425—Wire Association
A-427—American Welding Society
A-429—Standard X-Ray Machine Co.
A-431—Pittsburgh Pipe Cleaner Co.
B-424—Commerce Pattern Foundry & Machine Co.
B-421—Anderson & Sons
B-425—No information
B-427—Osborn Mfg. Co.
B-431—A. P. de Sanno & Son Inc.
C-431—Gardner Publications Inc.
C-421—Aluminum Co. of America, Aluminum Ore Co., American Magnesium Corp.
C-428—Niagara Blower Co.
C-424—R. W. Cramer Co. Inc.
C-420—Krouse Testing Machine Co.
B-502—Alloy Castings Co.
B-504—Radium Chemical Co., Inc.
A-504—Vascoloy-Ramet Corp.
B-508—American Institute of Mining & Metallurgical Engineers Inc.
B-511—Experimental Tool & Die Co.
B-512—No information
B-514—Steel Publications Inc.
A-514—Catskill Metal Works Inc.
B-516—Alox Corp.
B-520—Chemical Rubber Co.
A-518—Sciaky Bros.
B-524—C. Walker Jones Co.
B-526—Metal Industry Publishing Co.
A-524—No information
A-527—No information
A-525—American Brake Shoe & Foundry Co., American Manganese Steel Division
A-523—Sparkler Mfg. Co.
A-519—Porter-Cable Machine Co.
A-513—Reinhold Publishing Corp.
A-511—Morse Magneto Clock Co.
A-509—Brickseal Refractory Co.
A-510—Vanadium Corp. of America
A-501—Climax Molybdenum Co.
A-500—Resistance Welders Manufacturers Association (Acme Electric Welding Co., Eisler Engineering Co., Electroloy Co. Inc., Expert Welder Co., Federal Machine & Welder Co., P. R. Mallory & Co. Inc., Multi-Hydromatic Welding & Mfg. Co., National Electric Welding Machine Co., Progressive Welder Co., S-M-S Corp., Swift Electric Welder Co., Taylor-Hall Welding Corp., Taylor-Winfield Corp., Thomson-Gibb Electric Welding Co., Welding Machines Mfg. Co., Welding Sales & Engineering Co.)
D-410—A. Schrader's Son
D-414—Tinnerman Products Inc.
D-411—Bridgeport Brass Co.
D-418—Mahr Mfg. Co.
B-419—Buckeye Garment Rental Co.
B-418—Gray Mills Co. Inc.
B-415—Baker & Co. Inc.
B-411—Sentry Co.
B-405—Westinghouse Electric & Mfg. Co.
A-401—Motor Products Corp., Deep-
A-405—Harold E. Trent Co.
A-401—Motor Products Co., Deepfreeze Division
A-410—Harry W. Dietert Co.
A-411—Charles Bruning Co. Inc.
A-415—Despatch Oven Co.
A-419—Reeves Pulley Co.
A-418—American Machine & Metals Inc., Riehle Testing Machine Division
A-416—Industrial Publishing Co.
A-414—Morrison Engineering Co.



Exhibitors' Alphabetical Listing

A

Company — Booth

Acme Electric Welding Co., Huntington Park, Calif. A-500
Resistance welders.

Advance Polishing Wheels Inc., Chicago E-113
Polishing wheels.

Alloy Castings Co., Champaign, Ill. B-502
Castings.

Alox Corp., Niagara Falls, N. Y. B-516
Corrosion preventatives and lubricants.

Aluminum Co. of America, Pittsburgh; **Aluminum Ore Co.**, East St. Louis, Ill.; **American Magnesium Corp.**, Cleveland C-421
Aluminum ore and alloys; magnesium and its alloys.

Alvey Ferguson Co., Cincinnati S-162
Conveying machinery.

American Brake Shoe & Foundry Co., New York B-320
Brake shoes, iron castings.

American Brake Shoe & Foundry Co., American Manganese Steel Division, Chicago Heights, Ill. A-525
Alloy castings for heat and corrosion service.

American Brass Co., Waterbury, Conn. A-321
Copper alloys, welding rods.

American Car & Foundry Co., New York B-314
Electric bar, forging and rivet heaters.

American Foundry Equipment Co., Mishawaka, Ind. D-340
Airless abrasive cleaning and descaling equipment.

American Gas Furnace Co., Elizabeth, N. J. B-103
Gas heat treating furnaces; burners, accessories.

American Institute of Mining & Metallurgical Engineers Inc., New York B-508
Educational exhibit.

American Machine & Metals Inc., Riehl Testing Machine Division, East Moline, Ill. A-418
Testing machines.

American Metal Market Co., New York D-319
Publications: *American Metal Market.*

American Welding Society, New York A-427
Educational exhibit.

Ampco Metal Inc., Milwaukee B-131
Welding rods and high-strength nonferrous alloys.

Anderson & Brown Co., Cleveland B-137
Magnetic chucks.

Anderson & Sons, Westfield, Mass. B-421
Name plates, signs, dials and novelties, imprinting machines.

Andresen Inc., Pittsburgh B-210
Publications.

Armstrong Cork Co., Lancaster, Pa. D-138
Insulating firebrick and cements.

Atlas Foundry Co., Detroit B-320
Alloy castings.

Atlas Publishing Co., New York C-229
Publications.

Atlas Steels Ltd., Welland, Ont., Canada D-113
Alloy and carbon tool steels.

Automatic Temperature Control Co. Inc., Philadephia E-117
Valves and controllers.

B

Babcock & Wilcox Co., New York C-325
Refractories.

Baker & Co. Inc., Newark, N. J. B-415
Platinum wire, rod and sheet.

Banner Iron Works, St. Louis B-320
Alloy castings.

Barnett Foundry & Machine Co., Irvington, N. J. B-320
Alloy castings.

Bastian-Blessing Co., Chicago C-131
Welding and cutting equipment.

Company — Booth

Bausch & Lomb Optical Co., Rochester, N. Y. D-150
Optical instruments for metallography, spectrography.

Behr-Manning Corp., Troy, N. Y. C-141
Small power tools.

Black Drill Co., Cleveland D-146
Drills.

Brickseal Refractory Co., Hoboken, N. J. A-509
Refractories.

Bridgeport Brass Co., Bridgeport, Conn. D-411
Brass and copper mill products.

Bruning Co. Inc., Charles; Chicago A-411
Printing machines.

Brush Development Co., Cleveland B-142
Surface smoothness testers.

Buckeye Garment Rental Co., Cleveland B-419
Clothing.

Buehler, Adolph I.; Chicago E-111
Metallographic and laboratory equipment.

Butterworth & Sons, H. W.; Bethayres, Pa. B-320
Castings.

C

Canadian Radium & Uranium Corp., New York S-130
Radiographic equipment.

Carboloy Co. Inc., Detroit B-324
Cemented carbide tools and dies.

Carborundum Co., Globar Division, Abrasive Division, Refractories Division, Niagara Falls, N. Y. C-122
Abrasive materials; refractories; nonmetallic electric heating elements.

Catskill Metal Works Inc., Catskill, N. Y. A-514
Power machines.

Chase Brass & Copper Co., Waterbury, Conn. B-327
Nonferrous metals.

Chemical Rubber Co., Cleveland B-520
Laboratory supplies.

Chicago Flexible Shaft Co., Stewart Industrial Furnace Division, Chicago E-114
Flexible shaft drives; industrial furnaces.

Chicago Steel Foundry Co., Chicago L-102
Castings.

Chilton Co., Philadelphia B-121, C-203
Publications: *Automotive and Aviation Industries; Iron Age.*

Cleveland Graphite Bronze Co., Cleveland C-322
Nonferrous castings.

Cleveland Tapping Machine Co., Cleveland A-309
Tapping machines.

Climax Molybdenum Co., New York A-501
Molybdenum alloy steels and irons.

Commerce Pattern Foundry & Machine Co., Upton Electric Furnace Division, Detroit B-424
Industrial furnaces; castings.

Conover-Mast Corp., New York L-103
Publications: *Mill & Factory.*

Continental Industrial Engineers Inc., Chicago C-133
Heat-treating furnaces.

Cramer Co. Inc., R. W.; Centerbrook, Conn. C-424
Control equipment.

Crown Rheostat & Supply Co., Chicago A-310
Electroplating equipment and supplies.

D

DAILY METAL TRADE, Cleveland E-143
Publications.

Darwin & Milner Inc., Cleveland C-118
Tool steels.

Delaware Tool Steel Corp., Wilmington, Del. A-325
Tool steels.

De Sanno & Son Inc., A. P.; Phoenixville, Pa. B-431
Abrasive cutting and grinding equipment.

Company	Booth
Despatch Oven Co., Minneapolis Gas heat-treating furnaces.	A-415
Detecto Scales Inc., Brooklyn, N. Y. Weighing equipment.	C-232
Detroit Rex Products Co., Detroit Cleaning equipment.	D-311
Dietert Co., Harry W.; Detroit Spectographic equipment; testing equipment.	A-410
Doall Cleveland Co. Inc., Cleveland Machine tools.	B-141
Dow Chemical Co., Midland, Mich. Magnesium alloys.	B-111
DuPont de Nemours & Co., E. I.; Wilmington, Del. Chemicals.	D-134
Duraloy Co., Scottdale, Pa. Steel castings, pipe, tubes, valves, etc.	B-110

E

Company	Booth
Eastman Kodak Co., Rochester, N. Y. Industrial radiographic and X-ray equipment.	A-318
Eisler Engineering Co., Newark, N. J. Resistance welders.	A-500
Elastic Stop Nut Corp., Union, N. J. Self-locking nuts.	A-424
Electro Refractories & Alloys, Buffalo Refractories; alloys.	D-315
Electroloy Co. Inc., Bridgeport, Conn. Resistance welding electrodes.	A-500
Eutectic Welding Alloys Co., New York Welding alloys.	E-140
Experimental Tool & Die Co., Detroit Tools.	B-511
Expert Welder Co., Detroit Resistance welders.	A-500

F

Company	Booth
Farrel-Birmingham Co., Ansonia, Conn. Rolls, machinery and castings.	B-320
Federal Machine & Welder Co., Warren, O. Electric welding machines.	A-500
Federal Products Corp., Providence, R. I. Precision measuring instruments.	B-401
Firth-Sterling Steel Co., McKeesport, Pa. Carbide tools, dies; stainless, wear-resisting steels.	C-150
Florence Pipe Foundry & Machine Co., Philadelphia Castings.	B-320
Ford Co., J. B.; Wyandotte, Mich. Cleaning and washing compounds.	C-117
FOUNDRY, THE; Cleveland Publications.	E-143
Fulton Foundry & Machine Co., Cleveland Castings.	B-320

G

Company	Booth
Gardner Publications Inc., Cincinnati Publications: *Products Finishing, Modern Machine Shop; El Taller Mecanico Moderno; Oficina Mecanica Moderna.*	C-431
General Alloys Co., Boston Heat and corrosion-resisting alloys.	C-146
General Aniline & Film Corp., Agfa Ansco Division, Binghamton, N. Y. Photographic materials.	C-238
General Electric X-Ray Corp., Chicago X-ray inspection equipment.	E-130
General Foundry & Mfg. Co., Flint, Mich. Castings.	B-320
Globe Machine & Stamping Co., Cleveland Stampings.	B-335
Gordon Co. of Ohio, Claud S.; Cleveland Machine maintenance and service.	E-102
Gray Machine Co., Philadelphia Cutting and nibbling machinery.	S-124
Gray Mills Co., Chicago Coolant pumps.	B-418
Great Lakes Steel Corp., Ecorse, Mich. High tensile alloy steels.	S-150
Greenlee Foundry Co., Chicago Castings.	B-320
Gulf Oil Corp., Gulf Refining Co., Pittsburgh Cutting and quenching oils.	A-329

H

Company	Booth
H & H Research Co., Detroit Portable electric tools.	C-242
Hamilton Foundry & Machine Co., Hamilton, O. Castings.	B-320
Hammond Machinery Builders Inc., Kalamazoo, Mich. Grinders; abrasive belt surfacers; power tools.	D-122
Handy & Harman, New York Brazing solders and silver solders.	D-314
Heil & Co., Cleveland Chemical tanks; heating devices.	A-332
Hevi Duty Electric Co., Milwaukee Electric heat treating furnaces.	D-142
Hild Floor Machine Co., Chicago Industrial floor cleaning equipment.	C-324
Hitchcock Publishing Co., Chicago Publications: *Machine Tool Blue Book.*	A-314
Holden Co., A. F.; New Haven, Conn. Heat-treating equipment.	B-147
Holliday & Co., W. J.; Hammond, Ind., and Monarch Steel Co. Division, Indianapolis Cold finished steels and shafting.	C-315
Houghton & Co., E. F.; Philadelphia Heat-treating salts; lubricants; cutting oil; belting.	D-137

I

Company	Booth
Illinois Testing Laboratories Inc., Chicago Pyrometers; thermometers; control equipment.	E-133
Independent Pneumatic Tool Co., Chicago Portable electric and pneumatic tools.	C-314
Industrial Press, New York Publications: *Machinery.*	E-122
Industrial Publishing Co., Cleveland Publications: *Industry & Welding.*	A-416
Instrument Specialties Co. Inc., Little Falls, N. J. Control equipment.	C-335
International Nickel Co. Inc., New York Nickel and nickel alloys.	C-111

J

Company	Booth
Jones Co., C. Walker; Philadelphia Protective clothing.	B-524

K

Company	Booth
Kanawha Mfg. Co., Charleston, W. Va. Castings.	B-320
Kelley Co., J. W.; Cleveland Industrial oils and heat-treating supplies.	C-336
Kelley-Koett Mfg. Co. Inc., Covington, Ky. Industrial X-ray equipment.	E-114
King, Andrew; Narberth, Pa. Consulting engineer.	B-118
Kinney Iron Works, Los Angeles Castings.	B-320
Koehring Co., Milwaukee Castings.	B-320
Kold-Hold Mfg. Co., Lansing, Mich. Refrigerating equipment.	E-130
Krouse Testing Machine Co., Columbus, O. Repeated-stress testing machines.	C-420

L

Company	Booth
Lepel High Frequency Laboratories, New York High-frequency converters.	D-328

Company	Booth
Lester-Phoenix Inc., Lester Engineering Co., Phoenix Machine Co., Cleveland Die-casting machines.	A-341
Lindberg Engineering Co., Chicago Heat-treating furnaces; control equipment.	B-146
Lukens Steel Co., Coatesville, Pa. Steel mill products.	C-340

M

Company	Booth
MACHINE DESIGN, Cleveland Publications.	E-143
Machinery Mfg. Co., Vernon, Los Angeles Milling machines and jig borers.	D-335
Magnaflux Corp., Chicago Magnetic inspection equipment.	A-320
Magnetic Analysis Corp., Long Island City, N. Y. Magnetic analysis equipment.	D-327
Mahr Mfg. Co., Minneapolis Industrial furnaces.	D-418
Mall Tool Co., Chicago Tools.	D-321
Mallory & Co. Inc., P. R.; Indianapolis Welding electrode tips; electric contacts.	A-500
Manhattan Rubber Mfg. Co., Passaic, N. J. Abrasives.	D-323
Marquette Mfg. Co., Minneapolis Welding equipment and supplies.	A-315
Martindale Electric Co., Cleveland Small tools; dust masks.	B-114
Matchless Metal Polish Co., Chicago Polishing compounds.	E-118
McGraw-Hill Publishing Co., New York Publications: *American Machinist; Product Engineering.*	E-137
McKenna Metals Co., Latrobe, Pa. Carbide tools, wear resisting parts.	C-110
Meehanite Research Institute of America, Pittsburgh Castings.	B-320
Metal Industry Publishing Co., New York Publications: *Metal Finishing (Metal Industry).*	B-526
Minnesota Mining & Mfg. Co., Saint Paul Abrasive belt grinders.	B-340
Molybdenum Corp. of America, Pittsburgh Molybdenum, tungsten alloys; ferroalloys; metal powders.	D-111
Morrison Engineering Co., Cleveland Heat-treating furnaces.	A-414
Morse Magneto Clock Co., New York Watchmen's clocks and fire alarms.	A-511
Motor Products Corp., Deepfreeze Division, North Chicago, Ill. Refrigerating equipment.	A-401
Multi-Hydromatic Welding & Mfg. Co., Detroit Resistance welders.	A-500

N

Company	Booth
National Electric Welding Machine Co., Bay City, Mich. Resistance welders.	A-500
National Industrial Publishing Co., Pittsburgh Publications: *Industrial Heating.*	D-325
National Machine Works, Chicago Heat treating furnaces.	B-130
National Machinery Co., Tiffin, O. Forging equipment.	A-335
National Refining Co., Cleveland Industrial oils and greases.	A-420
NEW EQUIPMENT DIGEST, Cleveland Publications.	E-143
Niagara Blower Co., Buffalo Heat exchangers; refrigerating equipment.	C-428
Nicholson File Co., Providence, R. I. Files.	C-320
Norton Co., Worcester, Mass. Abrasive products.	C-138

O

Company	Booth
Oakite Products Inc., New York Cleaners.	E-134
Ohio Carbon Co., Cleveland Carbon brushes, contacts, plates, resistors and suppressors.	C-328
Ohio Crankshaft Co., Cleveland Electric induction hardening process.	A-324
Ohio Seamless Tube Co., Shelby, O. Welded tubing and sections.	D-110
Osborn Mfg. Co., Cleveland Industrial brushes; foundry equipment.	B-427

P

Company	Booth
Pangborn Corp., Hagerstown, Md. Blast-cleaning and dust-collecting equipment.	C-130
Park Chemical Co., Detroit Heat treating, buffing and polishing materials.	S-112
Parker-Kalon Corp., New York Screws and fastening devices.	B-134
Penton Publishing Co., Cleveland Publications: *STEEL, MACHINE DESIGN, DAILY METAL TRADE, THE FOUNDRY, NEW EQUIPMENT DIGEST.*	E-143
Perkins Co., Henry; Bridgewater, Mass. Castings.	B-320
Philips Metalix Corp., New York X-ray, radio and telegraph equipment.	B-337
Phillips Mfg. Co., Chicago Cleaning machines.	C-327
Picker X-Ray Corp., New York X-ray apparatus.	B-122
Pittsburgh Pipe Cleaner Co., Pittsburgh Pipe cleaning equipment.	A-431
Pohlman Foundry Co., Buffalo Castings.	B-320
Porter-Cable Machine Co., Syracuse, N. Y. Grinders, electric saws, sanders.	A-519
Precise Tool & Mfg. Co., Farmington, Mich. Tools.	A-311
Progressive Welder Co., Detroit Resistance welding equipment.	A-340, A-500

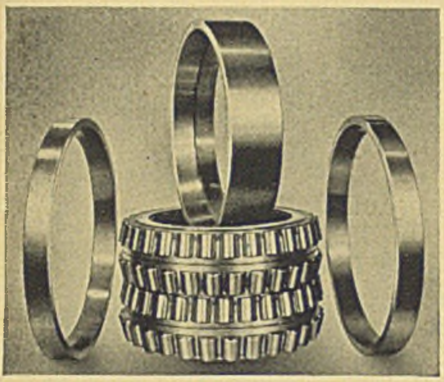
R

Company	Booth
Radium Chemical Co. Inc., New York Radiographic equipment.	B-504
Ransohoff Inc., N.; Cincinnati Cleaning machines.	B-311
Ransome Concrete Machinery Co., Dunellen, N. J. Revolving welding tables or positioners.	B-102
Reeves Pulley Co., Columbus, Ind. Power drives and variable-speed transmissions.	A-419
Reinhold Publishing Corp., East Stroudsburg, Pa. Publications: *Metals & Alloys.*	A-513
Resistance Welder Manufacturers' Association, Warren, O. Information on resistance welding.	A-500
Revere Copper & Brass Co., New York Copper and brass alloys and products.	B-306
Rolock Inc., Fairfield, Conn. Wire mesh baskets, wire cloth.	S-132
Rosedale Foundry & Machine Co., Pittsburgh Castings.	B-320
Ross-Meehan Foundries, Chattanooga, Tenn. Castings.	B-320
Rustless Iron & Steel Corp., Baltimore, Md. Steel mill products.	C-102

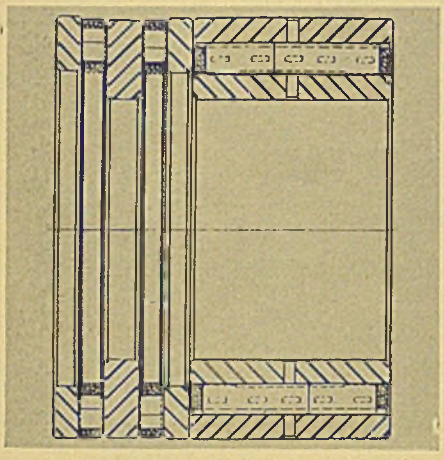
S

Company	Booth
S-M-S Corp., Detroit Resistance welders.	A-500
Safety Socket Screw Corp., Chicago Bolts, socket set screws, cap and shoulder screws, keys, wrenches, studs.	C-226
Scherr & Co., George; New York Optical instruments and testing machines.	E-110
Schrader's Son, A.; Brooklyn, N. Y. Valves, gages, brass fittings.	D-410

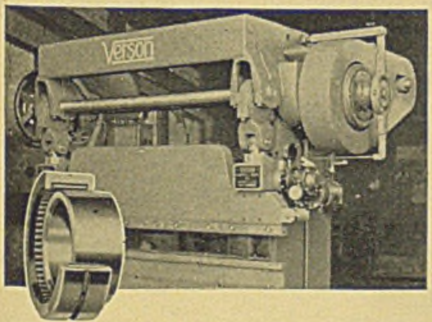
STEEL MILL NEWS
OF BANTAM BEARINGS



4-ROW TAPERED ROLLER BEARINGS, manufactured by Bantam in sizes up to 51" O.D., are especially suitable for such applications as back-up rolls and roll necks on hot and cold strip mills. Bantam Straight Radial Roller Bearings are also extensively used in this type of application.

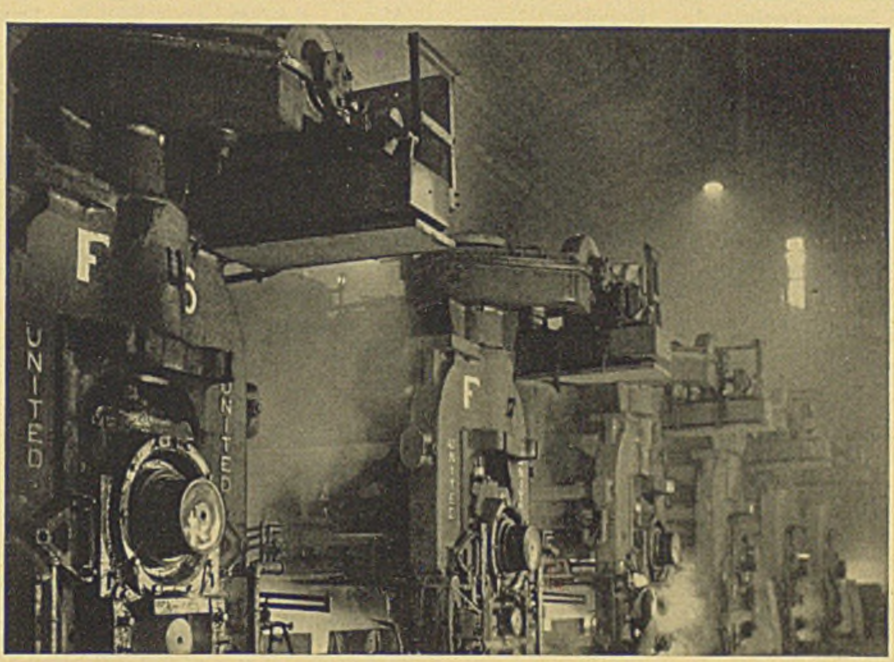


BANTAM-DESIGNED MILL TYPE BEARINGS combine a radial roller section with a double-direction thrust bearing. Used at one end of roll necks, these bearings provide necessary thrust capacity, permit use of Straight Radial Roller Bearings at opposite end. Bearings of this type are made in three lengths for each bore size, providing a wide capacity range.



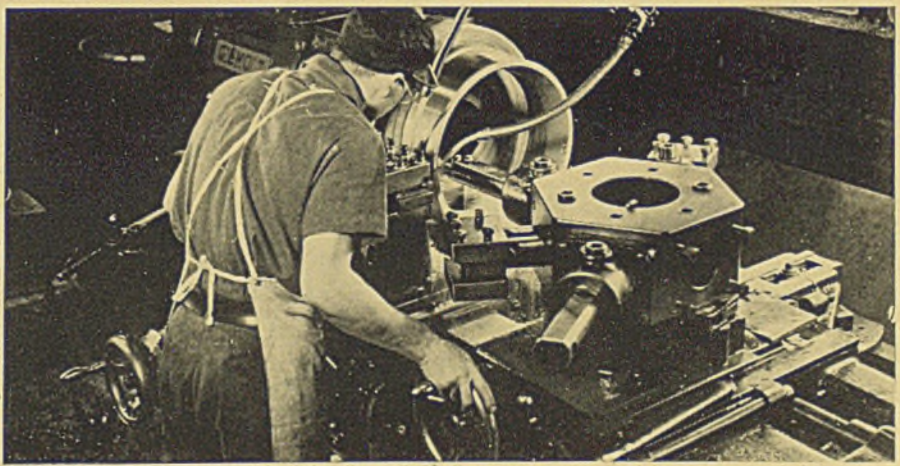
METAL FORMING PLANTS find many uses for this 45-ton press brake, built by Verson All-steel Press Company for such applications as straightening armor plate, forming aircraft parts, and producing munitions boxes and other equipment. High-speed flywheel shafts of these machines rotate on Bantam Quill Bearings.

EVERY MAJOR TYPE of anti-friction bearing is included in Bantam's line—straight roller, tapered roller, needle, and ball. With this broad background of experience, Bantam's engineers are well qualified to cooperate in the selection of standard bearings, or design special ones, for every steel mill application. If you have a bearing problem of any kind, TURN TO BANTAM.



BANTAM SERVES THE STEEL INDUSTRY with a wide range of sizes and types of anti-friction bearings engineered for severe service requirements. Typical application of Bantam Bearings is on work rolls and back-up rolls of this continuous hot strip mill in one of the country's major steel plants.

ULTRA-PRECISION IN LARGE BEARINGS made by Bantam is assured by special machining and grinding methods that result in extremely low tolerances, both in dimensions and in concentricity. Hardening techniques developed by Bantam engineers produce unusual toughness and strength, and contribute to successful bearing performance.



BANTAM BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA

Company	Booth
Sciaky Bros., Chicago Spot welding equipment.	A-518
Selas Co., Philadelphia Gas furnaces, burners, controllers.	D-102
Sentry Co., Foxboro, Mass. Hardening furnaces; high-temperature tube furnaces.	B-411
Sparkler Mfg. Co., Mundelein, Ill. Laboratory equipment.	A-523
Spencer Turbine Co., Hartford, Conn. Turbo compressors; gas boosters; vacuum cleaners.	E-141
Sperry Products Inc., Hoboken, N. J. Testing equipment.	A-306
Standard Oil Co. of Ohio, Cleveland Industrial oils and greases.	D-336
Standard X-Ray Machine Co., Chicago Inspection equipment.	A-429
Stearns-Rogers Mfg. Co., Denver Castings	B-320
STEEL, Cleveland Publications.	E-143
Steel Publications Inc., Pittsburgh Publications: *Heat Treating and Forging; Blast Furnace and Steel Plant.*	B-514
Sterling Alloys Inc., Woburn, Mass. Alloy castings.	B-115
Stuart Oil Co. Ltd., D. A.; Chicago Industrial oils and greases.	C-310
Surface Combustion Corp., Toledo, O. Gas heat treating furnaces; burners; accessories.	D-118
Swift Electric Welder Co., Detroit Butt, spot and projection welders.	A-500

T

Company	Booth
Tagliabue Mfg. Co., C. J.; Brooklyn, N. Y. Pyrometers; thermometers; controllers.	S-126
Taylor-Hall Welding Corp., Worcester, Mass. Resistance welders.	A-500
Taylor-Winfield Corp., Warren, O. Electric welders.	A-500
Tel Autograph Corp., New York Communication devices.	C-233
Tempil Corp., New York Hardening and tempering pellets.	B-138
Tennant Co., G. H.; Minneapolis Floor machines for waxing, polishing, steel wool burnishing.	S-110
Thomson-Gibb Electric Welding Co., Lynn, Mass. Resistance welders.	A-500
Tide Water Associated Oil Co., New York Industrial oils and greases.	D-324
Tinnerman Products Inc., Cleveland Fastening devices.	D-414
Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Titanium; ferroalloys; refractories.	A-336
Trent Co., Harold E.; Philadelphia Electric furnaces and heating elements.	A-405
Triplex Machine Tool Corp., New York; Ultra Lap Machine Co., Detroit; City Engineering Co., Hamilton Tool Co., Dayton, O. Automatic screw machines, hobbing machines.	D-310

V

Company	Booth
Valley Iron Works, St. Paul Castings.	B-320
Vanadium Corp. of America, New York Vanadium products.	A-510
Vascoloy-Ramet Corp., North Chicago, Ill. Pickling tanks; acid resisting equipment.	A-504
Victor Saw Works Inc., Middletown, N. Y. Saws.	A-328
Vulcan Foundry Co., Oakland, Calif. Castings.	B-320

W

Company	Booth
Wall-Colmonoy Corp., Detroit Hard-facing alloys.	B-339
Warren Foundry & Pipe Corp., Phillipsburg, N. J. Castings.	B-320
Welding Engineer Publishing Co., Chicago Publications: *Welding Engineer.*	S-158
Welding Machines Mfg. Co., Detroit Portable gun welding equipment.	A-500
Welding Sales & Engineering Co., Detroit Resistance welders.	A-500
Wellman Co., S. K.; Cleveland Metal friction materials.	E-142
Wells Mfg. Corp., Three Rivers, Mich. Metal band saws.	B-310
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Welding equipment, electrodes; electrical instruments.	B-405
Wilson Mechanical Instrument Co. Inc., New York Hardness testing machines.	C-137
Wire Association, Stamford, Conn. Educational exhibit, publications: *Wire and Wire Products.*	A-425

Where guns speak; a 16-inch howitzer made in Watervliet Arsenal in 1921 now standing guard on Atlantic seaboard—a gun we fortunately did not scrap