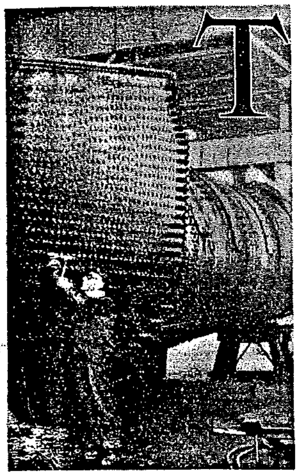
The Baldwin Works at Eddystone

The story of the development of the greatest locomotive building plant in the world, that of the Baldwin Locomotive Works at Eddystone, Pa., has created considerable interest throughout the railroad field. The following outline of the history and growth of this plant is intended as an introduction to a series of articles, which will appear in later issues, giving detailed descriptions of the various departments into which the boiler shop is divided and the methods and equipment employed in each of them. The publication of this material has been made possible through the courtesy and co-operation of the Baldwin Company

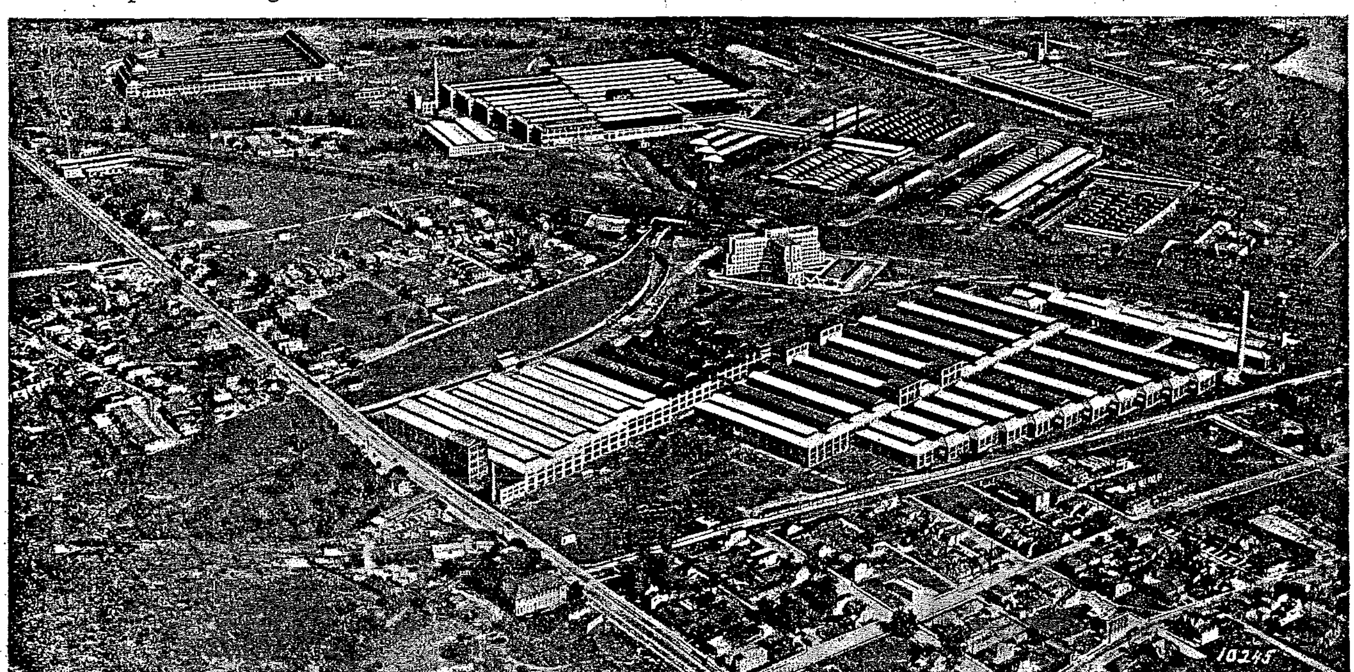


THE largest locomotive building plant in the world, and one of the largest of all industrial plants, has been developed at Eddystone, Pa., by the Baldwin Locomotive Works. The conception of this colossal plant had its beginning in 1906, when the board of directors, realizing that the demand for both foreign and domestic locomotives could no longer be adequately met in the congested business district of Philadelphia decided, after investigation, to purchase the plant of the Gruson Iron Works at Eddystone. The few buildings constituting this plant were unsuited to the requirements of a locomotive works and extensive changes were immediately started. A foundry and smith shop were erected and these departments moved from Philadelphia. The forgings and castings were shipped by rail to the main plant in the city where they were machined and assembled.

By 1907 locomotives had become so large that it was all but impossible to get them out of the Philadelphia plant. At times wheels had to be jacked up, side frames or doorways cut out and switch lamps removed in order that the engines could be moved to the railway for shipment. The erecting shop was congested and the movement of material slow and costly. To meet these conditions, a new erecting shop was designed and built at Eddystone. This building covered 7½ acres and was beyond the imaginative mind of the day. In this shop locomotives could be carried over other engines if necessary. Production was given a new impetus and the vision of an adequate plant for all future needs began to take form.

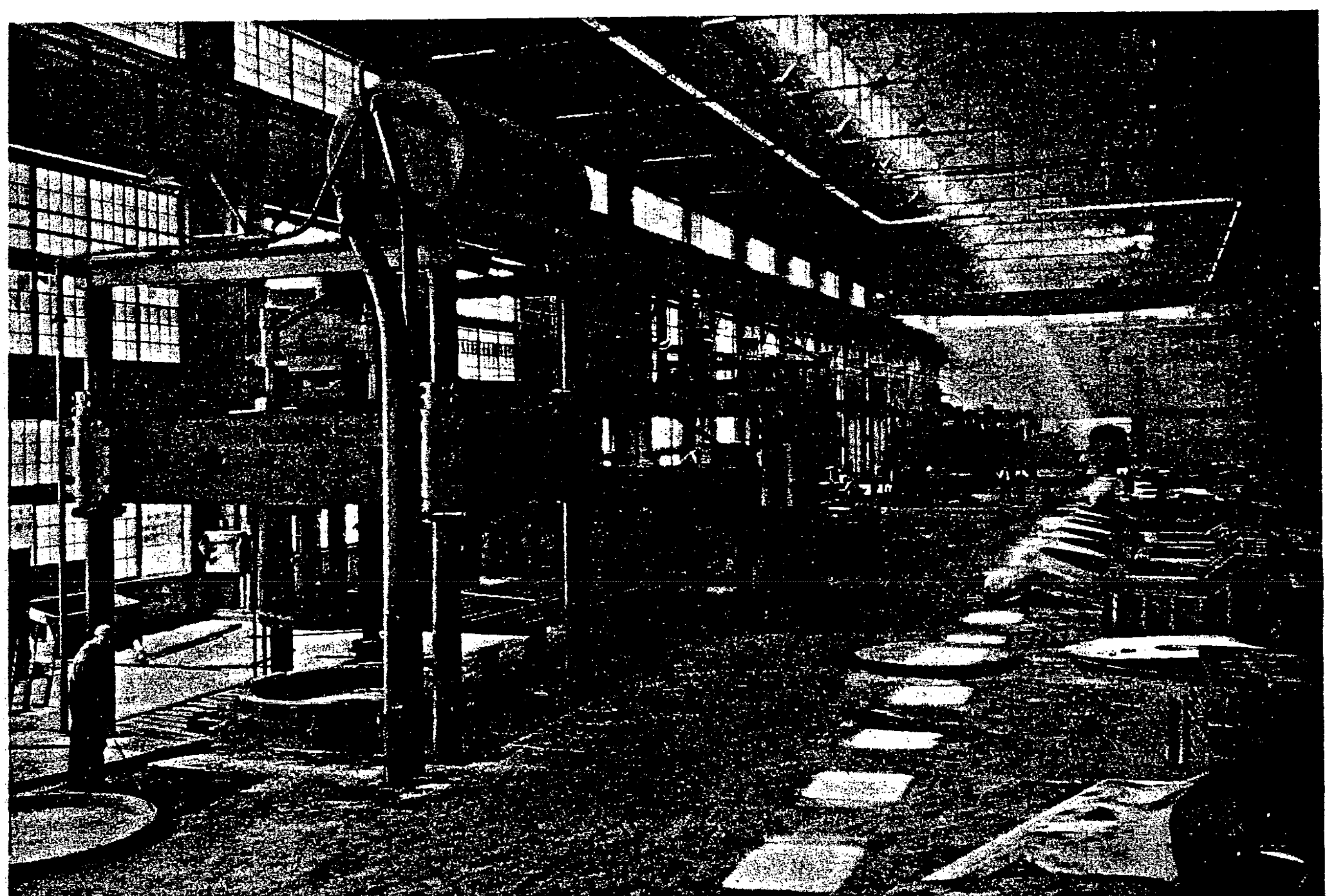
When in 1915 a building was constructed for the Remington Arms Company of Delaware, for the manufacture of rifles, the building proper was designed so that it could readily be converted into a boiler shop when rifles were no longer needed. The floor girders were so constructed as to be later used as cross-girders supporting crane runways. When the time came for changing, these girders could be re-erected without further fabrication. It was said to be the largest manufacturing building in existence under one roof. It covered a ground area of 17½ acres.

While rifles were being manufactured at the rate of 6,000 a day, there came a call for the manufacture of 3-inch shells. Two buildings and a power house were erected on swamp land along the river bank. The swamp was filled in and numerous temporary structures were erected to supplement the shell manufacture.

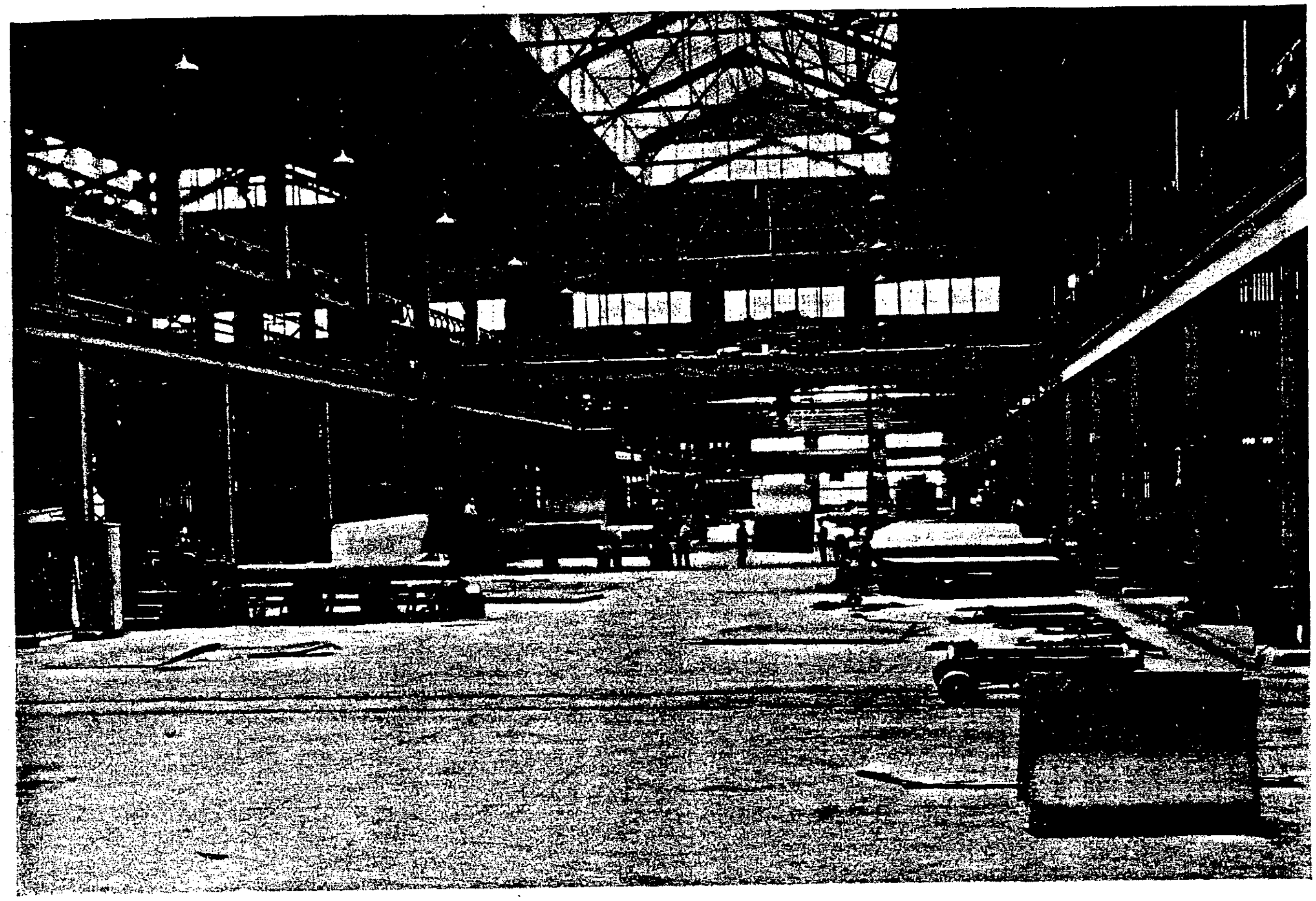


Airplane view of the Eddystone plant of The Baldwin Locomotive Works

Boiler drilling department at Eddystone

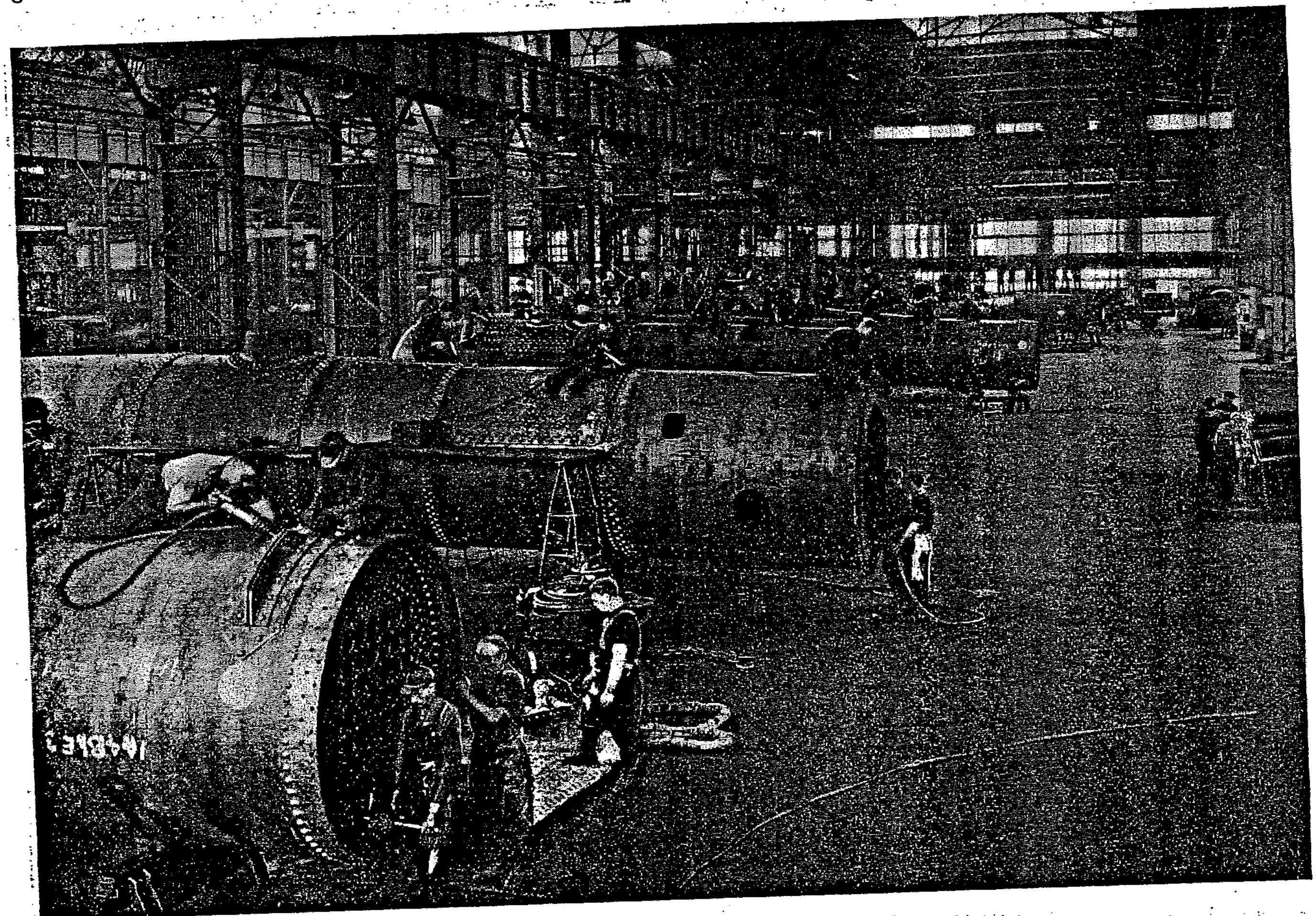


Heavy flanging department

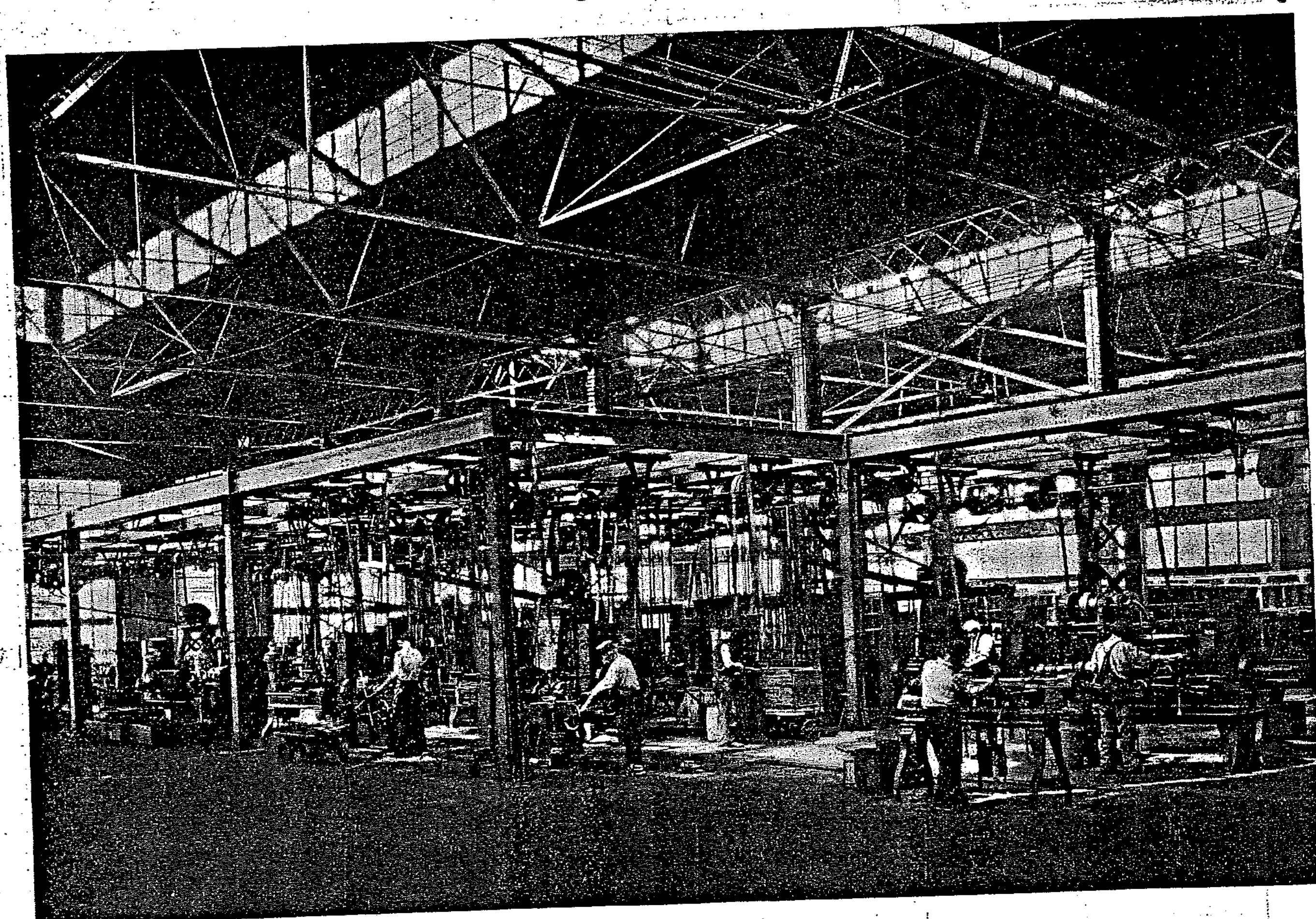


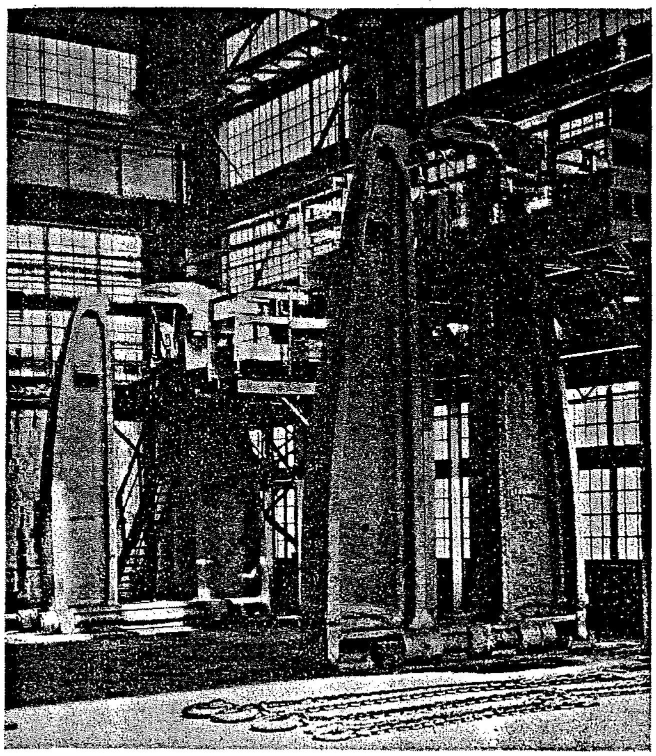
The plate rolls in this department accommodate any type and size of sheet

Riveting department



Finishing bay in the boiler shop





A pair of bull riveters

sultations with the heads of the various departments. With a few minor alterations, the shop stands today as it was originally designed. It is built directly into the side of the erecting shop, making a single building covering an area of 25 acres.

When locomotives are completed, railroad specifications require that they be weighed with extreme accuracy. A scale of 900 tons capacity having a weighing beam of 450 tons was especially designed. The platform of the scale is 17½ feet wide by 405 feet long, upon which steelyards can be placed to determine the weight on each wheel. The track entering the scale house has a reverse curve of 15 to 18 degrees in order to try out the clearance of the locomotive before shipping it to the customer.

The scale on which the boiler shop is laid out may be termed colossal. The mere fact that 15 acres are under one roof does not convey an adequate idea of its tremendous scope or the magnitude of the operations. Like all the other branches of the plant, it conforms strictly to the progressive manufacturing system. Each bay represents a complete unit of operation and the sequences are arranged so that the least possible distance is traveled by the material. All the manufacturing bays are supplied with raw material from spurs running to a main ladder track outside the building.

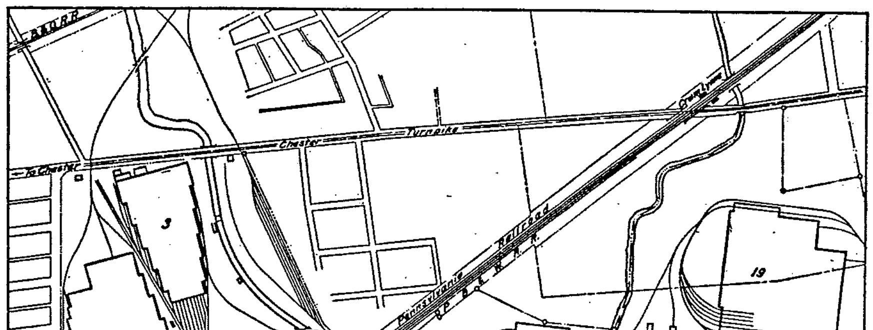
Every machine is so placed in this shop that its operation does not interfere with any other machine.

The close of 1918 saw the end of the rifle and munition work. The temporary buildings were cleared away and the great plan began to unfold. A new erecting shop was built, higher and roomier than the one erected in 1907; various machining departments were moved from the Philadelphia plant to the vacated permanent buildings. The progressive system of manufacturing governed the working plan of every installation.

An elevated plateau to the northeast, the site of an old race track, was chosen as the location of the tender shop and soon a modern building covering an area of 13½ acres was completed.

Events began to move very fast from this time. The boiler shop was moved to Eddystone. All that remained at the Philadelphia plant were the general offices, the brass foundry and machine shop, the motion work, bolt and stud shop and some few minor components. Since these manufacturing units delivered to the erecting shop it was decided to locate them so that they would feed directly into the bays as the locomotives moved through the progressive system. To the layman there was nothing especially difficult in this plan, but to the engineer it meant moving permanent roadways and bridges, changing the course of a river and building the shop directly over the river in order to get the necessary floor space and location.

This shop, known as Section D, took months in planning and con-



Plan of the Eddystone plant

1—Office Building; 2—Cafeteria; 3—Erecting Shop; 4—Boiler Shop; 5—Chemical Laboratory; 6—Physical Laboratory; 7—Pattern Shop; 8—Pattern Storage; 9—Foundry; 10—Spring Shop; 11—Smith Shop; 12—Wheel and Axle Shop; 13—Brake Equalizer Shop; 14—Box Shop; 15—Smith Shop; 16—Wharf; 17—Cylinder Shop; 18—Frame Shop; 19—Tank Shop and Tender Shop; 20—Scale House; 21—Erection Shop; 22—Machine Shop

It is evident that when the preliminary bays are worked to their economical capacity, there will be a time when their output will be in excess of the immediate requirements of the assembly and fitting-up bays. There is always a certain amount of fluctuation of the output. To meet this condition, a bay is provided which acts as a storage reservoir.

In the next article, a complete general description of the boiler shop layout, machine equipment, departments and methods will be given.

American Boiler Manufacturers' Mid-winter Meeting

A NOTICE has been sent by the president of the American Boiler Manufacturers Association to all members that the mid-winter meeting of the association will be held in Cleveland, O., February 5. A complete program of this meeting will be sent out shortly. The various divisions of the organization will hold separate sessions in the morning for the discussion of problems pertaining particularly to their work. In the afternoon a general session for all active and associate members will be held. The meeting will be presided over by H. E. Aldrich of the Wickes Boiler Company, Saginaw, Mich., the new president of the association.

Standing Committees

The standing committees appointed since the last annual meeting are as follows:

SMOKE PREVENTION ASSOCIATION CONFERENCE COMMITTEE:—Geo. W. Bach, chairman, Union Iron Works, Erie, Pa.; H. A. Pillen, Stanwood Corporation, Cincinnati, O.; O. A. Rochlitz, Kroeschell Boiler Co., Chicago, Ill.

ENTERTAINMENT COMMITTEE:—C. W. Middleton, chairman, Babcock & Wilcox Co., New York city; J. H. Broderick, The Broderick Co., Muncie, Ind.; F. W. Chipman, International Engr. Works, Framingham, Mass.

MEMBERSHIP COMMITTEE:—S. G. Bradford, chairman, Edge Moor Iron Works, Edge Moor, Del.; S. M. Harrington, Frost Mfg. Co., Galesburg, Ill.; H. E. Seabold, The Brownell Co., Dayton, O.

COST COMMITTEE:—W. C. Connelly, chairman, The D. Connelly Boiler Co., Cleveland, O.; Starr H. Barnum, The Bigelow Company, New Haven, Conn.; C. W. Edgerton, Coatesville Boiler Co., New York city; J. S. Hammerslough, Springfield Boiler Co., Springfield, Ill.; L. V. Reese, Erie City Iron Works, Erie, Pa.

ETHICS COMMITTEE:—J. F. Johnston, chairman, Johnston Bros., Ferrysburg, Mich.; A. R. Goldie, Babcock-Wilcox-Goldie-McCulloch, Ltd., Galt, Can.; C. E. Tudor, Tudor Boiler Mfg. Co., Cincinnati, Ohio.

COMMITTEE ON AUXILIARY EQUIPMENT:—A. C. Weigel, chairman, Hedges-Walsh-Weidner, Co., New York city; G. W. Bach, Union Iron Works, Erie, Pa.; Owsley Brown, Springfield Boiler Co., Springfield, Ill.

A. S. M. E. BOILER CODE CONFERENCE COMMITTEE:—E. R. Fish, chairman, Heine Boiler Company, St. Louis, Mo.; C. E. Bronson, Kewanee Boiler Corp., Kewanee, Ill.

UNIFORM BOILER LAW SOCIETY COMMITTEE:—E. R. Fish, chairman, Heine Boiler Company, St. Louis, Mo.; M. F. Moore, Kewanee Boiler Corp., Kewanee, Ill.; A. G. Pratt, Babcock & Wilcox Co., New York city.

FEEDWATER STUDIES COMMITTEE:—J. B. Romer, chairman, Babcock & Wilcox Co., Bayonne, N. J.; Wm. Bradford, Edge Moor Iron Works, Edge Moor, Del.; C. E. Bronson, Kewanee Boiler Corp., Kewanee, Ill.; L. E. Connelly, The D. Connelly Boiler Co., Cleveland, O.

COMMITTEE ON BOILER PERFORMANCE:—E. R. Fish, chairman, Heine Boiler Company, St. Louis, Mo.; L. E. Connelly, The D. Connelly Boiler Co., Cleveland, O.; W. H. Jacobi, Springfield Boiler Co., Springfield, Ill.; A. G. Pratt, Babcock & Wilcox Co., New York city; A. C. Weigel, Hedges-Walsh-Weidner Co., New York city.

COMMITTEE ON FINANCE:—A. G. Pratt, chairman, Babcock & Wilcox Co., New York city; S. H. Barnum, The Bigelow Company, New Haven, Conn.; W. C. Connelly, The D. Connelly Boiler Co., Cleveland, O.

TRADE EXTENSION COMMITTEES:—General chairman, Geo. W. Bach, Union Iron Works, Erie, Pa.

WATERTUBE DIVISION:—W. C. Connelly, chairman, The D. Connelly Boiler Co., Cleveland, O.; S. G. Bradford, Edge Moor Iron Works, Edge Moor, Del.; Owsley Brown, The Springfield Boiler Co., Springfield, Ill.; C. W. Middleton, Babcock & Wilcox Co., New York city; L. V. Reese, Erie City Iron Works, Erie, Pa.; A. C. Weigel, Hedges-Walsh-Weidner Co., New York city; E. G. Wein, E. Keeler Co., Williamsport, Pa.

H. R. T. DIVISION:—C. E. Tudor, chairman, Tudor Boiler Mfg. Co., Cincinnati, O.; Starr H. Barnum, The Bigelow Company, New Haven, Conn.; C. W. Edgerton, Coatesville Boiler Co., New York city; J. G. Eury, Henry Vogt Machine Co., Louisville, Ky.; Wm. Heagerty, Oil City Boiler Works, Oil City, Pa.

HEATING DIVISION:—Homer Addams, chairman, Fitzgibbons Boiler Co., New York city; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; R. B. Dickson, Kewanee Boiler Corp., Kewanee, Ill.; C. W. Edgerton, Coatesville Boiler Co., New York city; W. A. Nevin, Heggie Simplex Boiler Co., Joliet, Ill.

VERTICAL DIVISION:—F. B. Metcalf, chairman, International Boiler Works, East Stroudsburg, Pa.; Jos. Doyle, Ames Iron Works, Oswego, N. Y.; J. F. Johnston, Johnston Bros., Ferrysburg, Mich.

OIL COUNTRY:—J. H. Broderick, chairman, The Broderick Co., Muncie, Ind.; Hugh Donovan, Donovan Boiler Works, Parkersburg, W. Va.; Sjoerd Mensonides, Farrar & Trefts, Buffalo, N. Y.

EXPORT:—A. C. Weigel, chairman, Hedges-Walsh-Weidner Co., New York city; W. S. Gregg, C. H. Dutton Co., Kalamazoo, Mich.

Laying Out Octagons

(Continued from page 2)

cut away, leaving a face of 10 inches for the octagonal side. He would also discover that this ratio applies to all sizes of octagons, and that the face is always 10/24ths of the side of an enclosing square.

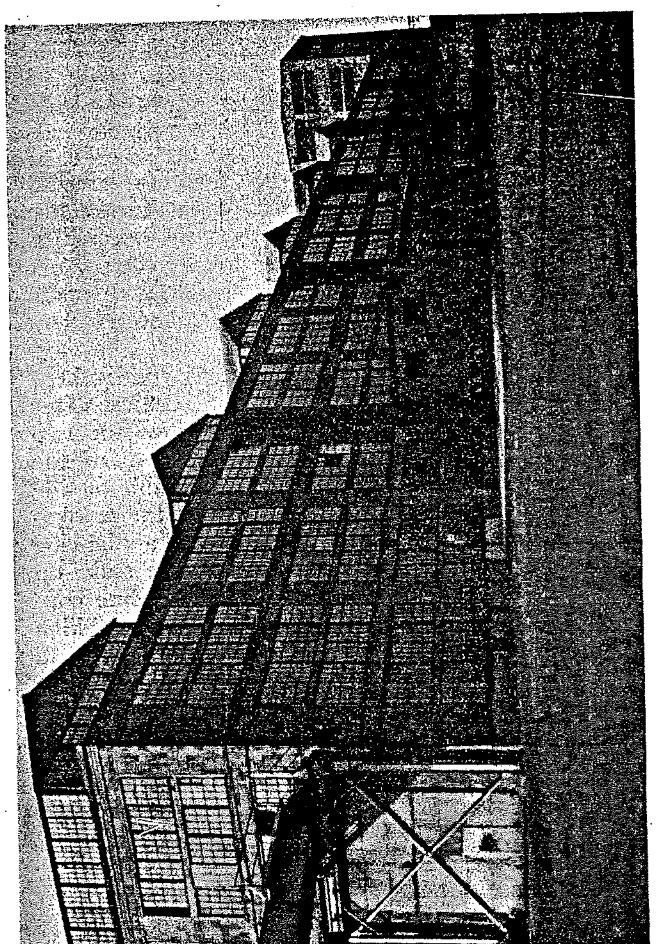
The workman would also find that for plates less than 18 or 19 inches square, the blade of the square would overhang, the plate not being wide enough to receive the length of the square blade. When this happened, a straight edge of another plate would be laid beside the one being marked, and the square blade made even with the edge of the second plate. When the plates to be laid out were 12 inches or less in width, it was found that a 12-inch scale could be laid across and marks made at 3½ and 8½ inches instead of 7 and 17 as on the 24-inch scale.

Should the layout man ever be required to layout a plate for an octagonal column, he can use a modification of this kink, which may possibly help him in "getting somewhere" with the perplexing octagon problem.

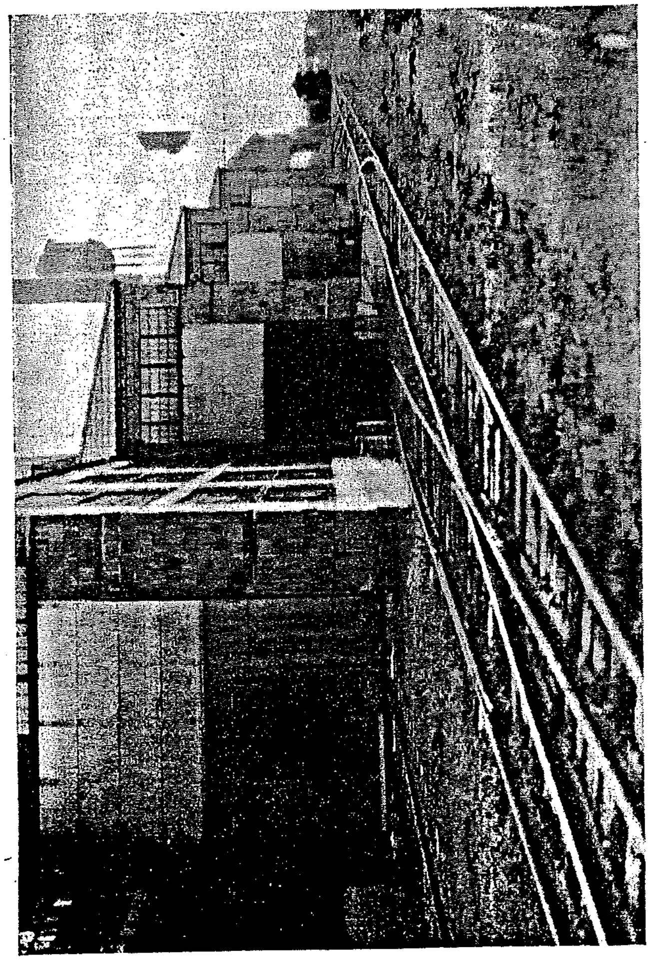
Upon laying out an octagon upon piece of plate 18 inches square, it may be found that the width of the octagon face is 7½ inches. Thus the width of the plate necessary for making an 18-inch octagon column will be 8 x 7½, or 60 inches, plus 3 times the thickness of the plate and perhaps more or less for the "take-up" due to bending.

Indianapolis, Ind. JAMES F. HOBART.

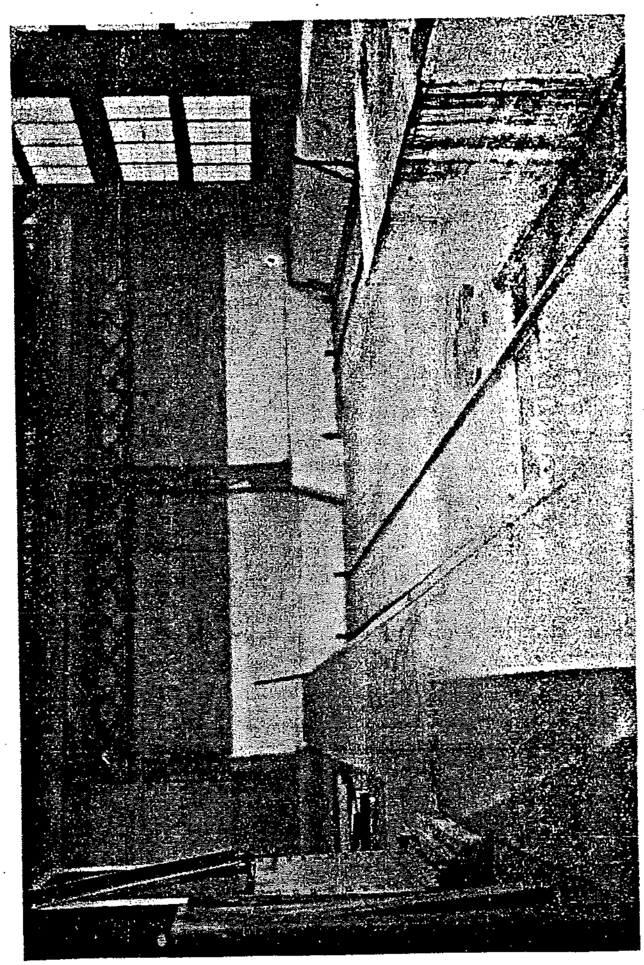
The National Flue Cleaner Company, Inc., Groveville, N. J., manufacturer of the National soot blower for return tubular boilers, announces the appointment of three new Ohio sales representatives, namely, Craun-Liebing Company, of Cleveland; Dennis Engineering Company, of Columbus, and the Bishop Engineering Company, of Cincinnati.



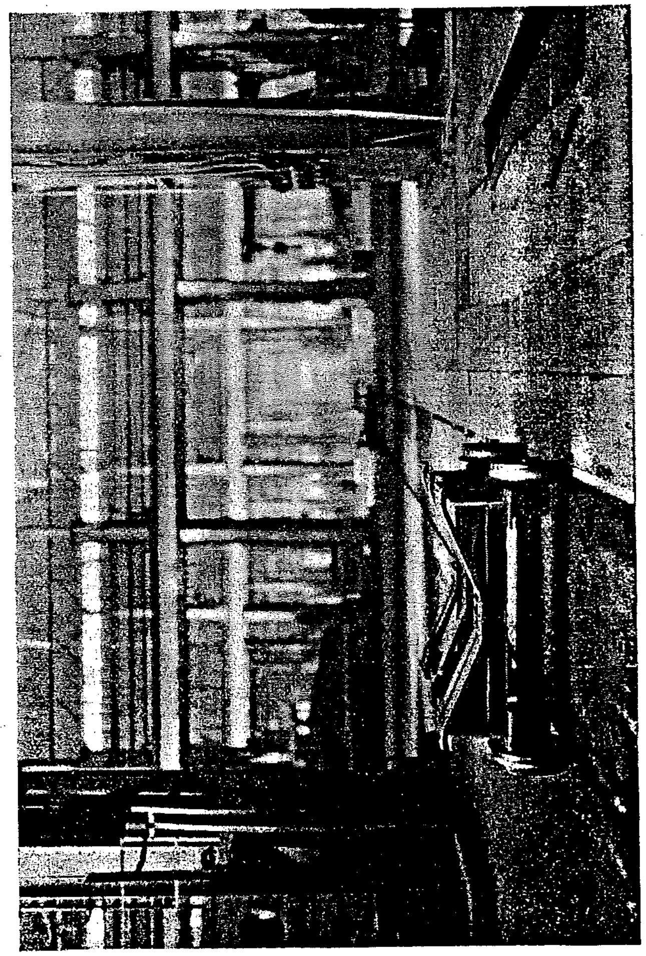
Northeast side of the boiler shop, showing type of construction



The southwest side of the shop is stepped back to provide for service tracks



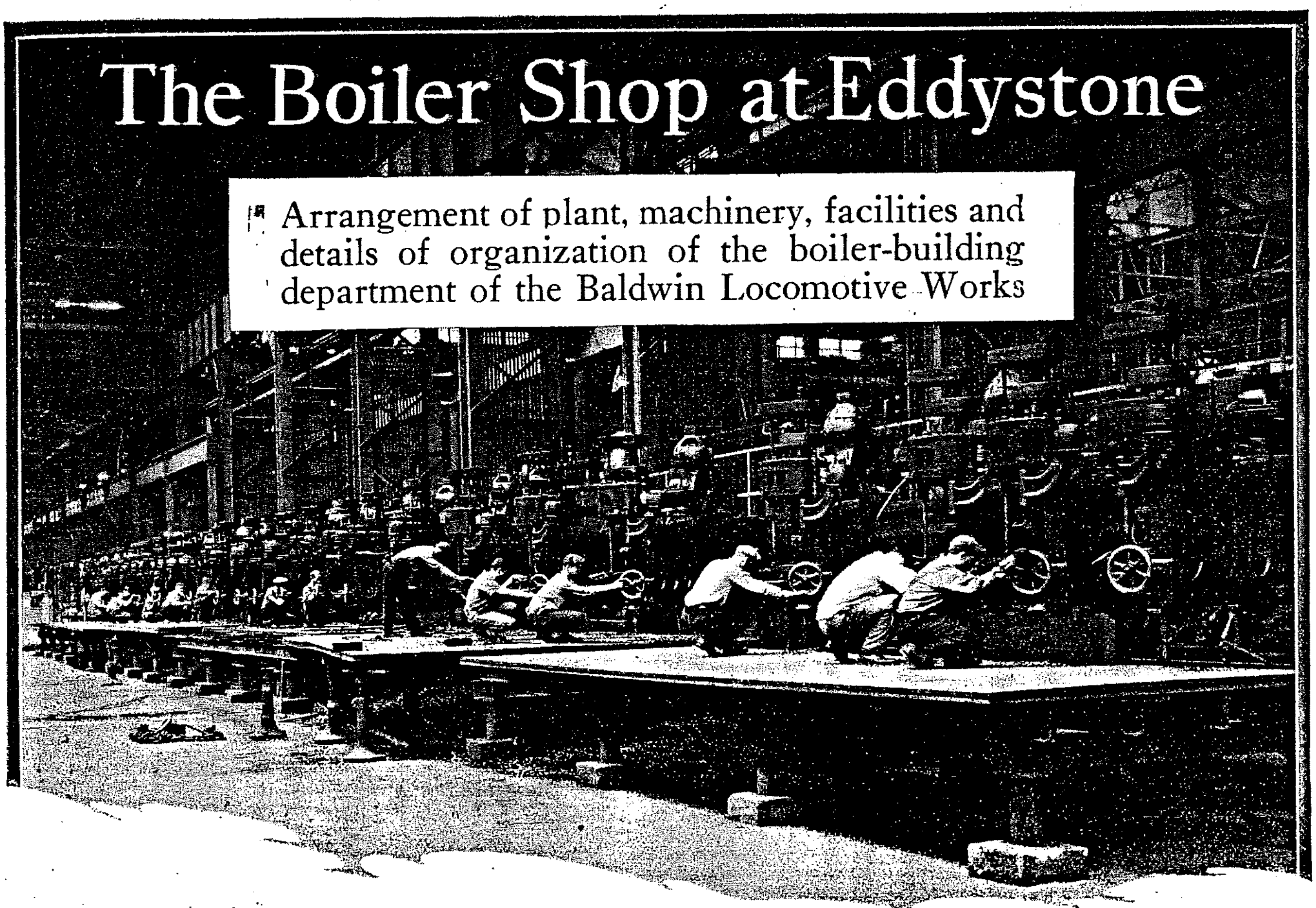
Material receiving pits in bay No. 12



Shop service track in panel No. 9, showing trucks used for transporting material

The Boiler Shop at Eddystone

Arrangement of plant, machinery, facilities and details of organization of the boiler-building department of the Baldwin Locomotive Works



Battery of multiple plate drills in action in the boiler shop

AT the Eddystone, Pa., plant of the Baldwin Locomotive Works one of the most important factors entering into the construction of locomotives is the boiler shop since on it, to a large extent, depends the production rate of the entire plant. From the brief outline of the development of this great organization which appeared in the January issue, it was learned that the building in which the shop is housed was constructed in 1915 as a rifle manufacturing plant of the Remington Arms Company. After the need for war material had passed, the plant was converted to its present use.

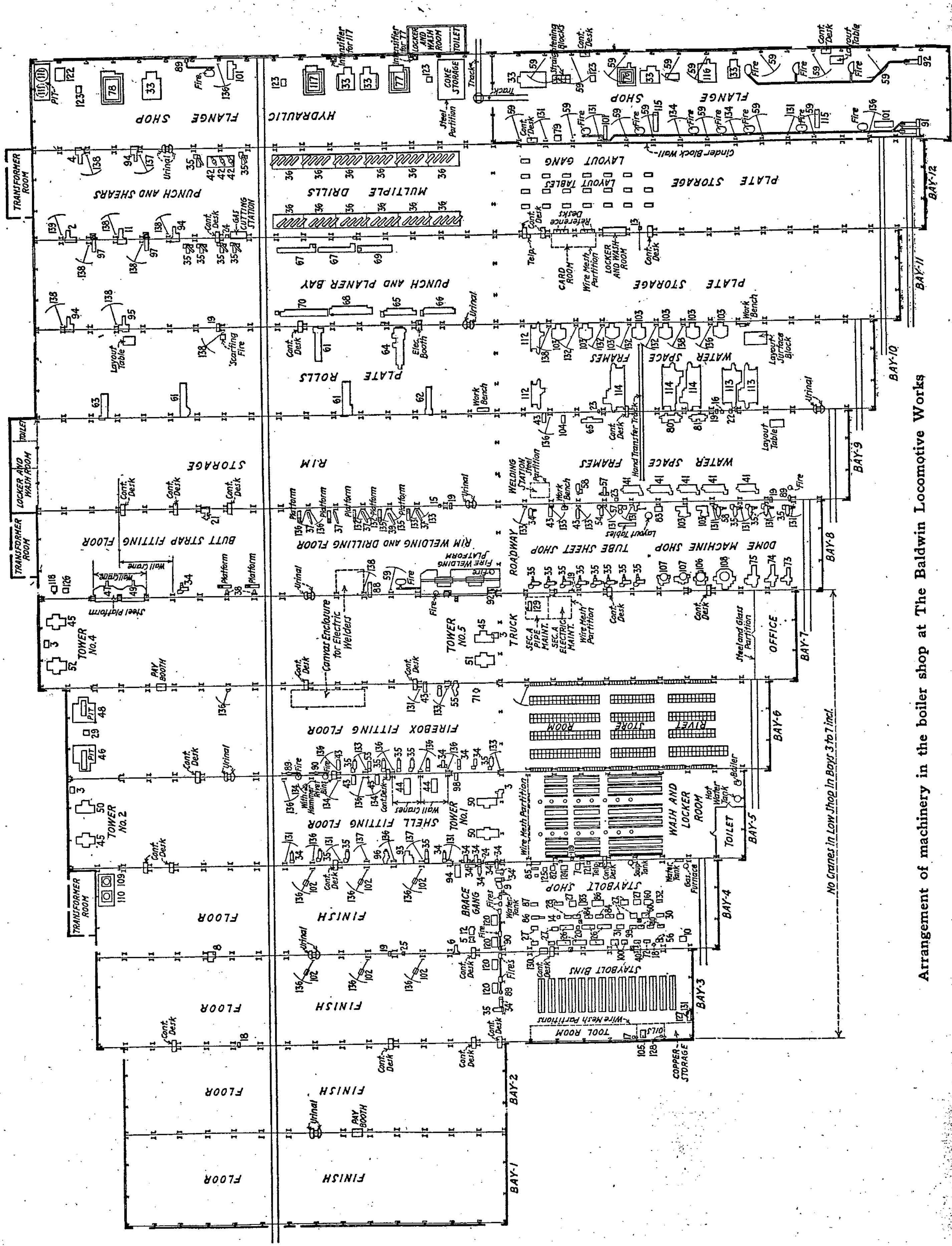
Referring to the shop layout shown on page 36, it will be noted that the boiler plant consists of 13 bays which extend transversely of the building. Longitudinally the building is divided into panels which at the widest part, bay No. 13, number up to 34. Since one side of the shop is served by incoming tracks, arranged on a ladder system, the building on this side is stepped back as shown by the illustration on page 34. Each bay in the shop is 80 feet in width, which for the 13 bays gives the building a total length of 1080 feet. The panels into which the shop is divided are designated by the center-to-center distance between supporting columns. The distance between columns is 24 feet so that in bay No. 13 the shop has a width of 816 feet. This is the widest point, while bay No. 1, in which there are 14 panels, is 336 feet in width. Between these two bays the width of the shop varies because of the step-back arrangement which provides for the ladder track. The total ground area covered by the shop is nearly 17 acres.

The building is constructed of brick and tile with steel sash windows to provide excellent natural lighting inside the shop. As originally used for arms manufacture, every second bay was arranged with three floors. To properly light these floors, which were open all around, the adjacent bays used for assembly were fitted with glass roofs. With no interfering floors, as the shop is now arranged, the shop is nearly as bright as the daylight itself.

The only break in the uniform appearance of the building is where riveting towers, of which there are four, are located. Two of these towers are in bay No. 5, one at panel No. 2 and the other at panel No. 16, while the remaining towers in bay No. 7 are also located in these same panels. Panel No. 18 divides the shop into what are known as the low and the high bays. The low side is so designated because the crane clearance for the bays in this section is only 20 feet, while in the high side the clearance is 35 feet. At only one point in the shop, bay No. 12, do the cranes from the low side extend into the high. It will be seen from the arrangement of the various departments into which the shop is divided that the fabrication of smaller parts is carried out in the low bays while the handling of heavy and the large plate assemblies is dealt with in the high bays.

The scheme of production can best be understood by a summary of the departments. These include in the order of bays the following:

Bay No. 13.—A complete flanging shop for both hand flanging and hydraulic flanging. Incidentally, the building adjacent to this department includes a complete die-making plant. A die storage yard is also located outside the building at the side of the flange department.



Arrangement of machinery in the boiler shop at The Baldwin Locomotive Works

Machine Tool Equipment in the Boiler Shop

No.	Name of Machine
1	¾-inch plate shear
2	36-inch shear
3	No. 1 rivet shear
4	60-inch shear
5	No. 1 bar shear
6	26-inch plate shear
7	No. 0 staybolt shear
8	Special rivet shear
9	Special shear
10	1¼-inch bar shear
11	No. 8 open-throat shear
12	No. 2 bar shear
13	Shear for templates
14	8-inch emery wheel
15	16-inch double emery wheel
16	9-inch emery wheel
17	12-inch double emery wheel
18	Double emery wheel
19	42-inch grindstone
20	10-inch emery wheel
21	No. 3 shears
22	24-inch emery wheel
23	6 WFA emery wheel
24	4 LA double emery wheel
25	6 LA emery wheel
26	Staybolt threader
27	Double-staybolt cutter
28	Single-staybolt cutter
29	18-inch die dresser
30	16-inch rounder
31	Double rounder
32	1-inch rounder
33	Furnace
34	48-inch radial drill
35	60-inch radial drill
36	4-spindle radial drill
37	72-inch radial column drill
38	Column drill
39	84-inch radial column drill
40	4-spindle multiple drill
41	8-spindle multiple drill
42	72-inch radial drill
43	Horizontal drill press
44	50-ton bull riveter
45	177-ton bull riveter
46	74-ton bull riveter
47	68-ton bull riveter
48	162-ton bull riveter
49	123-ton bull riveter
50	154-ton bull riveter
51	200-ton bull riveter
52	170-ton bull riveter
53	52-inch reaming machine
54	72-inch reaming machine
55	⅞-inch horizontal punch
56	Centering machine
57	48-inch tapping machine
58	60-inch tapping machine
59	3-ton hydraulic crane
60	Staybolt turner
61	16-foot bending rolls
62	12-foot bending rolls
63	No. 3 bending rolls
64	25-foot bending rolls
65	28-foot plate planer
66	20-foot plate planer
67	22-foot plate planer
68	25-foot plate planer
69	No. 1 Bp. plate planer
70	30-foot plate planer
71	Fire-door hole facer
72	4-spindle drill press
73	42-inch by 7-foot radius planer
74	40-inch radius planer
75	54-inch radius planer
76	236-ton flanging press
77	530-ton flanging press
78	1160-ton flanging press
79	¾-inch plate-flanging press
80	25-inch double-head shaper
81	18-inch shaper
82	No. 2 shaper
83	Lathe
84	Crown-bolt lathe
85	Radial staybolt lathe
86	Turret lathe
87	Forming lathe
88	100-ton gusset flattener
89	No. 5 blower
90	No. 6 blower
91	No. 7 blower
92	No. 8 blower
93	1-inch plate punch
94	No. 5 punch
95	No. 11 punch
96	No. 3 punch
97	No. 6 punch
98	48-inch post goose-neck drill
99	2-spindle multiple drill
100	Squaring press
101	Sectional flanging press
102	Hydraulic riveter
103	60-inch vertical milling machine
104	60-inch slotter
105	30-inch universal grinder
106	100-inch boring mill
107	76-inch boring mill
108	120-inch boring mill
109	2000-pound accumulator
110	14-inch by 14-inch accumulator
111	15-inch accumulator
112	3-foot by 3-foot by 12-foot open-side planer
113	16-inch by 49-inch by 60-inch open-side planer
114	5-foot by 5-foot by 18-foot open-side planer
115	150-inch hydraulic plate clamp
116	445-ton hydraulic press
117	790-ton hydraulic press
118	100-ton butt-strap press
119	6-inch twist drill grinder
120	No. 2 hammer
121	Single-staybolt saw
122	16-inch capstan
123	5-horsepower winch
124	Double-staybolt saw
125	Chaser grinder
126	Scarfing furnace
127	1-ton hoist
128	No. 2 oil pump
129	2-inch pipe machine
130	Platform scales
131	1-ton hand jib crane
132	1¼-ton hand jib crane
133	1½-ton hand jib crane
134	2-ton hand jib crane
135	½-ton hand jib crane
136	3-ton hand jib crane
137	4-ton hand jib crane
138	6-ton hand jib crane
139	7-ton hand jib crane

Bay No. 12.—Material-receiving pits, plate storage, layout department, multiple drilling department, punching and shearing section.

Bay No. 11.—Punching and planer section.

Bay No. 10.—Plate rolls and water space frame or mud-ring fabrication. This department extends into bay No. 9 in the low side of the shop.

Bay No. 8.—Dome machining shop, tube sheet shop, rim welding and drilling floor, butt-strap fitting floor.

Bay No. 7.—Bull riveting towers.

Bay No. 6.—Rivet storeroom, firebox fitting floor and bull riveter pits.

Bay No. 5.—Wash room and locker room, shell fitting floor, bull riveting towers.

Bay No. 4.—Staybolt shop, brace fitting gang, finishing floor.

Bay No. 3.—Staybolt shop, finishing floor.

Bays Nos. 1 and 2.—Reserve finishing floor.

The basis of the production scheme as employed at this shop is for materials to move transversely in each department by means of the shop cranes to panel No. 9 where a shop service track runs the entire length of the plant. All longitudinal movement between bays is by means of this track. Materials and parts are placed on special trucks, and either moved by hand or by gasoline tractors to the proper bay for their next operation, whence a crane in that bay spots them where required.

For the comfort and convenience of the personnel, three wash rooms and locker rooms are provided at central locations in the shop. In addition, numerous lavatory and fountain stations are installed near the various departments. Distances in this plant are so great that every effort has been made to concentrate all facilities and equipment for each department so that lost motion is avoided. The same is true of the production scheme. All material and parts in process of fabrication move from bay to bay in logical sequence without back-tracking. There are a few exceptions to this, which will be noted later.

Personnel in Boiler Shop

The normal production of the shop is 40 complete locomotive boilers a week. This production, of course, depends largely on the personnel which, in normal times, numbers about 2700 men. The piece-work system is employed.

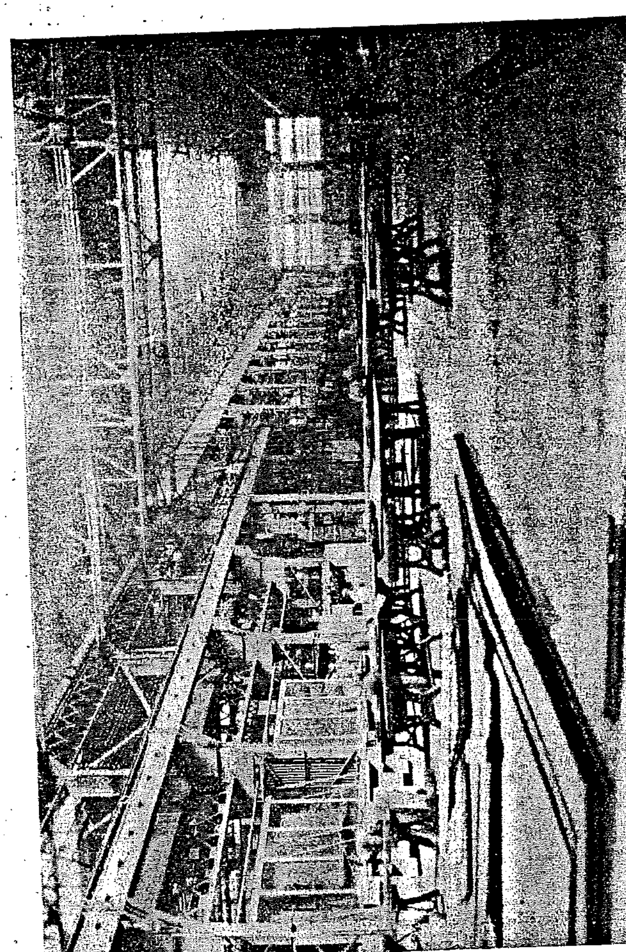
The shop is organized under the head of a superintendent to whom report two general foremen. Each general foreman has under him three foremen who are in charge of the main departments into which the shop is divided. Within the departments the staff is divided into gangs with a leader in charge of each. There are 21 of these leaders. The entire personnel organization is shown schematically in the illustration on page 40.

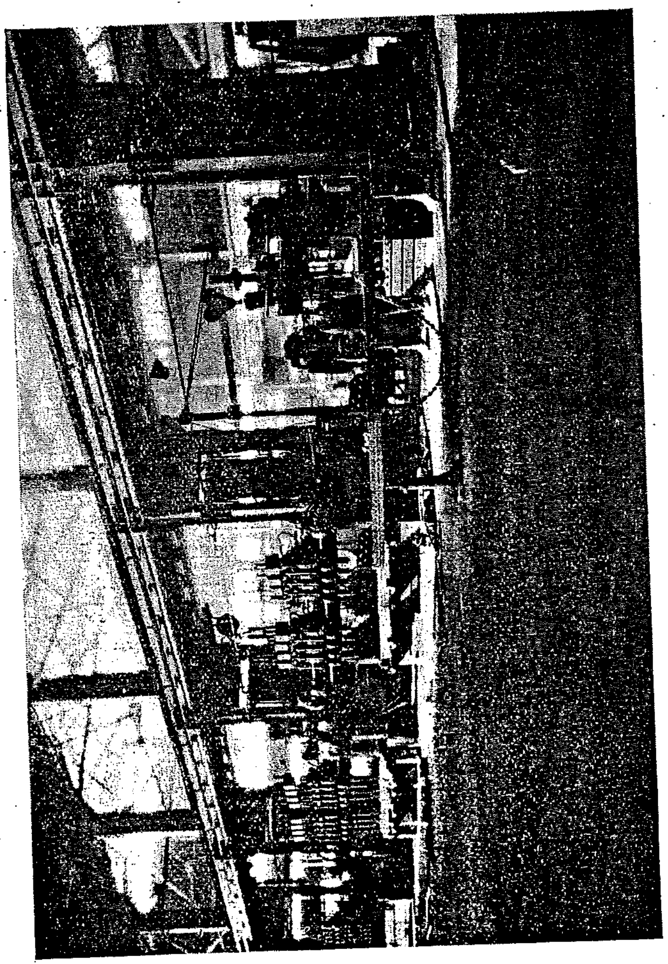
Machine Equipment

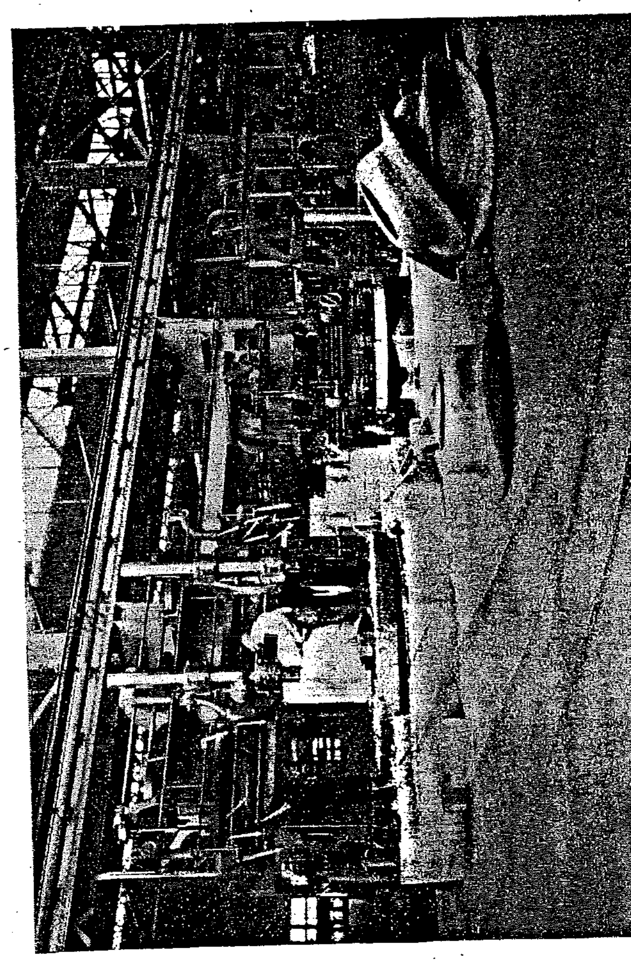
The machinery arrangement and general floor plan is shown on page 36 while the shop crane layout with the sizes and capacities of each is shown on page 40.

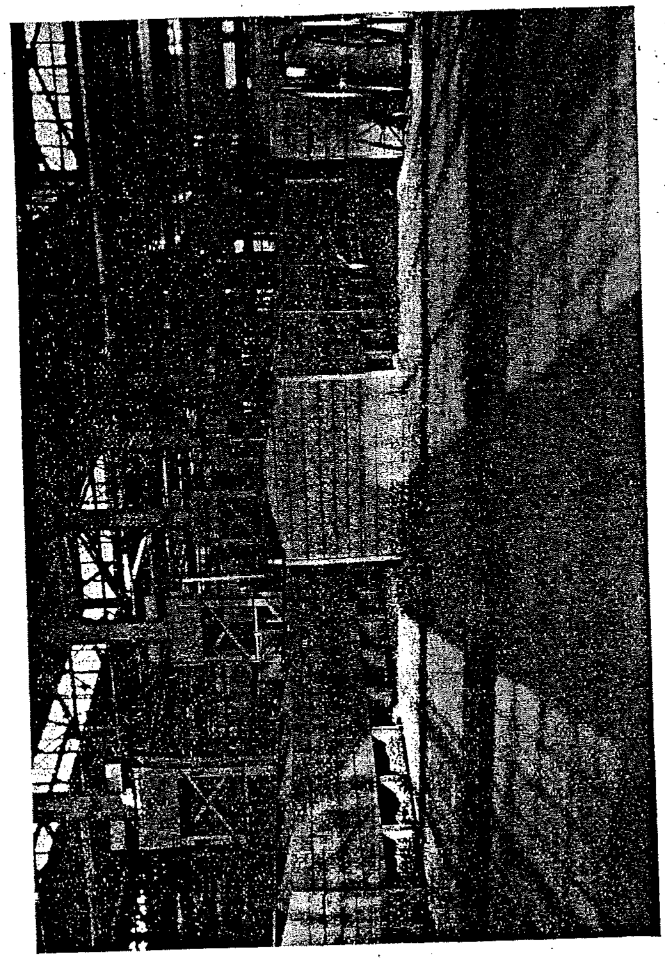
Some general statistics of the number and sizes of the principal machines will be of interest at this point:

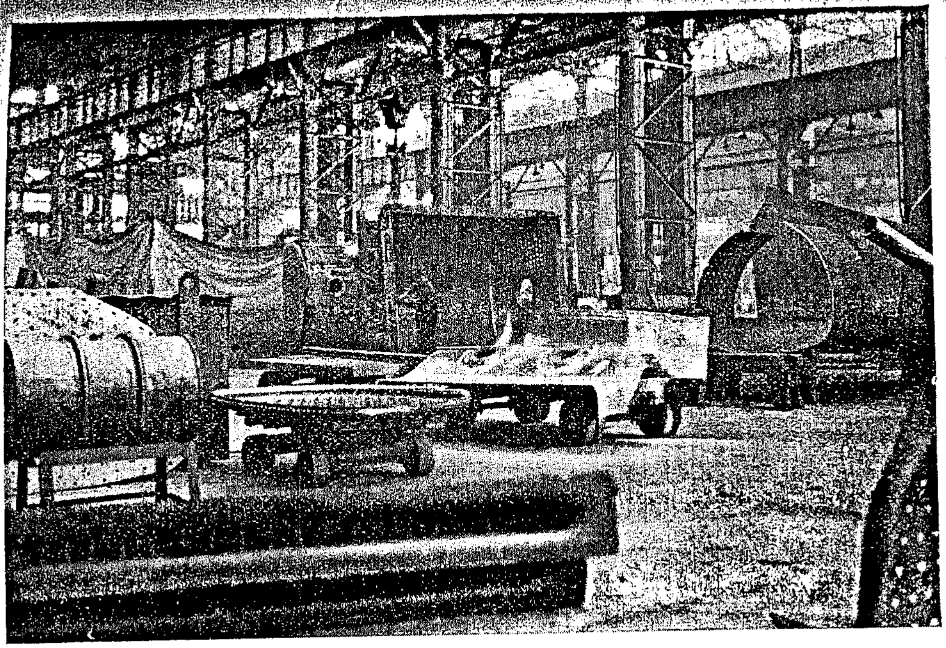
Serving the shop transversely are 32 overhead electric cranes ranging in capacity from 10 to 100 tons. In addition, special cranes are located in the riveting towers in bays Nos. 5 and 7 and over the riveting pits in bay No. 6. These cranes include: One 50-ton Niles; two 25-ton Milwaukee-Niles; three 25-ton Niles; one 25-ton Niles-Sellers; one 50-ton Pawling & Harnischfeger and one 50-ton Morgan. At all points in the shop where plates must be handled many times during fabrication, such as to serve the radial drills, shears, planers, and the like, hand-operated, hydraulic or electric wall


Laying out department in bay No. 12

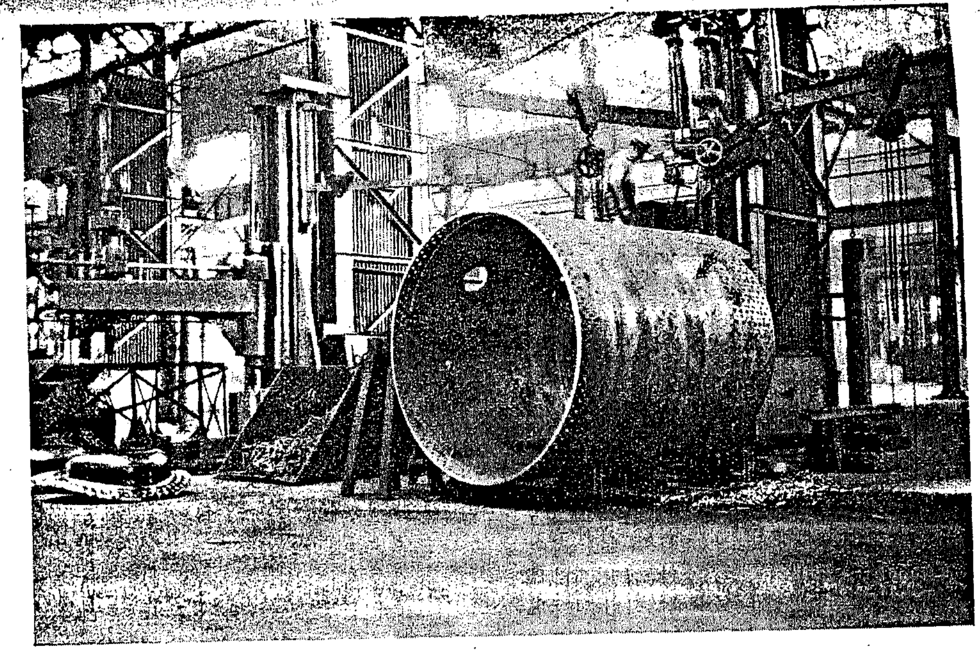

Fabricating water space frames


Machining domes

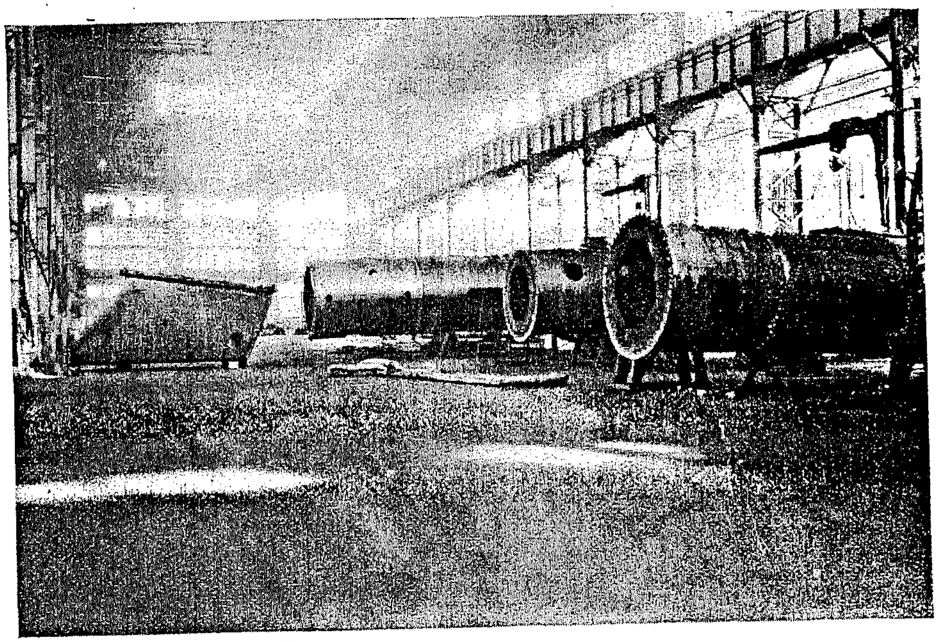

Rivet storage bins near hydraulic riveting department



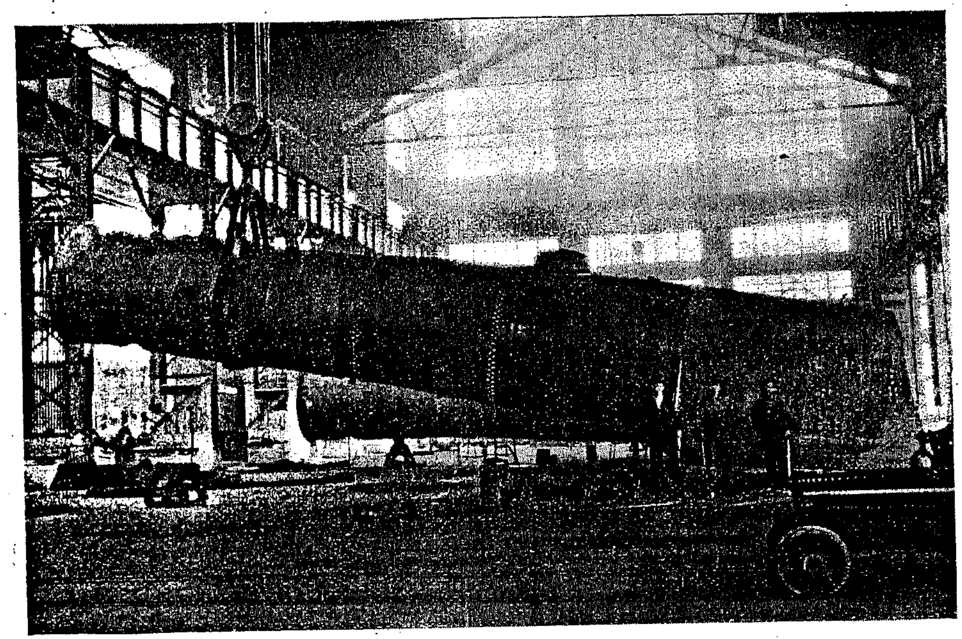
At work in the firebox assembly section



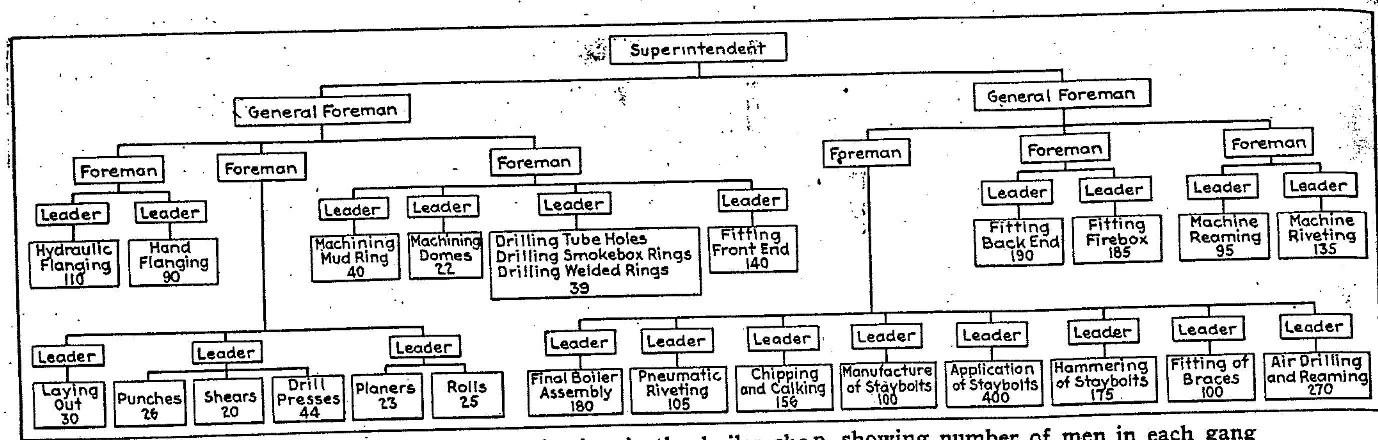
Drilling a boiler barrel course



Department where boiler barrels are assembled



A view in the finishing department



General scheme of personnel organization in the boiler shop, showing number of men in each gang

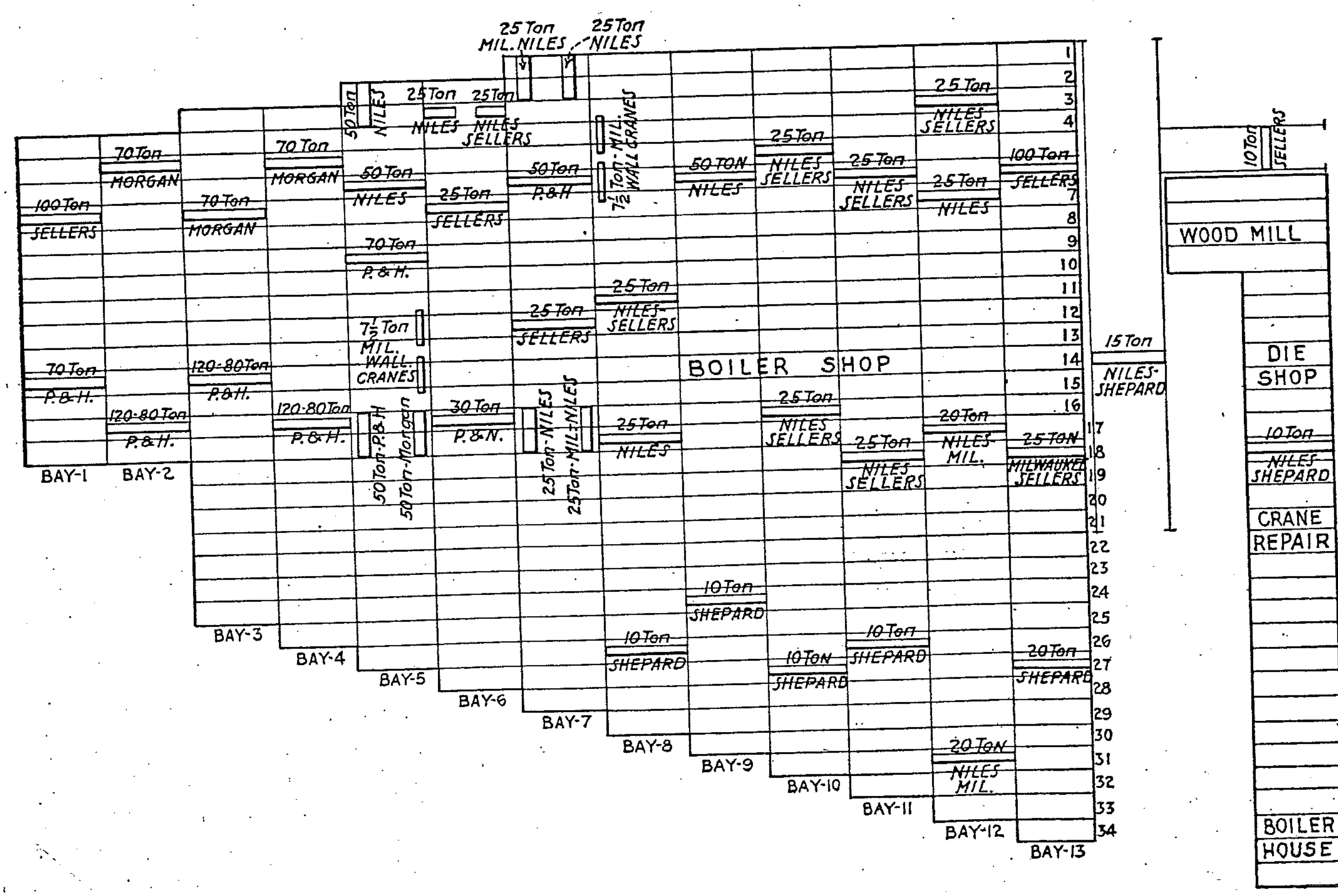
cranes are located. Approximately 75 cranes of these types are installed.

All rivet heating is done by Berwick electric heaters, of which there are about 25 in the shop. The heaters are moved to the job wherever required by the shop cranes.

Practically all holes in boiler sheets are drilled, and, for this purpose, a battery of 12 4-arm Sellers multiple drills is located in bay No. 12. In addition, there are many radial, vertical-spindle and other types of drills located in all departments where they are required.

In the riveting towers there are 8 bull riveters, while two more are located in the pits of bay No. 6. In the riveting towers there are one Chambersburg, 17-foot 1-inch stake riveter of 177 to 38 tons pressure; one Bement, 17-foot stake, 170 to 63 tons; one R. D. Wood, 18-foot 6-inch stake, 154 to 37 tons; one Bement, 17-foot 1-inch stake, 200 to 49 tons; one Southwark, 20-foot stake, 154 to 37 tons; one R. D. Wood, 17-foot 1-inch stake, 177 to 48 tons; one Southwark, 154 to 37 tons; one Southwark, 177 to 37 tons. In the riveting pits, there are one Sellers, 16-foot 8-inch stake, 74 to 23 tons and one Bement, 17-foot 1-inch, 162 to 54 tons.

In the rolling department the following plate rolls are included in the equipment: One Hilles & Jones, 16-foot rolls; one Bement, 12-foot 1-inch rolls; one Bement-Pond, 16-foot rolls; one Southwark rolls, 25-inch



Overhead crane arrangement in the boiler shop with make and capacity of each crane centers; one No. 3 Hilles & Jones rolls and one Southwark, 16-foot, rolls.

The principal plate-planing machines installed include the following: One Bement, 28-foot planer; one Bement, 20-foot planer; one Southwark, 25-foot planer; one Southwark, 30-foot planer; two Hilles & Jones, 22-foot planers.

The foregoing gives only a faint idea of the extremely complete machine equipment of this great plant. In general, it may be said that the mechanical facilities available can accommodate practically every operation that might occur in the fabrication of any type of heavy or light plate work and would be equal to any demand of quantity boiler production.

An interesting side light on the arrangement of machines is that, so far as possible, they are placed along the lines of columns or near the walls of the shop. This enables the use of the jib and wall cranes mentioned to serve the individual machines. It also ensures clear floor space for all assembly work, the transportation of materials and the storage of materials in each department until they are needed.

Boiler Fabrication

An idea of the production system may be gained from an outline of the various fabrication processes, from the time material comes into the shop until it is finally assembled.

Material is brought into the shop on the ladder track at the left side of the building. To accommodate large plates and to aid in handling them, receiving pits are located in bays Nos. 11 and 12. If many orders are on hand, the plates for each of them are piled flat on the storage floor, which is located at the receiving end of these bays. If required three or four cars of material can be accommodated at one time in the receiving pits. Extremely large plates, such as for one-piece crown and side sheets, are transported in well cars. The crane clearance for unloading is sufficient to handle such plates without difficulty.

From the storage section the material is taken to the laying out floor which is in bay No. 12 just beyond the storage space. All layout work is done by a skilled shop force which maintains a complete file of all boiler cards and all plate developments in a special storage room in this department.

From this point the plates are picked up by the shop crane and moved to the multiple drill presses further along in bay No. 12. After the holes are drilled, the sheets are trimmed to size at the shears or by means of the cutting torch. This department is located at the extreme end of this bay beyond the service track. Sheets intended for the flange shop, either to be hand or hydraulically flanged, are then moved to bay No. 13 along the shop track in panel No. 9. This is one instance where the material is diverted from the forward movement of the production system.

After the plates which do not require flanging are trimmed, they are moved along the shop track to bay No. 11 where they are planed. The next movement of this material is to bay No. 10 where the courses of the firebox and wrapper sheets are rolled to shape.

Bay No. 9 is held in reserve for periods of heavy production. From bay No. 10, therefore, the sheets used for boiler barrel courses move to bay No. 8 where they are assembled. Here also the longitudinal straps are riveted on the short stake bull machines. There are two of these bull riveters in this department; one Sellers, 10-foot stake, 68-ton pressure and one R. D. Wood, 12-foot 3-inch stake, 123 to 35 tons pressure. Rim fabrication drilling and welding are done here. The rim connections are made to the barrel courses in the bull riveters in bays Nos. 5 and 7. The courses are also connected on the bull machines in these bays.

In the case of firebox sheets, after leaving the rolling department, they are taken to bay No. 6 where the firebox fitting floor is located. The flanged sheets for the firebox assembly are brought from the flanging department in bay No. 13 first to the laying out floor for marking on the block and thence to the firebox fitting floor. The sheets assembled in this department include the firebox tube sheet, inside throat and door sheets, while the outside throat and backhead are taken to the shell assembly in bay No. 5.

The flanged sheets are not trimmed or drilled until they reach this point in the fabrication of the boiler. The firebox assembly is completed on the pit-type bull riveters in bay No. 6, with the exception of the door sheet which is riveted by hand.

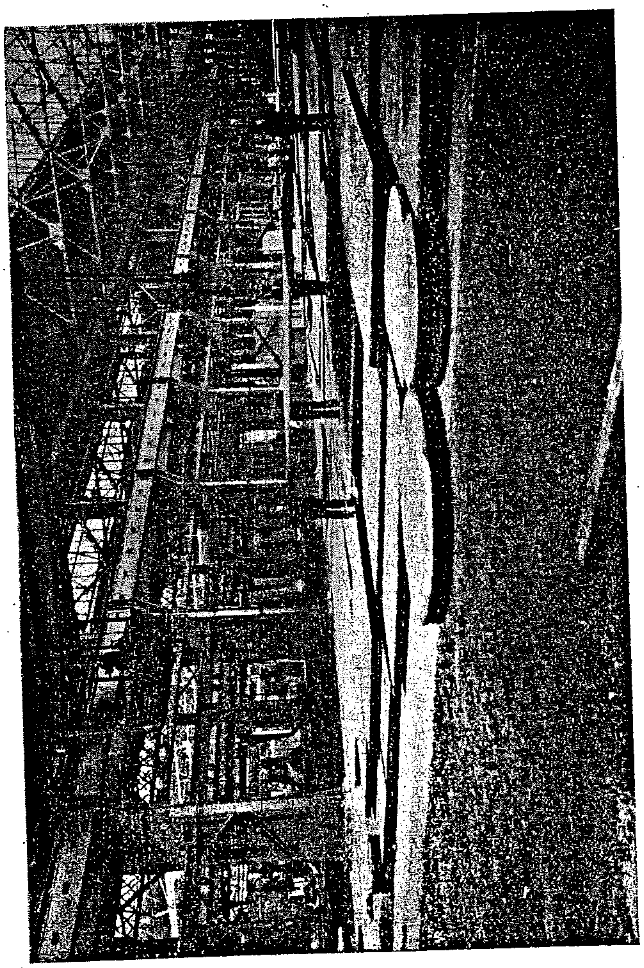
The final stage in completing the boiler is the assembly of the various units, which is carried out in finishing bays Nos. 3 and 4. Here the braces are installed, the backhead fitted, all of which is done before the firebox is dropped into place. At this point too the entire boiler is lined up to see that the firebox and other parts fit properly. Close tolerances are very rigidly maintained. The staybolts are applied and then the mud-ring is fitted. In this department the boiler is completed with the exception of the tube installation. For production reasons this is done in the erecting shop.

While the fabrication of the principal boiler sheets is going forward, the auxiliary operations, such as the flanging of sheets, the machining of water space frames, the domes, staybolt production, miscellaneous fittings, and the like, are all brought along together so that, when required in the assembly department, they are available without delay.

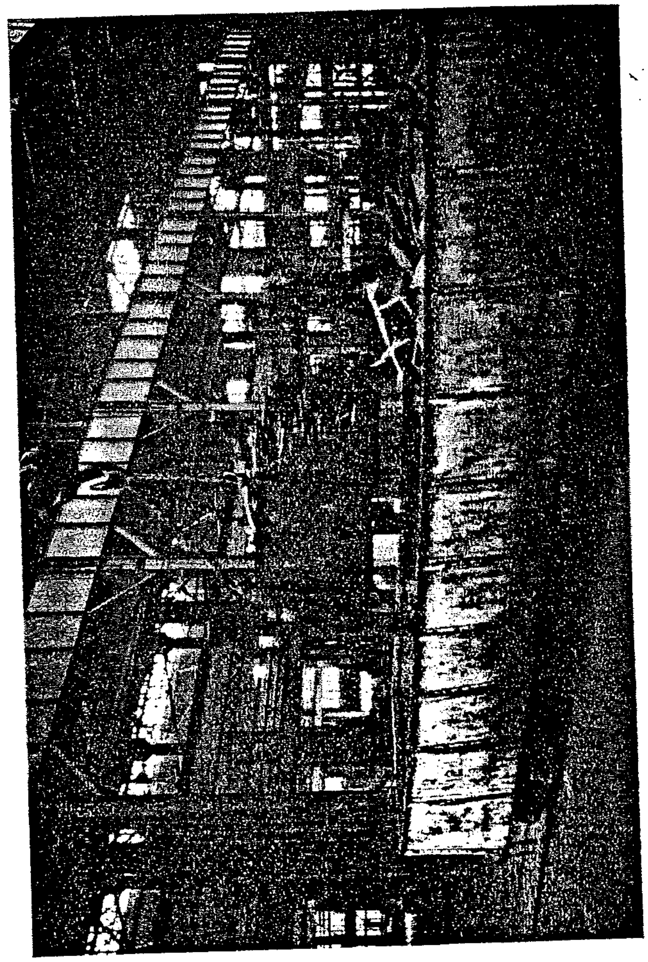
Another point in this connection, as will be noted from the arrangement of departments, is that all supplementary and supply sections are located as closely as possible to the departments where such materials or tools are mainly used. For example, the rivet storage is located near the bull riveting department and the finishing floor. This is true of the staybolt department. Since hand tools, taps, reamers, air tools, and the like, are principally needed in the finishing department, the tool room is located at this point. Following this same line of thought, the fabrication of small parts and the lesser sheets and mud-rings is carried out in the low bays of the shop where the crane clearance is ample to accommodate the work; thus leaving the high bays free for the movement and storage of larger sheets and assembly units.

This general outline of the boiler shop, as a whole, will be followed in later issues by detailed descriptions of the tools and methods employed in each of the departments into which the shop is divided.

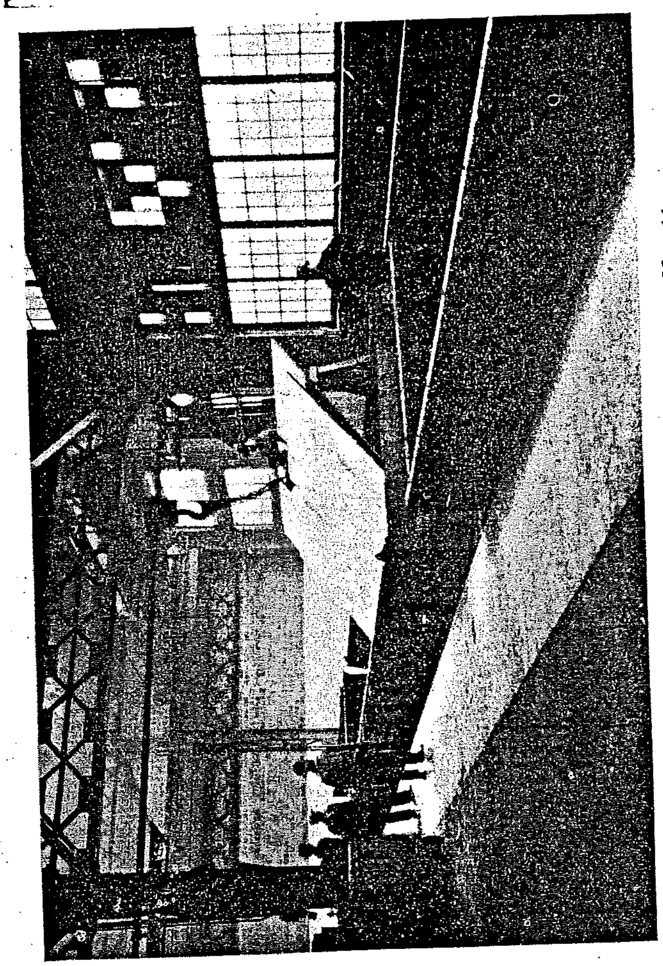
The Milburn Sales Corporation and the Milburn Paint Spray Corporation were incorporated on December 31, 1928, under the laws of the State of Maryland, to carry on the sale of a number of the products manufactured by The Alexander Milburn Company, Baltimore, Maryland. The Milburn Sales Corporation has taken over the selling of all equipment manufactured by The Alexander Milburn Company with the exception of the paint spray equipment and air guns for greasing purposes.



Method of handling plate in the storage department



Loading scrap material on freight cars by means of skips

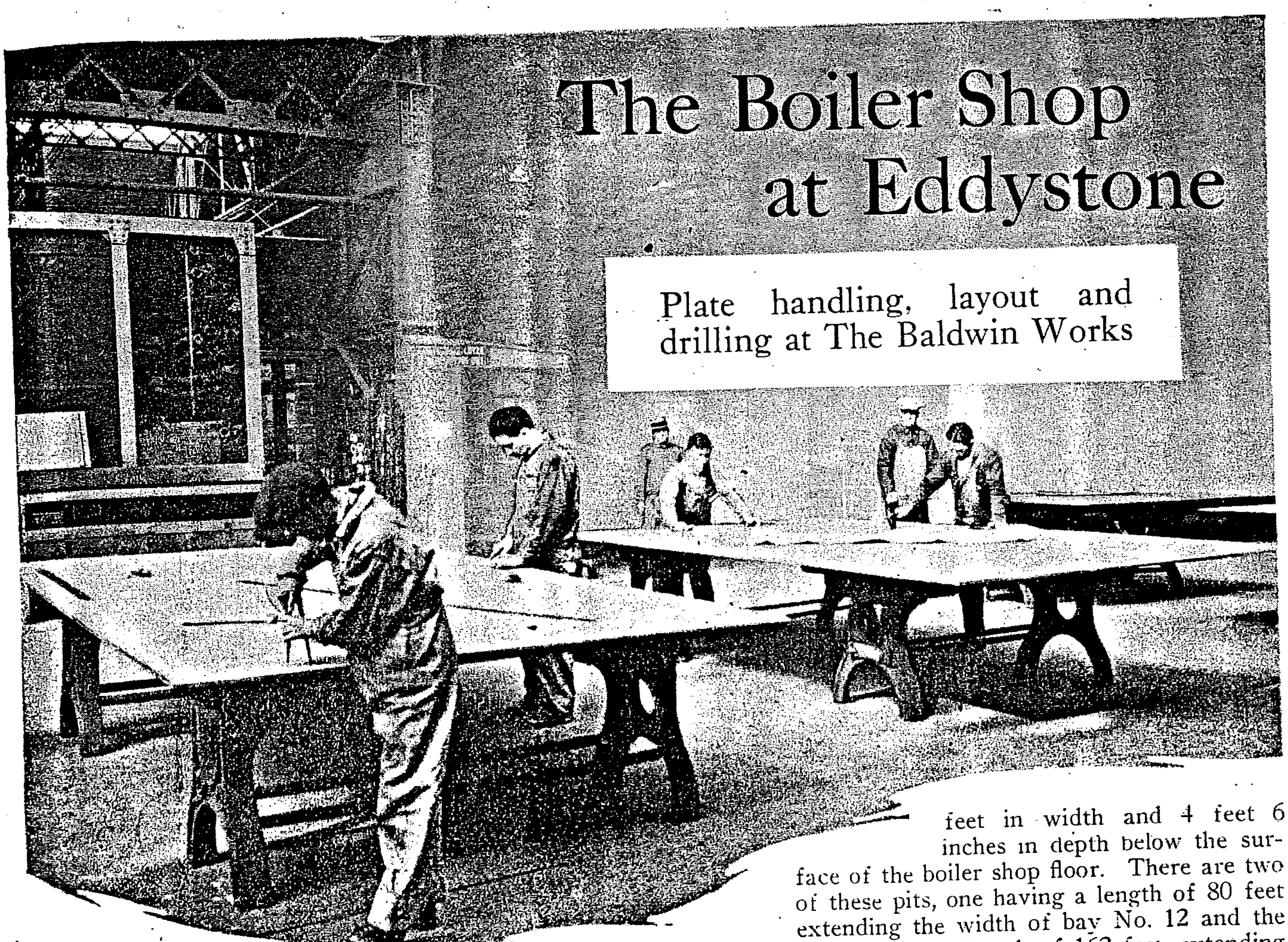


Unloading plate from freight cars in bay No. 11

Storage of boiler plate in bay No. 12

The Boiler Shop at Eddystone

Plate handling, layout and drilling at The Baldwin Works



THE flow of materials through the boiler building department of the Eddystone, Pa., plant of The Baldwin Locomotive Works follows an orderly procedure, requiring the least amount of material handling and clerical work. The layout of the shop, described in a previous article, provides the basis for the efficient employment of all equipment.

To obtain an idea of the course followed by material from the receiving platform, the requisition will be traced from the design department where the order for material originates. When the drawings for a locomotive boiler have been completed to the stage where material may be procured, the drafting department issues an order to the purchasing department for the required material. The purchasing department in turn orders the plates from the rolling mill, where they are rough cut to size and inspected by a representative of The Baldwin Locomotive Works. At the rolling mill, each plate is marked with a number corresponding to that on the bill of material, the serial number, the size of plate, and thickness, in addition to the steel mill's identification marks.

The material and shipping department advises the boiler shop of the material to be shipped from the steel mill each day. By this means, the shop is notified in advance of the actual receipt of material and is able to plan the work accordingly. When the material enters the boiler department, the car is traced by the traffic department and spotted in the receiving pits.

The receiving pits are located in the south end of the boiler shop and are served by the ladder track which enters the building by means of doors located at the southwest ends of bays Nos. 11 and 12. The pits are 11 feet in width and 4 feet 6 inches in depth below the surface of the boiler shop floor. There are two of these pits, one having a length of 80 feet extending the width of bay No. 12 and the other having a length of 162 feet, extending through both bays Nos. 11 and 12. The two receiving pits will permit the spotting of five cars at a time.

The door openings at the west end of the receiving pits are 18 feet 7 inches in height and 16 feet in width allowing ample clearance for the largest plates that require handling in the shop. A plate 197½ inches in width may be handled with ease through these doors when carried in a well car.

The receiving door is of the folding type built in three pieces with the hinges horizontal. The lower portion of the door is the same size as the width and depth of the receiving pit while the two upper portions are 16 feet in width. A hand-operated chain hoist is employed to raise and lower the doors, the lower corners of the second section running in a vertical track located on each side of the door opening. When being raised, the hinged portion is thrown outward.

The unloading and storing of materials comes under the charge of a contractor who is responsible for supplying material to the various departments in the boiler shop. In addition to all the overhead traveling cranes in the shop, this contractor has charge of the operation of two tractors, six trailers and six rail trucks.

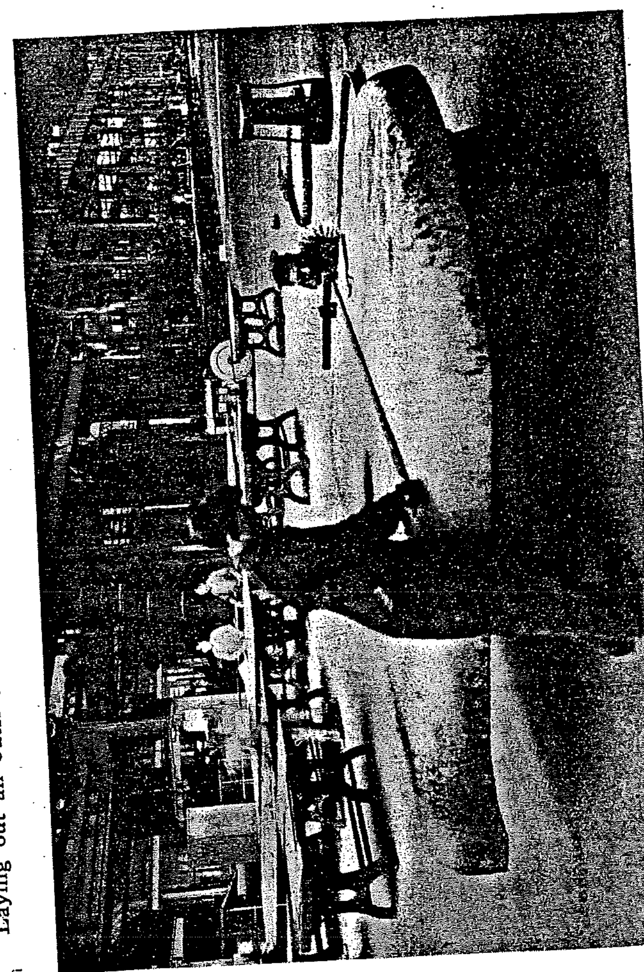
Cars spotted in bay No. 11 are served by one 10-ton Shepard crane and one 25-ton Niles-Sellers crane. Bay No. 12 is equipped with two 25-ton Niles-Milwaukee cranes that may serve the receiving pits. All sizes of plate clamps and safety dogs for each shape or weight of plate are available.

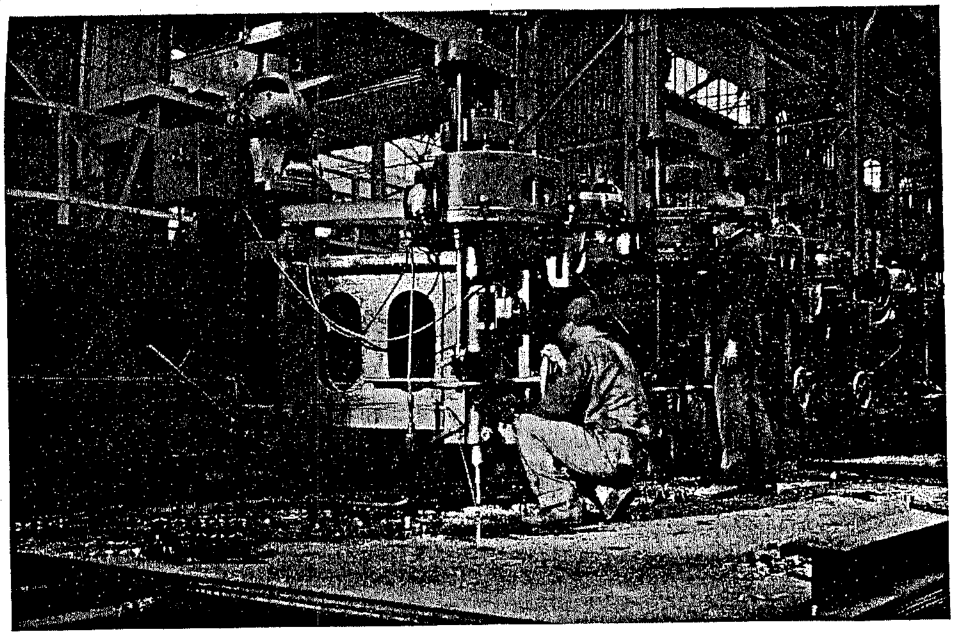
Boiler plate is stored between piers 24 and 31 in the south end of bay No. 12 adjacent to the receiving pits. Plates that do not require laying out, but require flang-

An inside throat sheet mounted on small surface block for complete layout

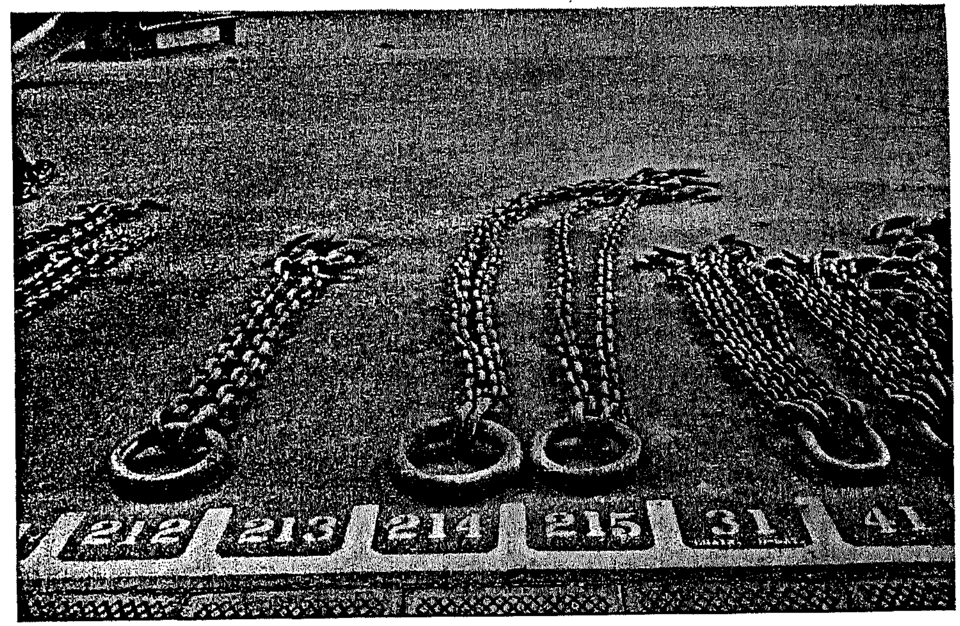
Interior of card room showing method of storing boiler cards

Laying out an outside throat sheet on the large surface block after flanging

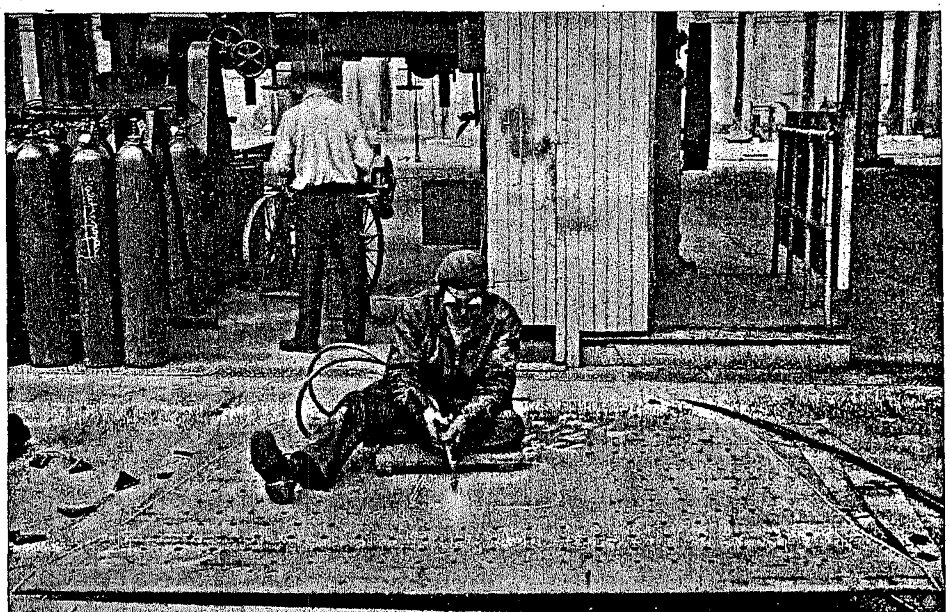




Drilling holes in five crown and sides sheets on the 4-spindle, radial drills

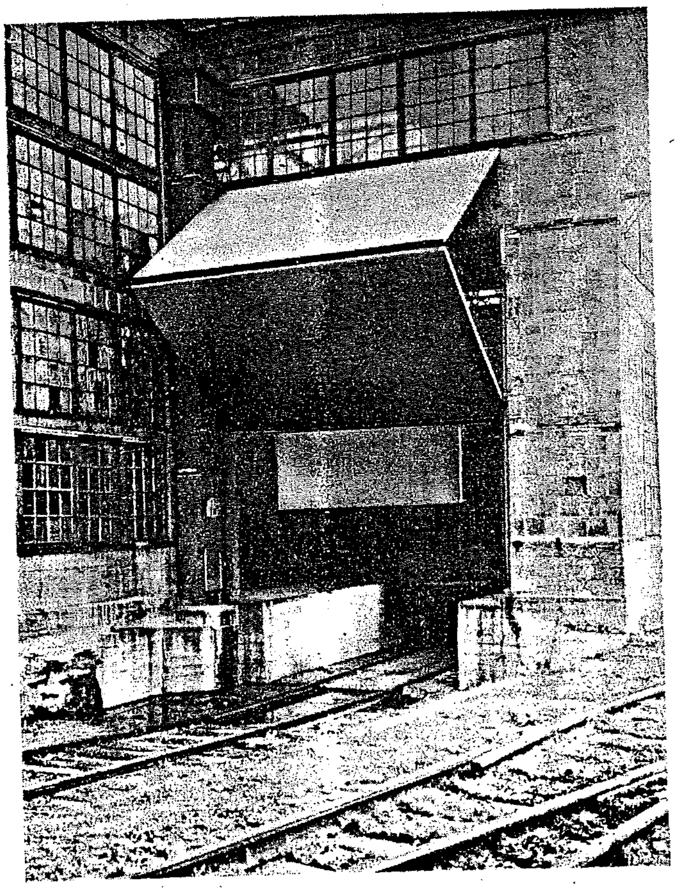


Chain storage in pier No. 17



Cutting the firedoor hole in the firebox back sheet

Cutting the edges of a roof top and side sheet before planing



Hinged door at the west end of the receiving pits

ing are sent directly to the flange shop in bay No. 13 This class of material includes sand box tops, domes, cylinder head covers, steam chest covers, smokebox fronts, smokebox front doors and other similar plates. Other material is stored in bay No. 12 in separate piles. Each group of sheets for one type of boiler is stored together in a separate section. Each type of plate in the given class of boiler is piled in a separate pile; for large plates, wooden spacers are placed between the sheets to facilitate handling.

As each plate is required for laying out, the contractor in charge of this work verbally orders the material from the contractor in charge of material storage. By this means a great deal of inter-department red tape is eliminated.

Layout Department

The layout department is located in bay No. 12 between piers 18 and 24. The shop equipment employed in this department consists of 23 tables, each 29 inches wide by 80 inches long and 32 inches high, constructed of 3-inch wooden planks mounted on cast-iron legs. In addition, there are two surface blocks, one 10 feet by 14 feet and the other 7 feet by 10 feet.

A small template shearing machine (illustrated) is located in pier 23. This is a piece of shop-made apparatus, consisting of an electric hand motor mounted on a bench constructed of plate and angle bar. The motor is placed with the shaft horizontal. Two 1¼-inch blades are mounted, one in a fixed position to the bench and the other on a ring which is set in motion by means of an eccentric mounted on the horizontal shaft. The shears are self feeding.

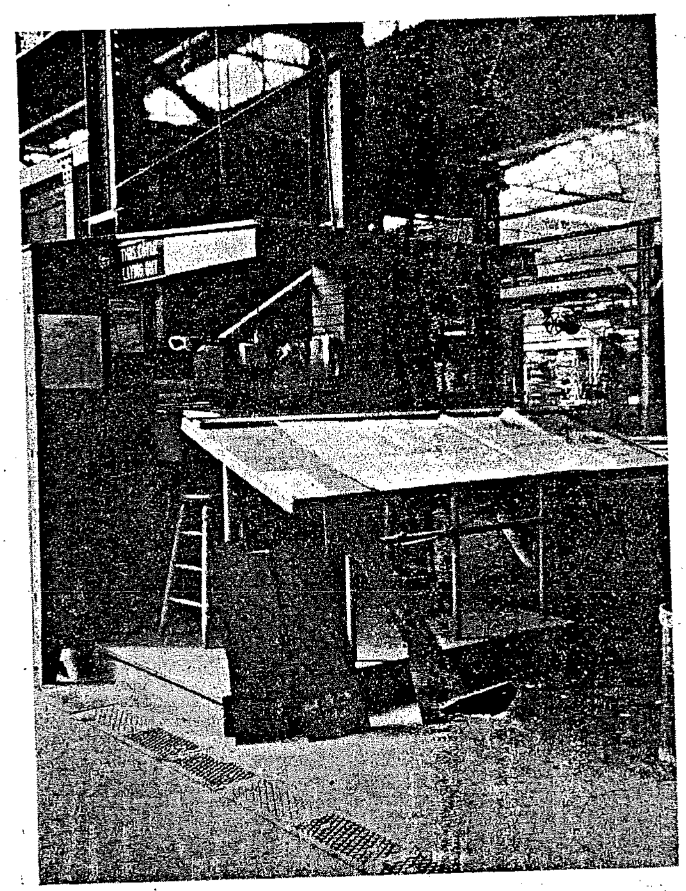
The layout of a complete boiler proceeds in the following order: Smokebox and smokebox liner; No. 1 ring, butt straps and liners; No. 2 ring, butt straps and liners; No. 3 ring, butt straps and liners; dome liner and dome; top and sides sheets and crown and sides sheets; front tube sheet; outside and inside throat sheets; back tube sheet; back firebox sheet; and backhead of boiler. The dome cap and smokebox front are the last sheets to be laid out.

Boilers are laid out full size in the shop by the layer-outs working in teams of two men each. When a drawing is first delivered to the layout department, one of the men draws a full-size working plan of the boiler from which all plates are developed on the bench. After it has served its purpose, the working plan is numbered and filed in the card room making it possible to duplicate a boiler or any sheet in it at any time. Boiler cards are also stored in the card room where they are filed in bins. Twenty-four cards are stored in each bin which is numbered according to the cards it contains. A record of all cards filed in the card room, together with the location and number, is kept in a large book for this purpose.

All plates that do not require flanging are laid out in complete form on the laying out table. This includes the layout of rivet holes, staybolt holes, flue holes, fitting holes, finished outline, etc. Every sheet is laid out by the laying out department with the exception of the front tube sheet which is fitted by the dome and front tube sheet contractor.

Flanged plates are laid out in reference to shape and contour only before being sent to the flange shop. After flanging, they are returned to the layout department where they are mounted on the surface block and checked for any discrepancy in flanging. They are then laid out complete.

Outside and inside throat sheets on being returned to the layout department are leveled up by means of screw jacks and fitted to a plan drawn on the surface block. This is done by means of a steel square projecting the



The contractor's desk in the layout department plan from the surface block vertically to the throat sheet. With the throat sheet in this position, the rivet lines are laid out and the rivet holes are located by means of templates taken from the side sheets along the waterleg of the boiler. A template made from the connecting boiler course is used to locate the rivet holes around the belt of the throat sheet. The staybolt holes and the water-space rivet lines are laid out from the plan on the surface block.

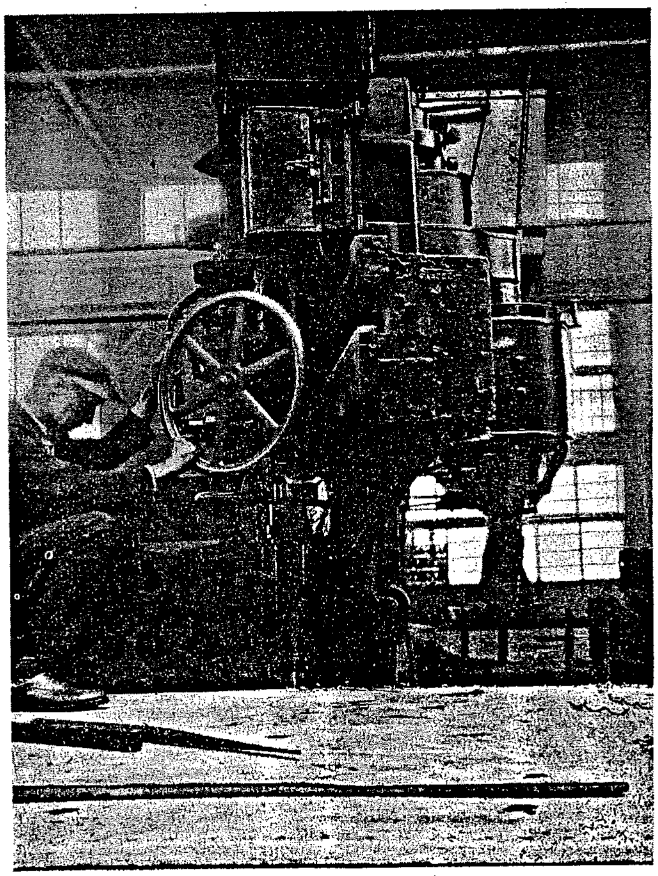
After the rivet holes are located, the plate cutting line is drawn and center punched. The staybolt holes and rivet holes are center punched and the sizes marked in white lead after which all staybolt holes are free-hand circled with white lead.

Before each plate leaves the layout department, it is stamped with the number of the boiler, serial number and sizes of washout holes. In the case of taper courses, the circumferences of the front and back are stamped but on all courses the front and back are indicated.

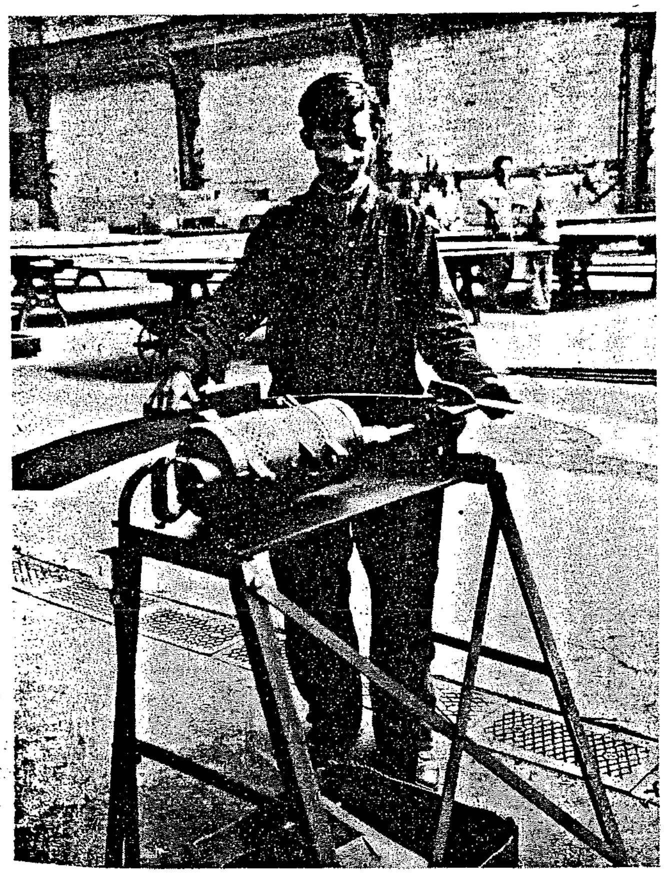
Drilling Department

After being laid out, the plates pass along the original line of material flow to the drilling and shearing department located in the same bay, between piers 1 and 16. For a distance of 168 feet are located 12 batteries of Sellers four-spindle multiple radial drills each having four arms and four motors. Operating at full capacity, 48 holes may be drilled at one time. Tables for drilling, running the full length of six batteries of drills, consist of five horizontal 8-inch I-beams raised to a height of 38 inches above the shop floor. The I-beams are spaced about 2 feet on centers.

The sheet as marked in the layout department is used as a pattern plate for drilling additional sheets of a similar design. The pattern plate is placed on the radial drill table and the holes are spotted. This is done by running a small drill slightly into the plate at each center-punch hole. By this means, the drill operator may operate two or more machines at a time due to the fact that a great deal of time is saved in eliminating the necessity for catching the center punch holes in the final drilling process. Where the hole has been started, the drill becomes self-centered.



A 72-inch radial drill in action



Cutting a template on a shop-made template-shearing machine

After the pattern plate holes are spotted, a series of duplicate plates to be drilled are placed upon the table with the pattern plate uppermost. About a dozen tack bolt holes are drilled in the plates which are assembled by means of tack bolts and a large H-beam is clamped to the edge of the plates to prevent warping. Four or five plates with a total thickness of about 3 inches are drilled at one time depending on the thickness of the plates.

After all the plates have been drilled, the duplicate plates are spread out on layout benches for lining up, layout of lap and outline, and stamping the plates with the number of the boiler, serial number and sizes of washout holes. The plates are then carried by crane to either the shears or to the oxy-acetylene burning table for trimming.

The flue holes and staybolt holes of flanged plates, such as backhead and furnace tube sheets are drilled on the 60-inch and 72-inch radial drills located in piers 7 and 8. This equipment consists of one 3-spindle battery of Sellers 72-inch radial drills, one Harrington 60-inch radial drill, and one Baush 60-inch radial drill. Rivet holes in the flange sheets are drilled on horizontal drill presses located in bay No. 8. In all plates, plug holes and other holes 2 inches in diameter and over are cut on the 60-inch and 72-inch radial drills.

Where sheets are less than ½ inch in thickness, they are generally trimmed by means of shears. Material is awkward, is trimmed by means of the oxy-acetylene over this thickness or shaped so that the shearing process burning process. Firedoor holes and large openings are generally burned.

The gas-cutting apparatus is located in bay No. 12 in pier 8 and consists generally of a manifold, connecting 24 bottles of oxygen, and a smaller manifold for acetylene. For every 5 bottles of oxygen, one bottle of acetylene is used though only one bottle of acetylene is employed at a time.

Three motor-driven shears are located in the north end of bay No. 12 and are each served bv hand jib cranes. Two shears are located in pier 2. On the west side, is a 36-inch Bement-Miles shear served by a 7-ton hand jib crane having a maximum reach of 17 feet 5 inches. On the east side of pier 2 is located a 60-inch Bement-Miles shear which is served by a 6-ton hand jib crane having a reach of 19 feet. In pier 4 is located one No. 8 Southwark open-throat shear and a 6-ton jib crane having a reach of 18 feet 9 inches.

The only sheet in which countersinking is done by the drilling department is the smokebox.

A motor-operated Hisey-Wolf double emery wheel, having wheels 12 inches in diameter with 1½-inch faces, is located in pier 8.

The entire drilling and shearing department is served by one 25-ton Niles-Sellers and one 25-ton Niles traveling crane. By this means manual material handling is reduced to a minimum.

An interesting innovation in the method of storing crane chains (system illustrated) is employed in the boiler shop. The contractors having the use of hoisting chains store them on the floor at the side of the bay. In bay No. 12, chain is stored in piers 7 and 17. Each chain is numbered. Marked on the shop floor in large white numerals is the corresponding number of the chain. The chain is stored opposite this number in such a way that it is displayed for inspection at all times. Adjacent to the row of numbers corresponding to the chain numbers is the number of the contractor who is responsible for all chains thus stored. By this method of storage, loss of chain is prevented and each contractor is better able to account for his property. Skips conveniently located throughout the shop are employed to collect scrap material and turnings. When filled, these skips are transported by means of cranes to pier 9 where the scrap is dumped into cars and removed from the shop by way of the track running through pier 9. Empty skips are stored in the north end of bay No. 12.

The next issue will contain a detailed description of the equipment and methods employed in the flanging department.

High-Pressure Watertube Boilers

Progressive circulation and economizer used to reduce mechanical difficulties

By Louis A. Rehfuss

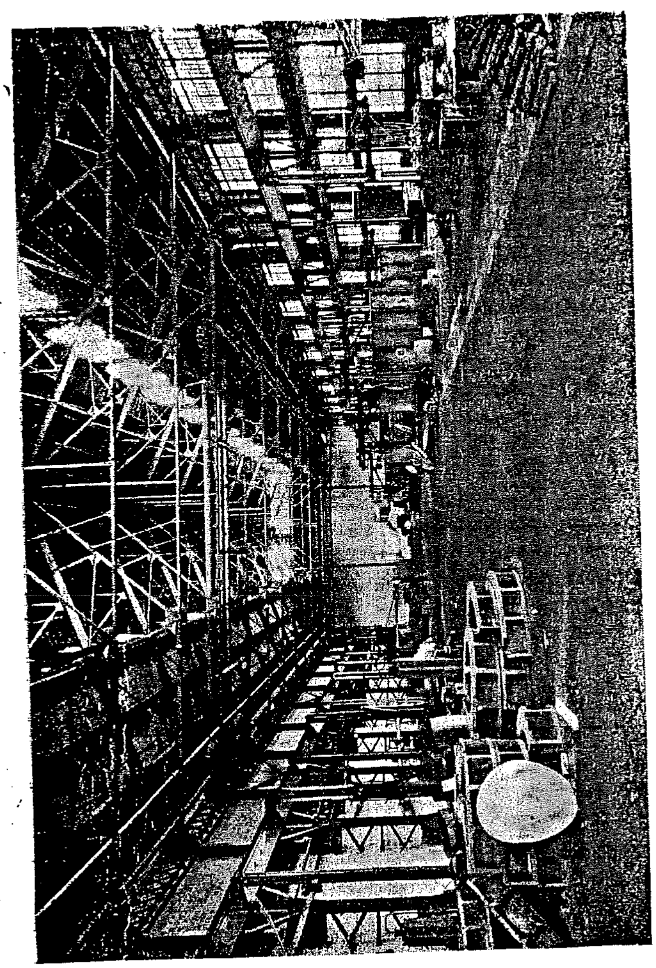
HIGH steam pressure versus condensing back pressures has been a debatable subject for those interested in advancing the thermal efficiency of the steam locomotive. Both have their advocates and there is unquestionably much to be said on either side. The fact that the condensing principle has so far only been applied to European locomotives need not detract from its essential interest to the American railway fraternity.

The employment of the condensing principle is recognized as likely to give a greater increment in heat utilization than higher steam pressures, but it is also true that it does this only at the expense of far more radical changes in design than are involved in the use of higher pressures. Such changes as the substitution of turbine for reciprocating drive, the use of expensive high-speed gears with reduction ratios of 20 to 1, the employment of high capacity condensers with limited cooling agencies available, and the use of mechanical draft, all illustrate the complexity of the problem involved. The power required for mechanical draft, condenser fans and other auxiliaries constitutes a charge on the gain in thermal efficiency that leaves the net thermal gain but little greater than the gain possible by a proper utilization of the high-pressure principle.

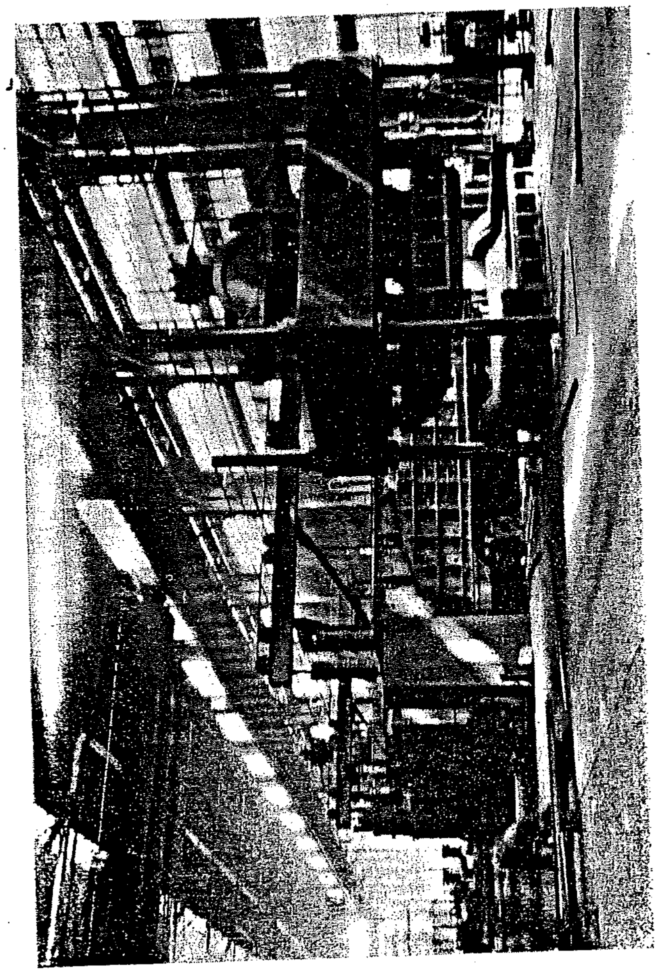
Critics of high steam pressures in their comparisons of steam at different pressures usually state conditions which do not give the higher pressures the same benefits from superheating that they give the lower pressures. Because of the advisability of restricting the steam temperature to a reasonable limit, such as 700 degrees F., the comparison is made to show only 29 percent gain in the Rankine cycle efficiency in increasing the steam pressure from 250 to 750 pounds per square inch, where the steam temperature is restricted to 700 degrees F. in each case. Since this assumption means a high superheat in the case of the low-pressure steam and a low superheat for the high-pressure steam, the comparison is somewhat misleading. However, since high-pressure engines are designed compound in order to get the expansion ratio required for efficiency, compound superheating may also be utilized, which introduces a gain not ordinarily considered. Because of the high pressure of the initial steam, the intermediate-pressure steam has sufficient pressure and hence sufficient density to make its superheating an attractive and feasible proposition without employing an abnormally large superheater, where it would not be considered at lower pressure ranges with their excessive steam volumes.

The further objection to high pressures in the decreased boiler efficiency resulting from the lower temperature head between the high temperature boiler water and the furnace gases can of course be met, as has been suggested several times, by the employment of an economizer, or feed-water preheating section next the smokebox.

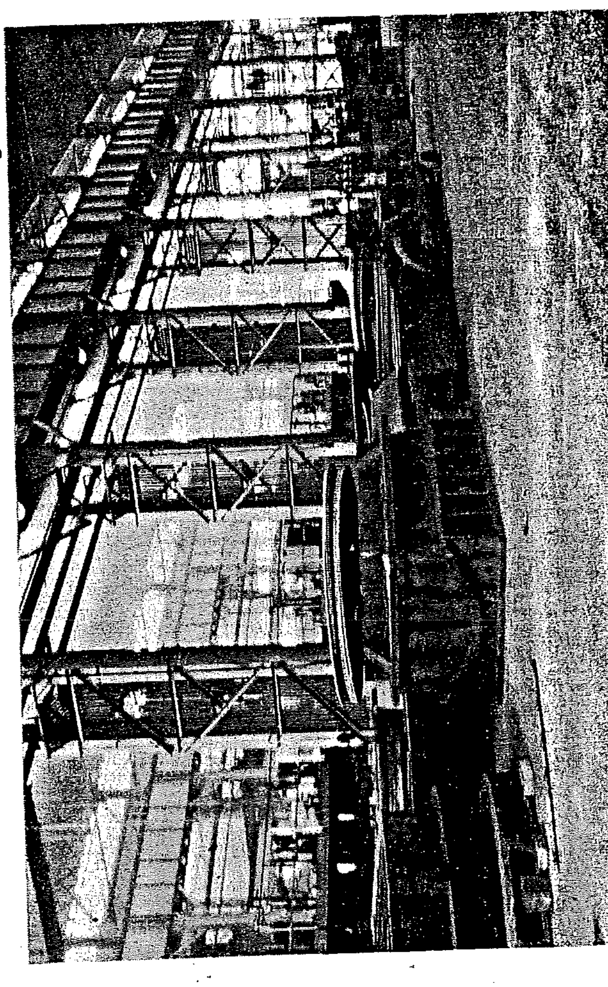
On the other hand, the use of high pressure involves far less changes in locomotive designs than does the condensing operation. A watertube boiler, compound drive and preferably the use of poppet valves would be required. By the use of the latter, limited cut-offs with extensive steam expansion may be employed with a minimum of wire drawing of the steam. Of these changes the design of a satisfactory all-watertube boiler offers probably the greatest problem.



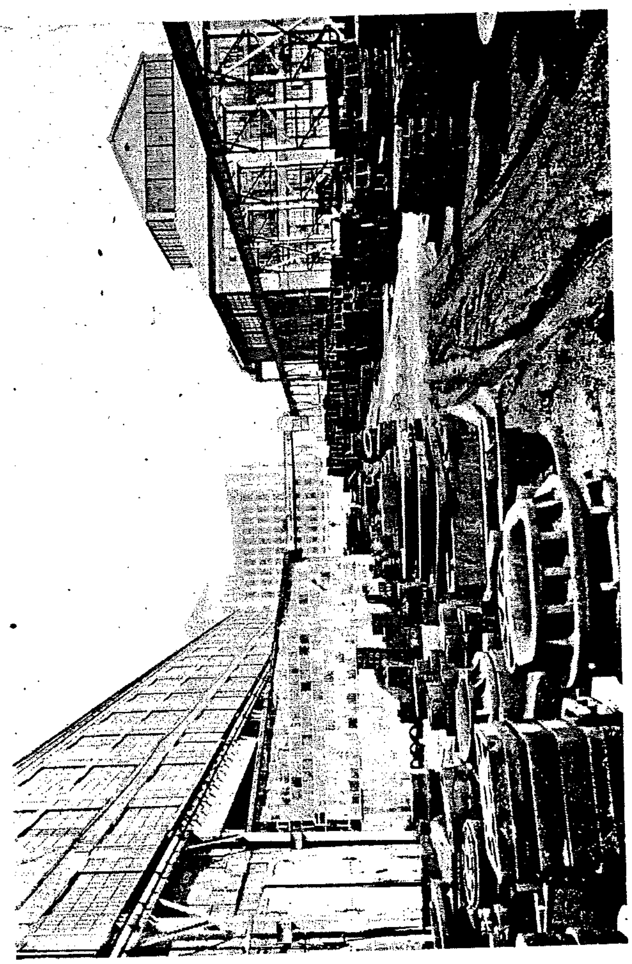
General view of lower shop looking north



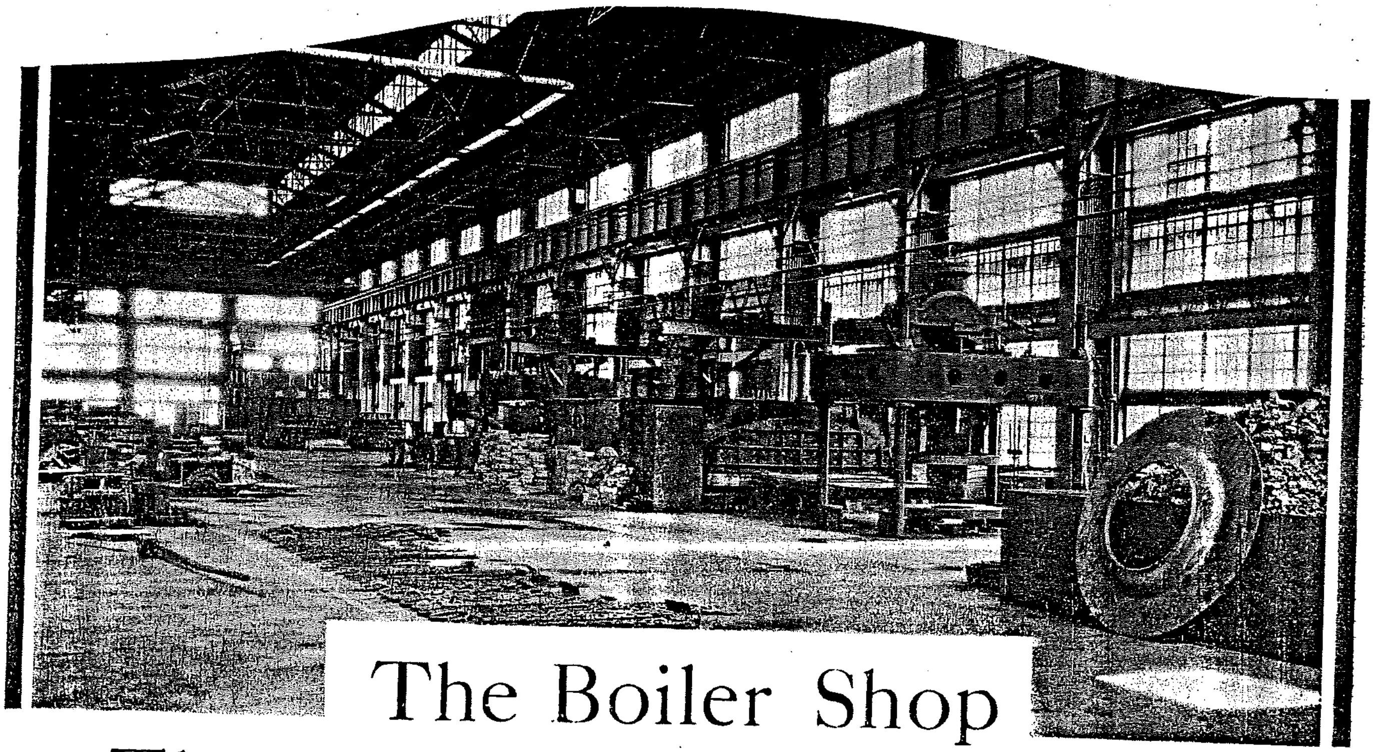
General view of the upper bay showing an R. D. Wood flanging press and its furnace



Die storage at the side of upper bay No. 13



Die storage at the east side of the main boiler shop



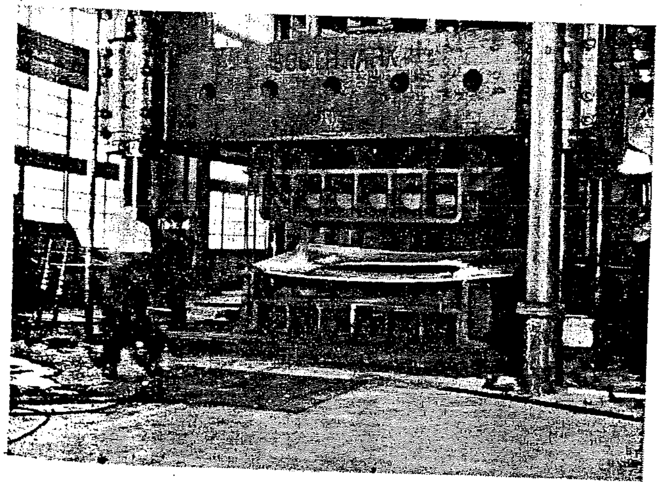
The Boiler Shop at The Baldwin Locomotive Works

Methods employed in the flanging department of the Eddystone plant

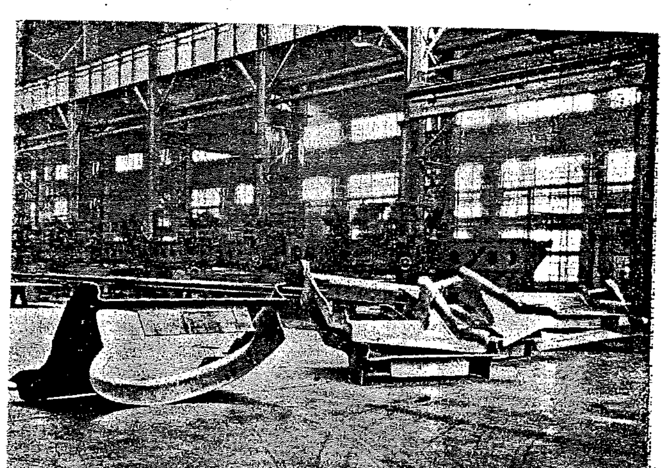
IN the process of constructing locomotive boilers at The Baldwin Locomotive Works, Eddystone, Pa., one of the departments that contributes in a large degree to the success of economical and efficient boiler production is the flange shop. Located in the extreme easterly portion of the main boiler shop, the flanging department occupies what is known as bay No. 13 which comprises a space between two lines of columns 80 feet apart and extending the width of the shop, a distance of 816 feet. Columns, are spaced every 24 feet in the width of the shop and because of this the bay is divided into 34 panels or sections.

The area is divided into two sections, an upper and lower bay. The upper bay, extending between panels 1 and 17, is served by two electric overhead traveling cranes, a 100-ton Sellers crane and a 25-ton Milwaukee-Sellers crane. The lower bay, which extends between panels 17 and 24 and which is enclosed by a cinder-block wall, is served by one 20-ton Shepard electric overhead traveling crane. The upper bay is also served by one 3-ton hand jib crane located adjacent to an R. D. Wood sectional flanger in panels 7 and 8, while the lower shop is amply supplied with jib cranes of 3-ton capacity and under. This equipment includes fourteen 3-ton hydraulic jib cranes, one 3-ton hand jib crane, two 2-ton hand jib cranes and three 1-ton hand jib cranes.

Outside the main building and extending a distance



Throat sheet in the 1160-ton Southwark press

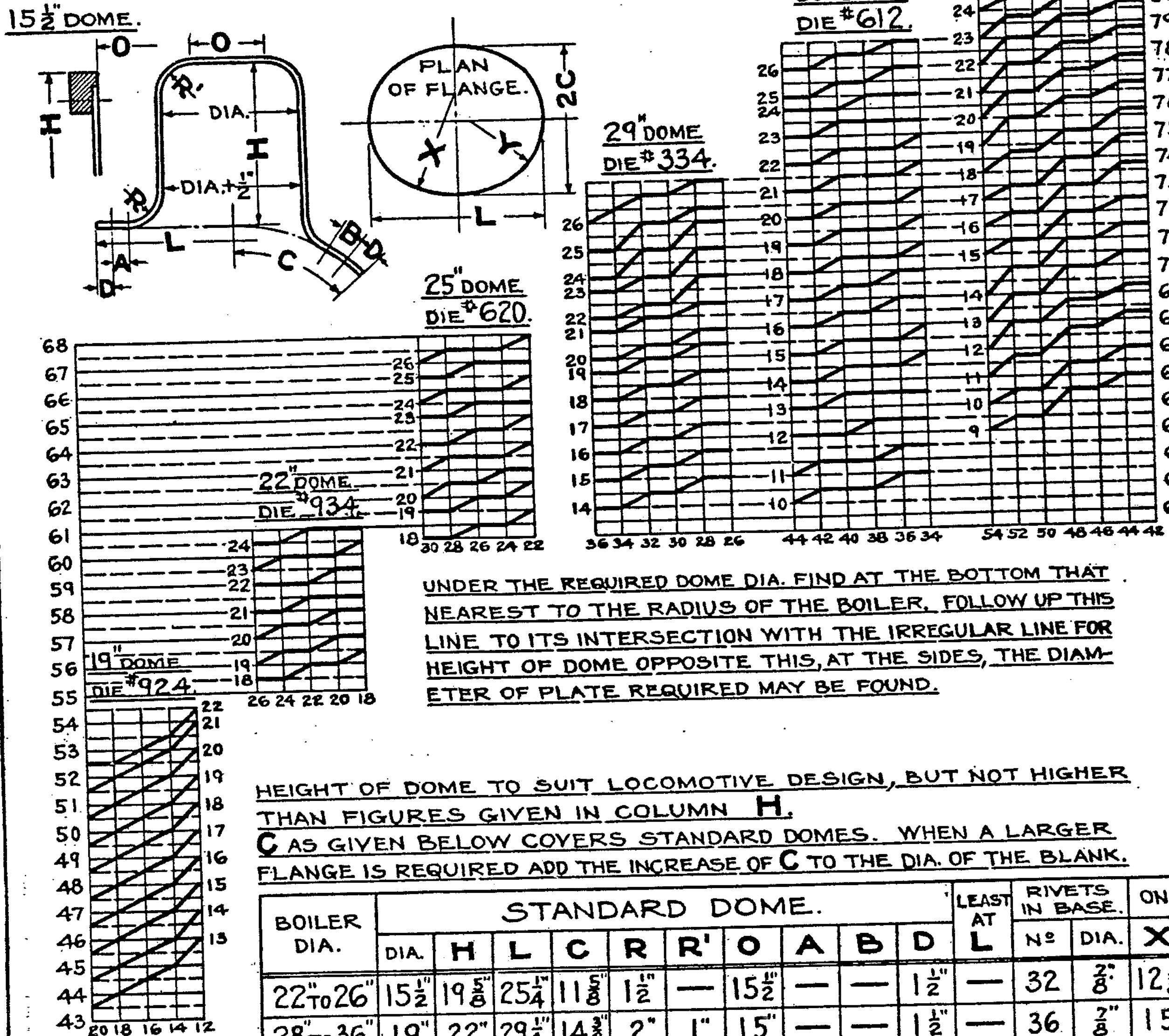


Throat sheets returned to layout department after flanging

THE BALDWIN LOCOMOTIVE WORKS
ENGINEERING DEPARTMENT
PHILADELPHIA. PA.

STANDARD DOMES

ORDER BOILER PLATE $\frac{3}{4}$" X 48" DIA. FOR ANY 15½" DIA. DOME 19" HIGH OR LESS - RAD. 11" TO 13" - DIE No 995.
ORDER BOILER PLATE $\frac{13}{16}$" THICK FOR 19" & 22" DOMES.
ORDER BOILER PLATE $1\frac{1}{8}$" THICK FOR 25", 29", 33" & 36" DOMES.

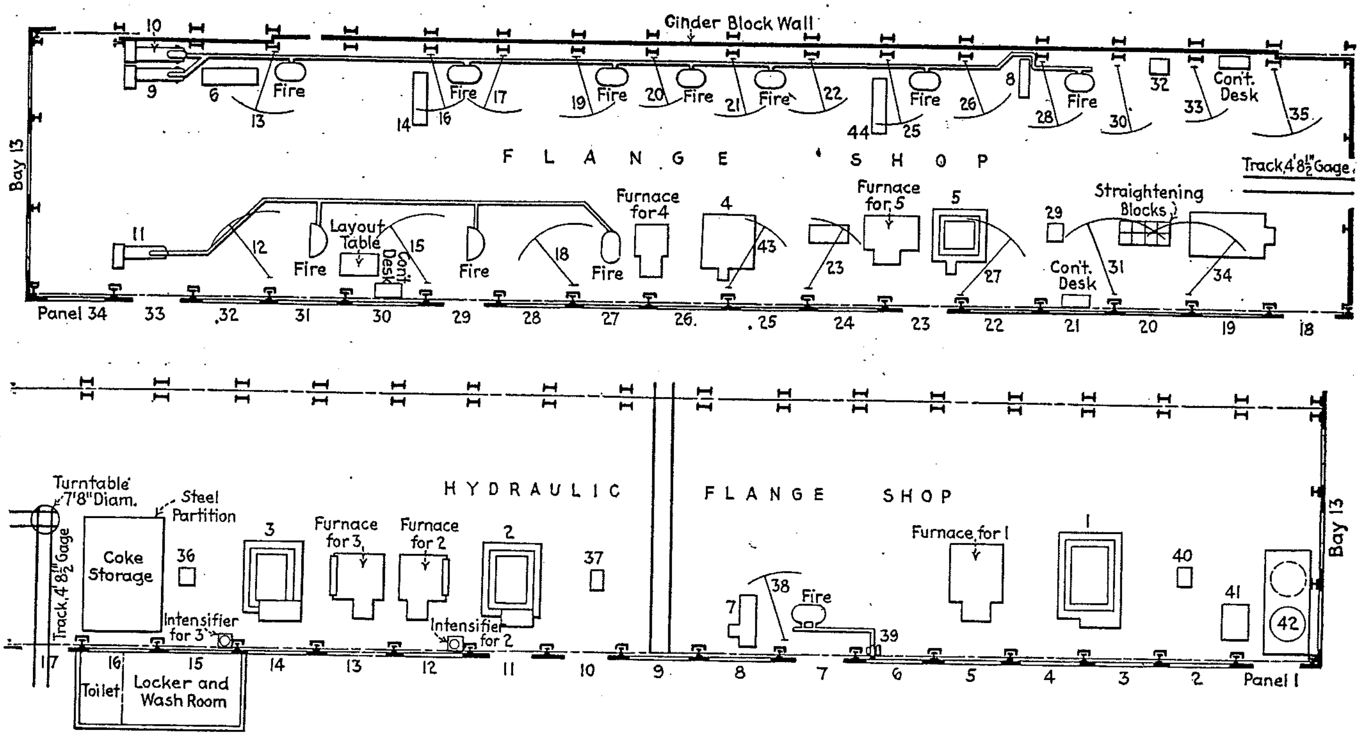


UNDER THE REQUIRED DOME DIA. FIND AT THE BOTTOM THAT NEAREST TO THE RADIUS OF THE BOILER. FOLLOW UP THIS LINE TO ITS INTERSECTION WITH THE IRREGULAR LINE FOR HEIGHT OF DOME OPPOSITE THIS, AT THE SIDES, THE DIAMETER OF PLATE REQUIRED MAY BE FOUND.

HEIGHT OF DOME TO SUIT LOCOMOTIVE DESIGN, BUT NOT HIGHER THAN FIGURES GIVEN IN COLUMN **H**.
C AS GIVEN BELOW COVERS STANDARD DOMES. WHEN A LARGER FLANGE IS REQUIRED ADD THE INCREASE OF **C** TO THE DIA. OF THE BLANK.

BOILER DIA.	STANDARD DOME.										LEAST AT L	RIVETS IN BASE.		ON FLAT.	
	DIA.	H	L	C	R	R'	O	A	B	D		No	DIA.	X	Y
22" TO 26"	$15\frac{1}{2}$"	$19\frac{5}{8}$"	$25\frac{1}{4}$"	$11\frac{5}{8}$"	$1\frac{1}{2}$"	—	$15\frac{1}{2}$"	—	—	$1\frac{1}{2}$"	—	32	$\frac{7}{8}$"	$12\frac{5}{8}$"	$11\frac{5}{8}$"
28" TO 36"	19"	22"	$29\frac{1}{4}$"	$14\frac{3}{8}$"	2"	1"	15"	—	—	$1\frac{1}{2}$"	—	36	$\frac{7}{8}$"	15"	$13\frac{5}{8}$"
38" TO 44"	22"	24"	$36\frac{3}{4}$"	$17\frac{7}{8}$"	2"	2"	15"	$1\frac{7}{8}$"	$1\frac{7}{8}$"	$1\frac{1}{2}$"	36"	72	$\frac{7}{8}$"	$18\frac{3}{8}$"	$16\frac{7}{8}$"
46" TO 54"	25"	26"	$41\frac{3}{4}$"	$20\frac{1}{8}$"	2"	$3\frac{5}{8}$"	15"	$2\frac{1}{2}$"	$2\frac{1}{2}$"	$1\frac{1}{2}$"	$40\frac{1}{2}$"	88	$\frac{7}{8}$"	$21\frac{3}{8}$"	$19\frac{5}{8}$"
56" TO 68"	29"	26"	$49\frac{1}{4}$"	$22\frac{1}{2}$"	2"	$3\frac{5}{8}$"	$19\frac{1}{2}$"	$2\frac{1}{4}$"	$2\frac{1}{4}$"	$1\frac{5}{8}$"	46"	96	1"	26"	21"
70" TO 84"	33"	26"	$52\frac{1}{2}$"	$24\frac{1}{4}$"	2"	$4\frac{1}{2}$"	$21\frac{1}{2}$"	3"	$2\frac{1}{2}$"	$1\frac{5}{8}$"	50"	96	1"	28"	$23\frac{1}{2}$"
86" & OVER	36"	26"	55"	$25\frac{3}{4}$"	2"	$4\frac{1}{2}$"	24"	3"	$2\frac{1}{2}$"	$1\frac{11}{16}$"	$52\frac{1}{2}$"	96	$1\frac{1}{8}$"	$28\frac{3}{4}$"	$24\frac{9}{16}$"

Chart for determining plate diameters for the fabrication of standard domes



Layout of the flange shop showing location of machines described in tables below

Table 1—Four-Post Hydraulic Flanging Presses

Machine Number	1	2	3	4	5
Machine location (panel)	3–4	11	14	25–26	22–23
Name of maker	Southwark	Southwark	R.D.Wood	R.D.Wood	Fielding, Platt&Co.
Width between front posts	15' 0"	12' 0"	12' 0"	8' 4"	7' 0"
Width between side posts	10'10"	8' 0"	8' 0"	4' 0"	2' 7"
Length of table	18' 0"	15' 0"	15' 0"	9' 0"	7' 6"
Breadth of table	11' 7"	10' 2"	10' 0"	8'10"	7' 6"
Maximum height between plattens	6' 0"	4' 0"	4' 0"	4' 0"	3' 4"
Main table pressure (tons)	1160	603	503	370	236
Center ram pressure (tons)	260	186	224	115	...
Top ram pressure (tons)	460	{214 / 305	426	...	...
Four jacks pressure (tons)	280	191	151	169	85
Main table stroke	72"	48"	48"	44"	21"
Center ram stroke	36"	48"	48"	44"	...
Top ram stroke	42"	36"	29"	...	...
Four jacks stroke	36"	26"	24"	24"	21"
Furnace width	16' 4"	12' 9"	12' 9"	8' 3"	8' 3"
Furnace depth	15' 0"	13' 5"	13' 5"	10'10"	15' 6½"
Furnace front height	4' 0"	3' 4"	3' 4"	3' 0"	2' 6"
Furnace center height	3' 6"	3' 9"	3' 9"	3' 6"	3' 0"
Distance from press to furnace	21' 4"	14' 4"	14' 0"	10' 6"	8' 6"
Furnace location (panel)	5	12	13	26–27	23–24

Table 2.—Hydraulic Sectional Flanging Presses

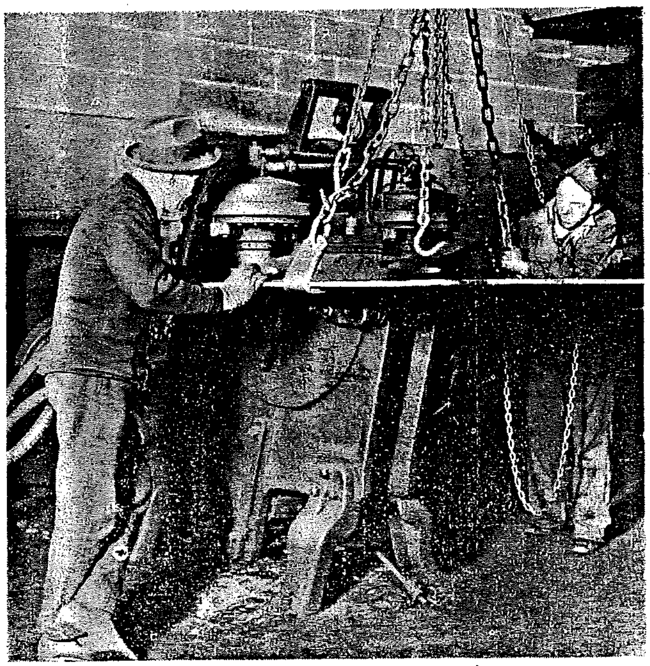
Machine Number	6	7	8
Name of maker	Southwark	R. D. Wood	Morgan Engineering Co.
Height between table and rams	45"	46"	48"
Distance between inner ram and frame	52"	62"	40"
Distance between inner and outer rams	19"	19"	16½"
Width of press	10' 0"	9' 6"	7' 0"
Width of table	5' 0"	4' 6"	3' 6"
Pressure of inner ram (tons)	106	92	48
Pressure of outer ram (tons)	106	92	48
Pressure of horizontal ram (tons)	59	48	..
Location (panel)	32	8	22

Table 3.—Machines Located in Bay 13

Machine No.	Machine	Location Panel
9	No. 7 Sturtevant blower	33
10	No. 7 Sturtevant blower	33
11	No. 8 Sturtevant blower	33
12	3-ton Baldwin hydraulic crane, 21' 10" reach	31–32
13	3-ton Baldwin hand jib crane, 20' 0" reach	31–32
14	150" Baldwin hydraulic plate clamp	30
15	3-ton Baldwin hydraulic crane, 21' 8" reach	29–30
16	3-ton Baldwin hydraulic crane, 18' 3" reach	29–30
17	1-ton Baldwin hand jib crane, 17' 4" reach	28–29
18	3-ton Baldwin hydraulic crane, 19' 1" reach	27–28
19	3-ton Baldwin hydraulic crane, 18' 7½" reach	27–28
20	2-ton Baldwin hand jib crane, 15' 8" reach	26–27
21	3-ton Baldwin hydraulic crane, 17' 9" reach	25–26
22	2-ton Baldwin hand jib crane, 16' 6" reach	24–25
23	3-ton Baldwin hydraulic crane, 22' 0" reach	24–25
24	150" Baldwin hydraulic plate clamp	24
25	3-ton Baldwin hydraulic crane, 19' 11" reach	23–24
26	3-ton Baldwin hydraulic crane, 17' 10" reach	22–23
27	3-ton R. D. Wood hydraulic crane, 23' 2" reach	22–23
28	1-ton Baldwin hand jib crane, 20' 8" reach	21–22
29	5-horsepower Baldwin electric winch	21
30	3-ton Baldwin hydraulic crane, 21' 9½" reach	20–21
31	3-ton R. D. Wood hydraulic crane, 23' 9" reach	20–21
32	McCabe ¾" plate air operated cold flanging press	20
33	1-ton Baldwin hand jib crane, 17' 2" reach	19–20
34	3-ton R. D. Wood hydraulic crane, 22' 3" reach	19–20
35	3-ton Baldwin hydraulic crane, 21' 6" reach	18–19
36	5-horsepower Baldwin electric winch	15
37	5-horsepower Baldwin electric winch	10
38	3-ton Baldwin hand jib crane, 21' 0" reach	7–8
39	No. 5 Sturtevant blower	6
40	5-horsepower Baldwin electric winch	2
41	16-inch American Engineering Co. electric capstan	2
42	Birdsboro hydraulic accumulator	1
43	3-ton Baldwin hydraulic crane, 22' 6" reach	25–26

corresponding to panels 1 to 21 is located the die storage yard. This yard is served by a 15-ton Niles-Shepard overhead traveling crane and a railroad track which enters the main shop in panel 17. With this arrangement, dies stored in any part of the die storage yard may be picked up by the outside traveling crane and carried to panel 17 where they are loaded on a small flat car and transported inside the shop. Once inside the shop, they may be picked up by either of the two cranes in the upper bay and carried to any desired location. For the purpose of transporting dies to the lower bay, a turn-table is located in panel 17 by which the flat car may be shunted on a short track extending into panels 18 and 19. There, the die may be picked up and spotted at any location in the lower bay.

With this orderly system of material handling, operating in conjunction with the most up-to-date flanging equipment, a description of which is given in the ac-



Firebox sheet being flanged on a McCabe pneumatic flanging machine

companying tables, it is not difficult to see that waste motion and time are greatly reduced as compared with hand-flanging methods. Hydraulic flanging is employed as far as possible in the construction of boilers and for this purpose a great number of dies are on hand for use on the hydraulic flange presses.

Only a limited number of dies in current use are stored inside the shop. These are located in bay No. 13 adjacent to bay No. 12 in the upper bay, but a space is always kept clear to allow the passage of tractors in their work of handling plates in and out of the shop. Thus with the use of dies, flanging operations are reduced to a minimum, most of the work being done with one heat only. However, domes and a number of other parts, such as sand box tops, cylinder heads, steam chest casings, valve head covers, and the like, which require a drawing-out process, often employ more than one heat to prevent excessive thinning of material.

All plates that require flanging on entering the boiler shop are stamped with the number of the boiler and the serial number prior to being sent to the flange shop. The class of plate, mentioned in the previous paragraph that does not require trimming prior to flanging is sent directly to the flange shop after being stamped. Other plates, such as throat sheets, firebox sheets, backheads, back tube sheets, etc., are laid out to size in the layout department and are trimmed before being flanged.

Dome Fabrication

Domes may be fabricated on either of the three flanging presses in the upper bay and the number of dies employed in the flanging process depends upon the height and diameter of the dome. Usually from one to five heats are necessary.

The drawing process of dome fabrication causes the reduction of plate thickness to a slight degree. For this reason it is necessary to order material with enough excess thickness to allow for this reduction. For convenience in ordering, the required thickness together with the diameter of the plate necessary for the efficient fabrication of a dome of definite size, is worked out by the drafting room and is presented in the form of the curves shown in one of the illustrations. From these curves, the required diameter and thickness of flat plate may be determined for the construction of a dome of given diameter and height. These curves have been worked out as a result of years of experience in dome construction and represent the greatest economies in plate size for any given type of dome.

The dies for dome flanging are set up in the flanging press with the ball or plunger portion of the die attached to the center ram of the press. The upper ring is rigidly hung from the upper or fixed platten and the lower ring is mounted on the four jacks.

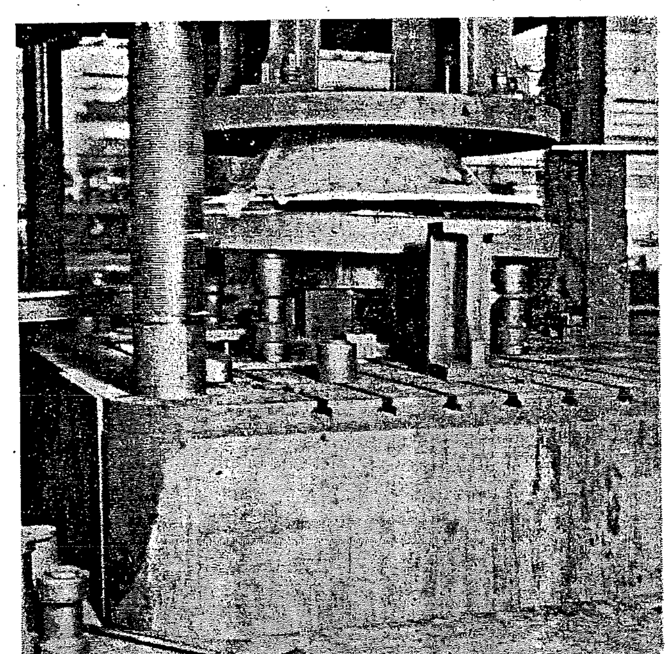
Before the flat plate from which the dome is to be formed enters the flange shop, a ¾-inch diameter hole is drilled in the center of the plate. This hole serves as a guide in centering the plate in the press, as during the first drawing process, a small bolt is screwed into the top center of the ball portion of the die. It is over this bolt that the hole in the plate is fitted. This bolt is only used for centering plates during the first process as, after the first drawing, the dome is self-centering.

The flat plate is heated in the furnace adjacent to the flanging press and the temperature of the plate is checked by means of an optical pyrometer. The large flanging furnaces are fitted with Leeds & Northrup recording electrical pyrometers, which are used for controlling the temperature to which the plates are heated.

The furnace is equipped with Best burners through which the oil is piped under pressure and atomized by means of compressed air. This burner is located in a combustion chamber at the side of the furnace.

When the plate is heated, the furnace door is opened by means of a lever located at the press-control station and a grab dog attached to a winch cable is fastened to the hot plate. By means of the winch the plate is hauled from the furnace across a bridge of rails to the press. This bridge is pivoted at the furnace end and is simply blocked up to the proper height at the die end.

When the plate has been centered in the press, the lower ring is first raised to meet the upper ring, then the plunger or ball is brought into action which draws the plate out to a conical shape. During this process the two rings are held in such a position that a certain amount of plate slippage may be obtained. By this



Dome in its conical form after flanging on the first ring means the plate is drawn to shape and not forced. This serves to retain the plate thickness and not reduce it beyond the allowable limit.

High domes are put through a series of rings, each ring being reduced in diameter until the required dome diameter is reached.

The dies are machined as carefully as possible during the process of manufacture to prevent the formation of ripples in the sheet. However, a limited number of ripples are bound to occur. These are removed during the flanging operation by the process of paddling which consists of using a metal paddle or shim placed wherever a ripple is seen and bringing the rings together. This process localizes the entire pressure of the machine on the point where the paddle is applied. After flanging, however, the heavier sheets are taken to the sectional flanger located in the upper bay where such ripples that could not be removed by the paddling process are taken out.

When the required height and diameter of dome is reached, the dies are changed and a saddle die is set up. The plunger is fastened to the top ram of the press and the saddle dies are arranged with one portion attached to the jacks and the other to top platten.

The partially-finished dome is heated and dropped into place on the lower saddle die and the plunger is inserted to insure the correct height of the dome. The dies are then brought together and the dome is fitted with a curvature corresponding to the diameter of the boiler.

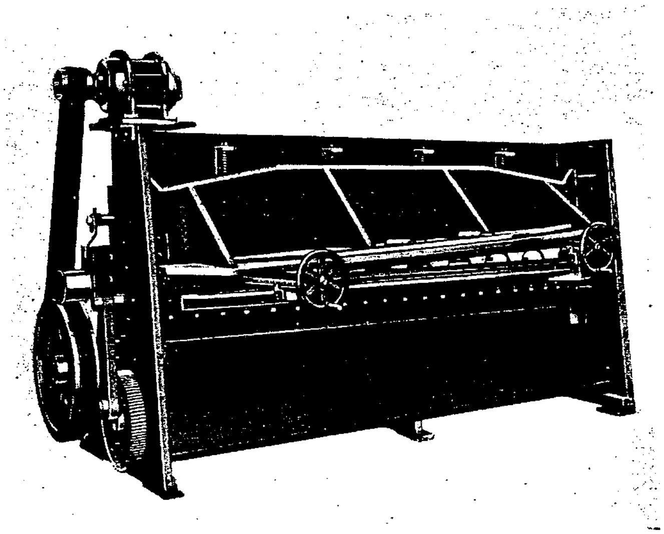
After the process is completed, the dome is allowed to cool slowly. This act of annealing reduces the coarse crystalline structure of the plate and restores the plate to practically its original form.

In following the progress of material through the process of boiler manufacture at The Baldwin Locomotive Works, a further description of the machinery and methods employed in the flanging department will appear in the May issue of THE BOILER MAKER.

All-Steel Squaring Shears

As an addition to its present line of steel bending equipment the Dreis & Krump Manufacturing Co., Chicago, Ill., is now manufacturing all-steel squaring shears.

These shears are a radical departure from the old cast-iron type, being entirely of steel-plate construction, electric welded throughout. They are unbreakable and non-deflecting. Timken roller bearings on the flywheel shaft insure ease of operation and saving of power. Super uniform pressure hold-down assures a uniform amount of pressure on the metal before the cutting operation is started and the same pressure is held until the completion of the stroke.



Rear view belt motor driven type squaring shears

Standard equipment includes a centralized system of lubrication, operated with a hand plunger which oils the slides and bearings with the exception of the Timken roller bearings, which require greasing, and the clutch which is either equipped with oil or grease cups.

Another new feature is that the shear is completely guarded on both ends, front, and rear with heavy sheet steel guards. The illustration shows the under-drive type shear. This illustration, rear view, shows the belted motor-drive type of motor arrangement, crank gear drive, construction of the upper knife bar, screw adjusting back gage, equipped with steel scale and pointer, and rear guard.

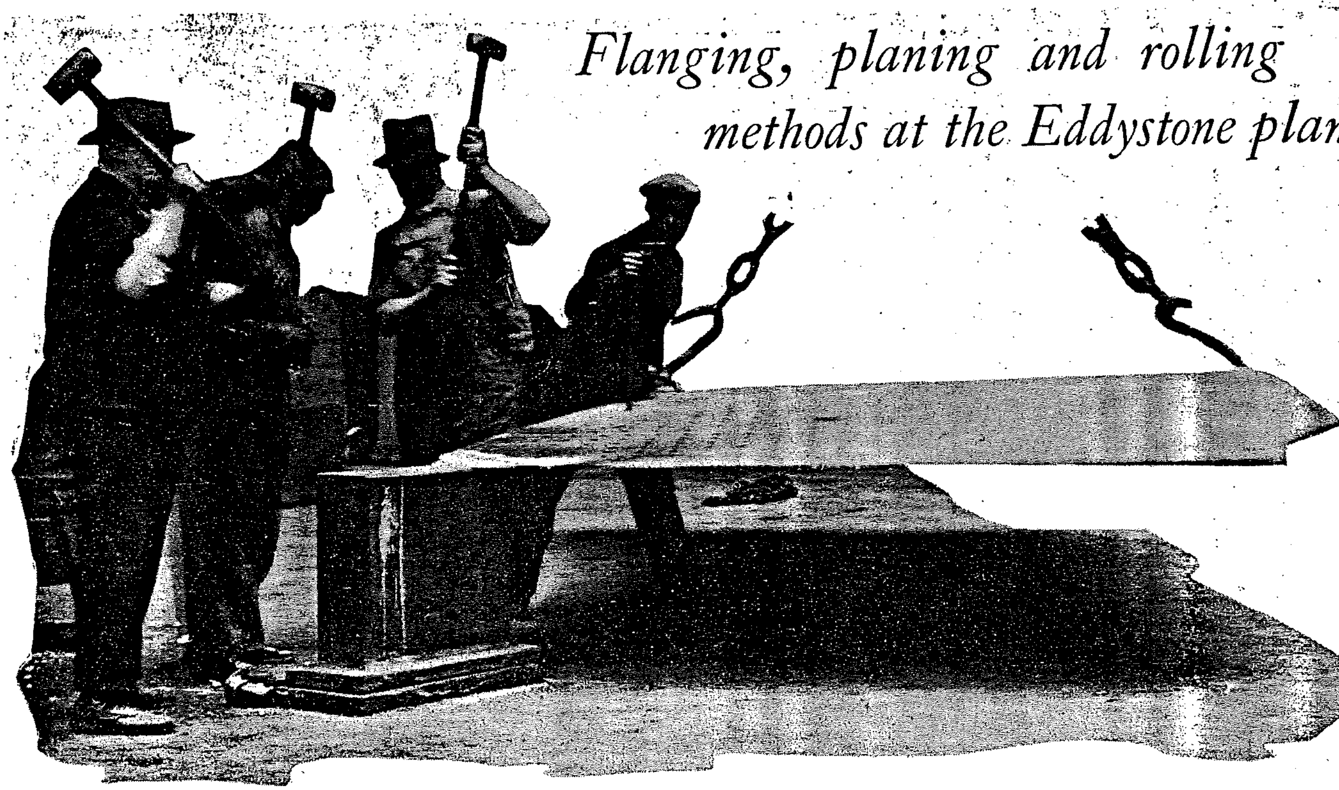
Steel Boiler Orders

New orders for 1025 steel boilers were placed in February, as reported to the United States Department of Commerce by 81 manufacturers, comprising most of the leading firms in the industry, as compared with 1075 boilers in January and 1171 in February, 1928. The following table presents the number and square footage of each kind of boiler ordered for the past fourteen months, including comparisons with the corresponding period last year.

	Total year, 1928		November, 1928		December, 1928		January, 1928		February, 1928		January, 1929		February, 1929	
	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.
GRAND TOTAL	19,672	17,684,811	1,660	1,459,440	1,343	1,308,125	1,244	992,785	1,171	1,285,211	1,075	1,253,015	1,025	1,129,064
STATIONARY Total	19,441	17,144,880	1,650	1,453,601	1,321	1,229,847	1,229	974,288	1,137	1,084,341	1,067	1,248,260	996	1,067,414
Watertube	1,315	6,909,982	95	592,747	72	609,446	84	347,057	98	525,138	*99	*705,279	87	494,757
Horizontal return tubular	1,513	1,884,401	108	130,810	71	87,259	89	141,219	87	123,146	*65	*74,204	107	142,931
Vertical firetube	1,726	495,674	148	38,640	161	39,162	145	35,981	148	48,174	*132	*40,531	138	38,906
Locomotive (not railway)	392	263,201	29	28,715	25	14,480	20	9,407	30	19,452	18	9,670	17	11,141
Steel heating[1]	12,685	6,152,393	1,055	496,657	883	391,571	769	359,401	682	320,078	618	310,628	489	248,292
Oil country	956	900,317	111	109,449	63	53,807	41	32,992	34	28,020	71	64,399	98	89,501
Self contained portable[2]	680	462,627	61	45,736	38	30,187	62	36,566	54	19,052	53	32,516	52	38,964
Miscellaneous	174	76,285	43	10,847	8	3,935	19	11,665	4	1,281	11	10,433	8	2,922
MARINE Total	231	539,931	10	5,839	22	78,278	15	18,497	34	200,870	8	4,755	29	61,650
Watertube	99	467,084	1	400	15	72,850	6	10,532	18	194,112	...	....	21	50,112
Pipe	3	3,623	...	....	1	848	..	....	...	....	...	....	1	706
Scotch	112	59,649	9	5,439	4	3,350	9	7,965	16	6,758	8	4,755	6	10,399
2 and 3 flue	13	5,577	...	....	2	1,230	..	....	...	....	...	....	...	....
Miscellaneous	4	3,998	...	....	...	....	..	....	...	....	...	....	1	433

[1] As differentiated from power. [2] Not including types listed above. * Revised.

Flanging, planing and rolling methods at the Eddystone plant



The scarfing gang in action

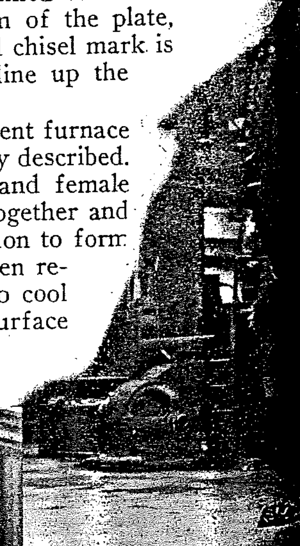
IN addition to the flanging methods described in the April issue of The Boiler Maker the fabrication of throat sheets and miscellaneous locomotive flanged plate is carried out in the flanging department of The Baldwin Locomotive Works, Eddystone, Pa. While all of this work is accomplished in bay No. 13, light miscellaneous material is usually flanged on the R. D. Wood four post flanging press located in panel 14 of the upper bay.

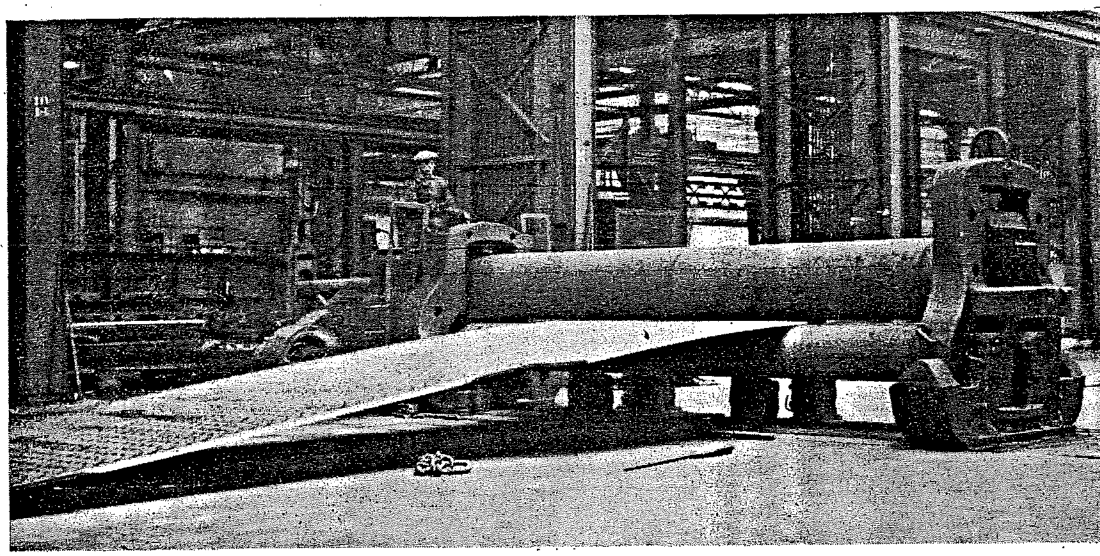
Flanging Throat Sheets

The process of flanging throat sheets is carried out in a single heat, a three-piece die being employed. This die consists of a male piece, a female piece and a plunger or ball. These are set up for operation with the ball portion of the die first hung from the top ram. The male and female portion are set in the press together and lined up with the ball after which the female die is fastened to the table and the male portion fixed to the top platten.

Prior to receipt of the plate by the flanging department, the throat sheet is laid out and trimmed to size with enough excess material retained to serve as a tie piece in flanging. At the bottom of the plate, in line with the center line, a cold chisel mark is made to enable the flangers to line up the heated plate in the die.

The plate is heated in the adjacent furnace and hauled to the die as previously described. After being lined up, the male and female portions of the die are brought together and then the plunger brought into action to form the front flange. The sheet is then removed from the press, allowed to cool slowly and transported to the surface block for lining up.

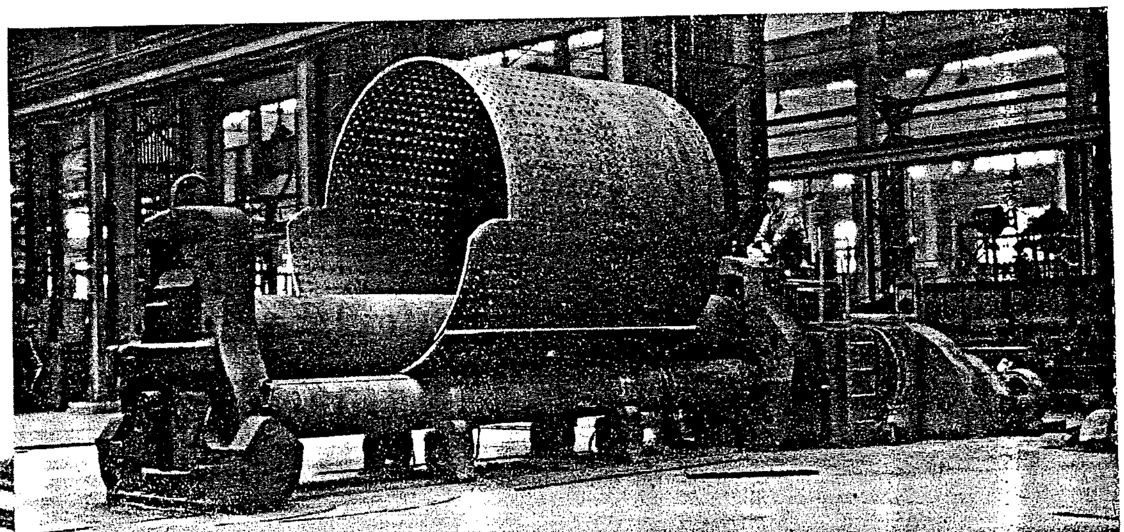




(Above) Partially rolled boiler course

(Left) Sheet entering plate roll

Boiler Work at the Baldwin Locomotive Shops



(*Right*) *Final rolling operation on a cylindrical boiler course*

When the throat sheet is completely flanged, the tie piece is removed by the oxy-acetylene burning process.

The complete fabrication of flange plates is controlled by one man located at a station at the side of the press where all the control levers are placed. The furnace door lever, winch control, table lever, top ram lever, jack lever and center ram lever are within easy reach of this man and facilitate in the rapid completion of flanging, while the plate is in its most favorable working state.

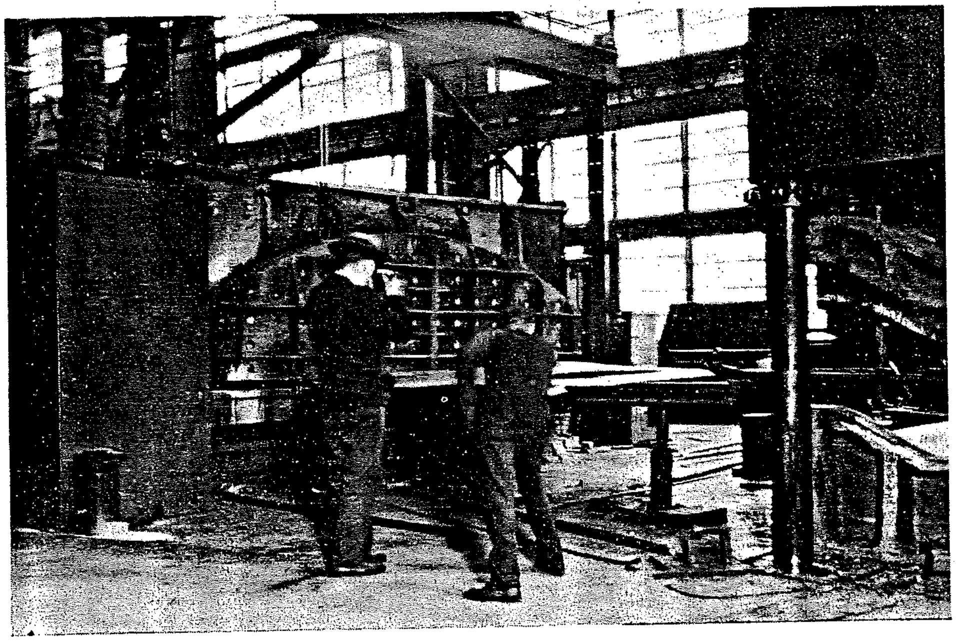
The hydraulic pressure system for the flange shop is entirely separate from the pressure system used in the bull riveters located in another part of the shop. The system employed in bay No. 13 is maintained at a pressure of 1500 pounds per square inch and an accumulator located at the north end of bay No. 13 acts as a balancer to the hydraulic pressure line. This is a storage of water designed to maintain an even pressure over the entire system.

Hand flanging is resorted to only where no dies are available to fabricate the material on a hydraulic flanger. This is often the case in small orders where the expense of making new dies is not warranted. In the course of time, however, so many dies have been constructed for hydraulic flanging that it is often possible to find a die somewhat similar to the required size. In such case, the sheets are flanged on the approximate die and the alterations are made by hand. In the case of throat sheets, where the exact die is not available, the belt is generally flanged with a die and the wings partially flanged on the sectional flanger. Firebox sheets, where there is no die, are generally flanged by hand, although the McCabe cold flanger or a combination cold flanging and hand flanging is often used. The corners are flanged by hand in the hand fires. These sheets are all annealed and straightened after flanging.

Located in the lower bay for service of the hand flangers and sectional flanging machines, are ten hand fires. These fires consist of an oval ring lined with clay and firebrick in the bottom of which is a perforated plate which allows the passage of blower air.

Three Sturtevant blowers supply blower air to the fires through an underground conduit. The fires burn coke and are banked around the edges with soft coal, while cord wood is used to cover the sheet and thereby reduce the draft of cold air on the plate.

The door holes in firebox backheads are flanged prior to the main hydraulic flanging work. This is generally done on a Morgan Engineering Company flanger located in the lower bay. Because of the small size of the door opening and the relatively long flange, several heats are required to complete the process. Where the flange is



A heated throat sheet on the bridge of rails after leaving the furnace

very short, the door hole may be flanged in one heat.

Hand flanging at The Baldwin Locomotive Works is reduced to a minimum and while it is resorted to in many cases, flanging by means of dies is the generally accepted practice.

Time, the important factor in boiler production has been saved by the employment of the most modern of flanging methods. By these methods the class of workmanship entering into boiler flanging has resulted in the interchangeability of similar boiler parts and the more rapid production of duplicate locomotive boilers.

Planing Department

In following the predetermined flow of material through the boiler shop, plates for the barrel of the boiler, shell plates, butt straps and liners pass from the drilling department in bay No. 12 to the planing department located in the upper part of bay No. 11. This department occupies a space between panels 9 and 17 and is served by two 25-ton Niles-Sellers electric overhead cranes.

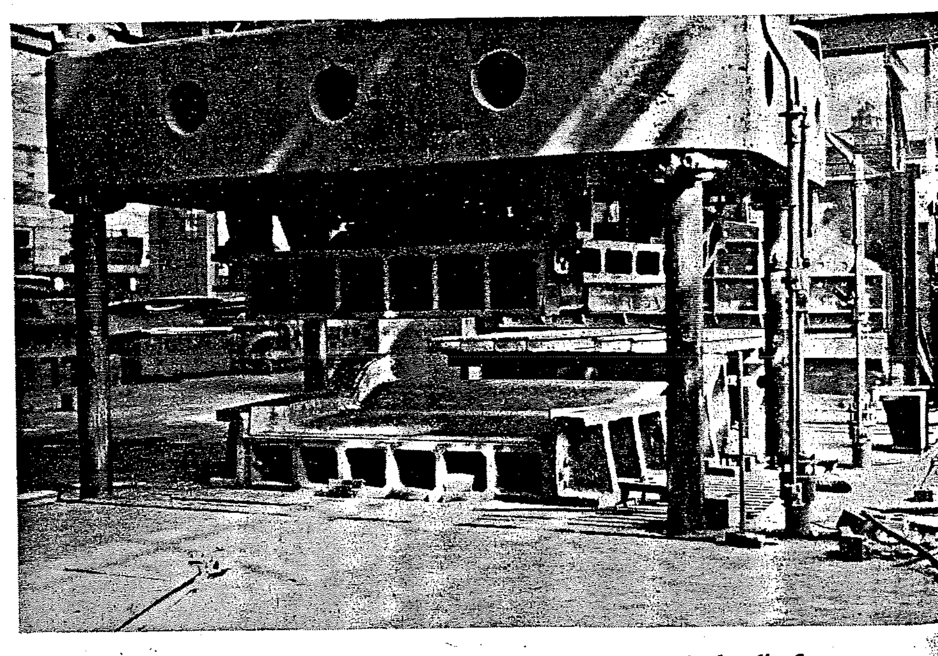
Seven planing machines are located in this department, four being placed adjacent to bay No. 10 and three at the side toward bay No. 12. Their capacities range from plates 20 feet in length in the smallest machines to plates of unlimited length. This is possible by extending the plate over other machines. In panels 10 and 11 on the side of the bay adjacent to bay No. 12 is located a Hilles & Jones planing machine having a length between housings of 26 feet 8 inches, and having a cutting surface of 21 feet 2 inches at a speed of 16 feet 9 inches per minute. A plate 61 feet 9 inches may be worked. A 10-horsepower motor, mounted on a separate stand drives the planer through a connecting belt.

In panels 11 and 12 is located another Hilles & Jones planer having approximately the same dimensions. The maximum plate, however, is limited to 27 feet and the motor which is rated at 15 horsepower is mounted on a bracket on the building column and operates the planer through a belt drive at a speed of 16¼ feet per minute.

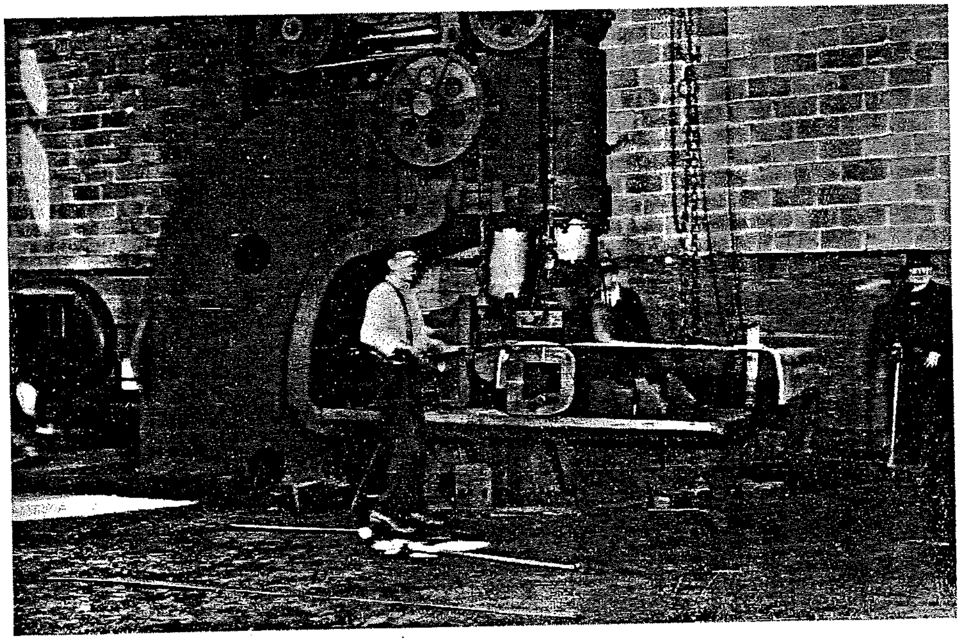
A Southwark planer having a distance between the housings of 22 feet 6 inches and capable of taking a 20-foot plate is located in panels 13 and 14. This will make a cut of 15 feet at a speed of 19 feet 10 inches per minute when driven through a belt by a 25-horsepower motor mounted on the base of the planing machine.

On the side of the bay adjacent to bay No. 10 and extending between panels 10 and 11 is located a Southwark planer having a distance between the housings of 34 feet 6 inches and capable of taking a 36-foot 3-inch plate. This machine is operated by a 20-horsepower motor mounted on the machine and driving the planer through gears at a speed of 18 feet per minute. The longest cut is 28 feet 8 inches. Between panels 12 and 13 is located a 31-foot 6-inch Southwark planer of unlimited capacity. A cut of 24 feet 11 inches may be made at 20 feet per minute by means of a 27-horsepower motor direct connected through gears to the planer.

A 27-foot Bement planer located in panel 13 is capable of taking a 28-foot 6-inch plate in cuts of 20 feet 11 inches each. This machine has a cutting speed of 20 feet per minute and is driven by an 18-horsepower motor mounted on a column bracket and connected to the machine by a belt.



Throat sheet dies set up in an R. D. Wood 4-post hydraulic flanger



Shaping a boiler sheet on a Southwark sectional flanger

In panels 15 and 16 is located a 26-foot Bement planer of unlimited capacity and having a cutting length of 20 feet 3½ inches and a speed of 22 feet 2 inches per minute. An 18-horsepower motor mounted on a separate stand drives the machine through a belt.

In all machines with the exception of the last mentioned, the clamp which holds the plate in position for cutting is actuated by two hydraulic rams located at each end of the clamp. Wooden blocks are placed under the clamp to localize the pressure and keep the plate from slipping. On the Bement planer in panels 15 and 16, nine hydraulic rams take the place of the clamps in the other machines. While other machines have a movable clamp, this machine has a fixed girder with nine individual rams.

On all machines, table rollers are mounted in brackets at a level with the planer table to facilitate the handling of plates during the planing operations.

Planing Operations

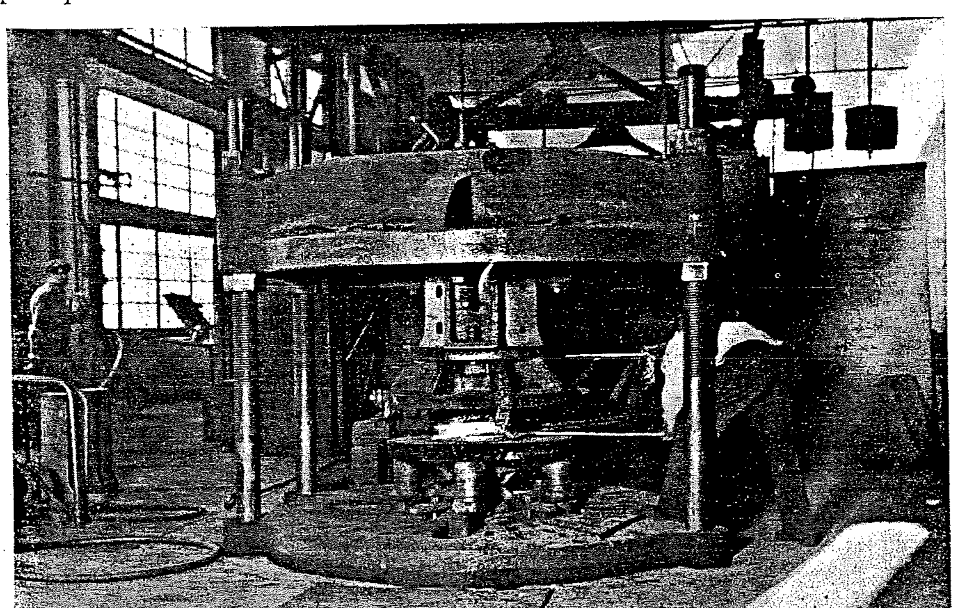
When the drilling operations on the plates have been completed, the sheets are lined up to the proper lap which is laid out exact from the center of the outside rivet hole. The plate is then sheared or burned and transported to bay No. 11 by truck on the track in panel 9. In bay No. 11 the plate is picked up by the overhead crane and spotted at the desired machine.

The planer operator places bolts at the ends of the plate in the outside rivet hole in order to facilitate the lining up of the plate in the planer carriage. When set, the sheet is clamped in the machine where it is held fast by hydraulic rams having a pressure of 1200 pounds per square inch.

Straight plates may be planed in one cut. Conical courses must be shifted in the machine and short cuts are used. Bevels or surfaces are made in a number of cuts with a finish cut considerably lighter than the rough cuts. When the plate edge is to be calked, a standard bevel of 78 degrees is used, other bevels to suit special conditions may be made as desired.

All the planing machines, with the exception of the 26-foot Bement planer, have two tool holders on the carriage for right and left hand feed. This allows the machine to cut in both directions. The 26-foot Bement planer has the left-hand cutter removed to allow the machine to cut closer to the end of the plate or to plane special shapes.

The planing department personnel consists of eight men for each shift. One man operates each of the seven machines and one man acts as a helper, serving all machines. These men come under the direct charge of a contractor for planing and plate rolling operations.

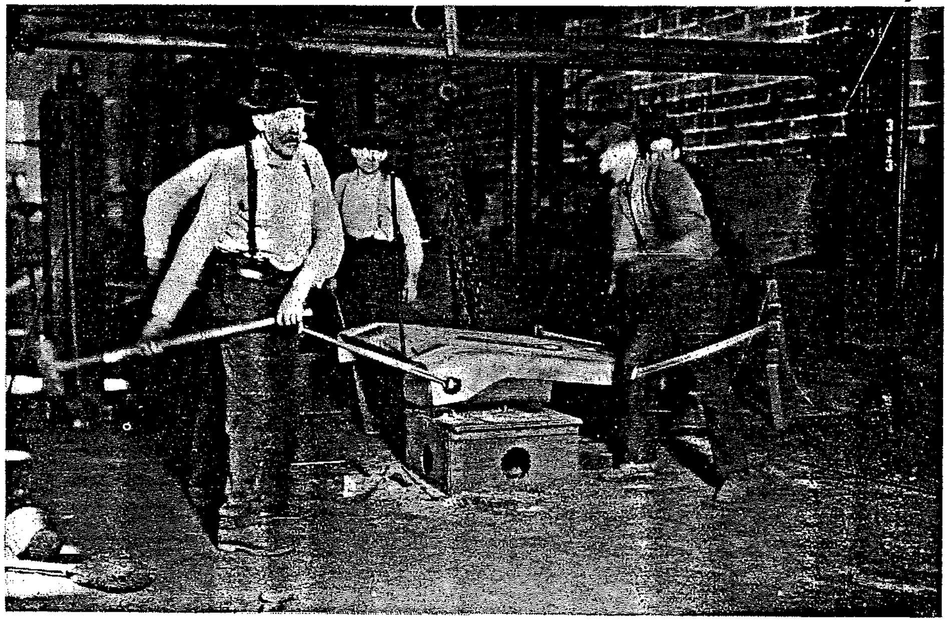


Fabricating valve head covers in the Fielding, Platt & Co. flanging press

Rolling Department

The contractor in charge of planing is also responsible for the plate rolling operations in boiler shop. This department is located in the upper portion of bay No. 10 between panels 1 and 17 and is served by two 25-ton Niles-Sellers cranes. Its equipment includes six plate rolls. One roll has a length of 11 feet; one, 12 feet; three, 16 feet and one 18 feet. All machines are of the three-roller type, the diameters of the top roll varying between 11¼ inches for the smallest machine to 26 inches for the largest machine. The bottom rolls vary between 8¼ inches in diameter to 17⅞ inches. Nominally, the smallest diameter of cylinder that may be rolled is 14 inches. Plates up to 1½ inches in thickness may be rolled.

The method of rolling one piece crown and side sheets for a combustion chamber boiler employed at The Baldwin Locomotive Works was developed at that plant many years ago. This process requires the crown and side portions to remain flat until the barrel section is rolled.



A backhead in the process of being flanged by hand

The legs of the plate which are joined to the cylindrical portion of the boiler are rolled independently of the rest of the sheet. A rod with a thickness of ⅛ inch and a width of 1 inch is placed between the combustion chamber and the top rolls. A block of wood of required thickness to produce the desired bend is placed under the sheet on one of the lower rolls. The upper roll is then lowered and the plate receives a curvature which is checked by means of a template. This process is continued at various intervals along the chamber leg until the entire leg has been given the proper curvature. The opposite leg is then rolled in the same manner.

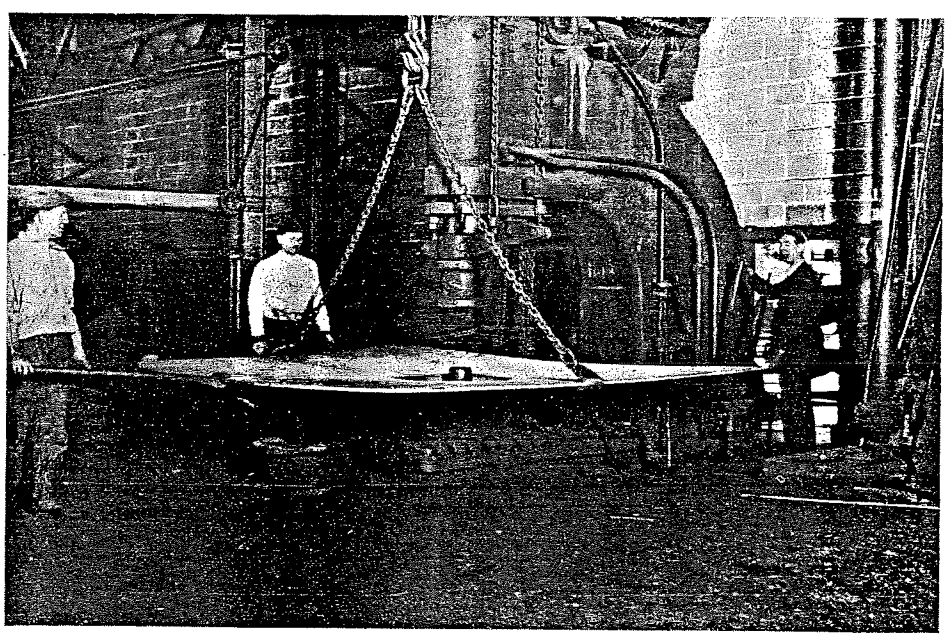
The crown of the combustion chamber sheet is rolled with a wide curve without the use of a rod. Only in the case where holes are large or far apart is a rod used to increase the curvature and eliminate humps at these points. This portion of the sheet as well as the corners or junctions between the crown and sides are rolled until the template fits the curvature. The corners are rolled over a rod.

Tapered courses are shaped to curvature with a number of settings of the rolls and are checked by means of templates. When the sheet is in the flat condition, it is laid out in the following manner to determine the location and limits of each rolling operation: Bisect the large and small arcs of the sheet and again bisect half of the small arc. The small arc is then quartered. Take the distance of one quarter the small arc and set it off on the large arc from the center of the arc and the ends. Considering the entire large arc, this will give four points. Now measure one quarter of the large arc and bisect the distance between this point and that point caused by setting off one quarter the small arc from the edge of the plate. Draw a line between this new point on the large arc and the point marking one quarter of the small arc. Set the rolls on this line and roll the course to the end.

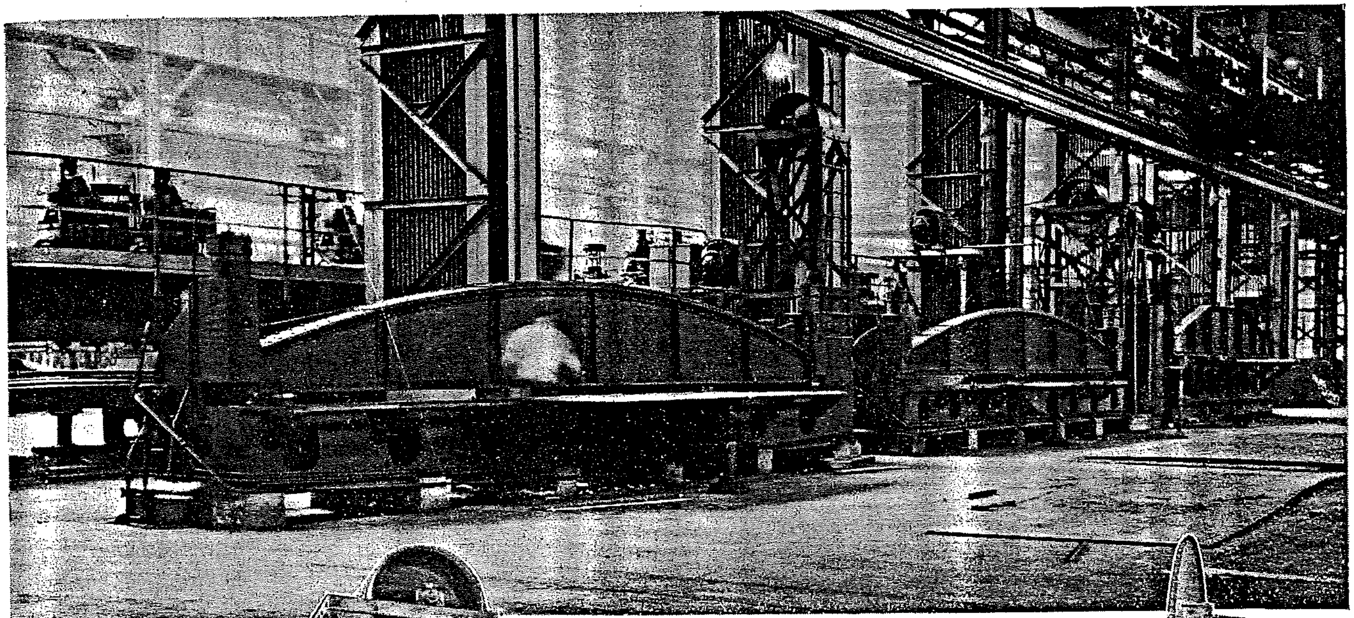
Now set the rolls on a line between one quarter the distance of the large arc and one quarter the distance of the small arc and roll the course to the center of the plate determined at the small arc.

Now reverse the process and roll the other side of the plate in the same manner. The flat portions are rolled over to obtain the required curvature.

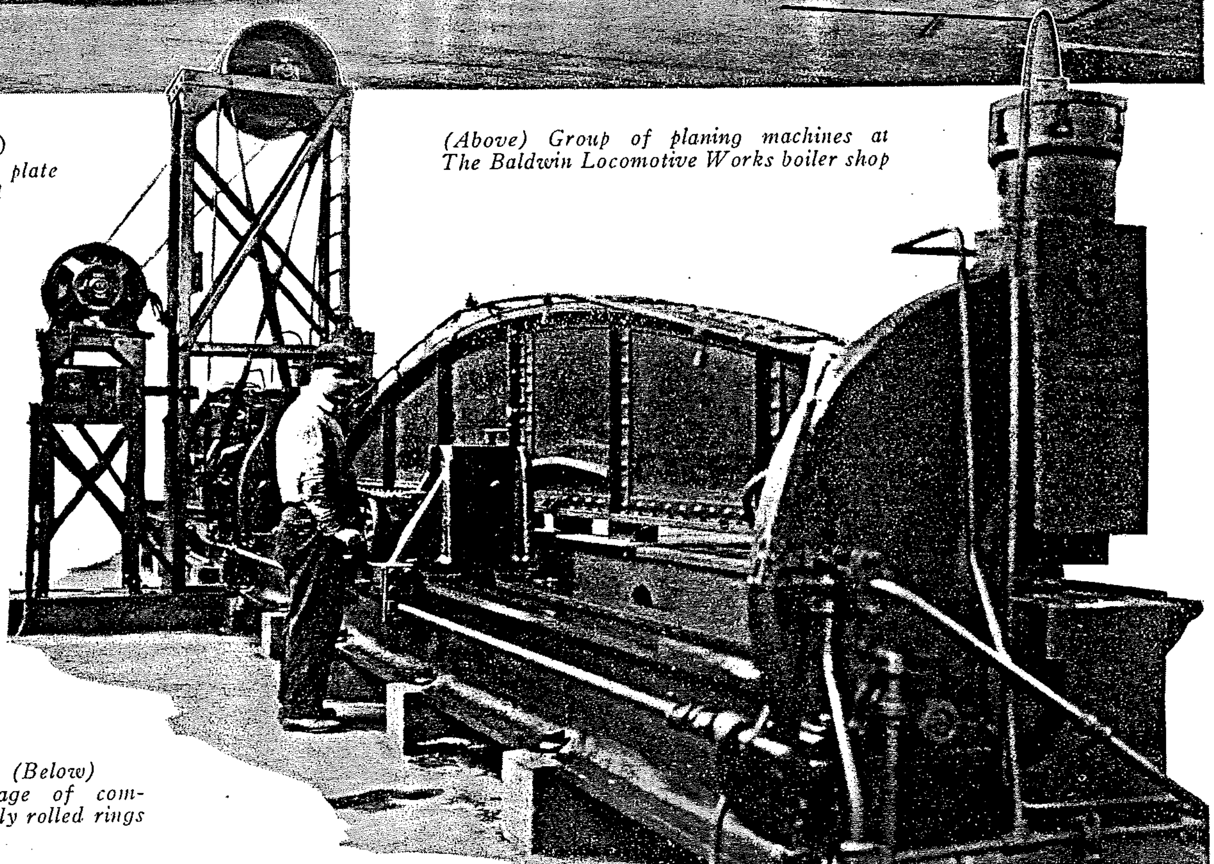
For the purpose of rolling the edges of any plate to the proper radius, a small bar of steel depending on the thickness of plate to be rolled, is placed beneath the plate on the top of one of the bottom rolls. Beneath the upper roll and on the plate is placed a rod one inch square, which when the rolls are brought together gives the plate the proper curvature. This process is re-



Flanging the door hole of a firebox back sheet on a Southwark sectional flanger

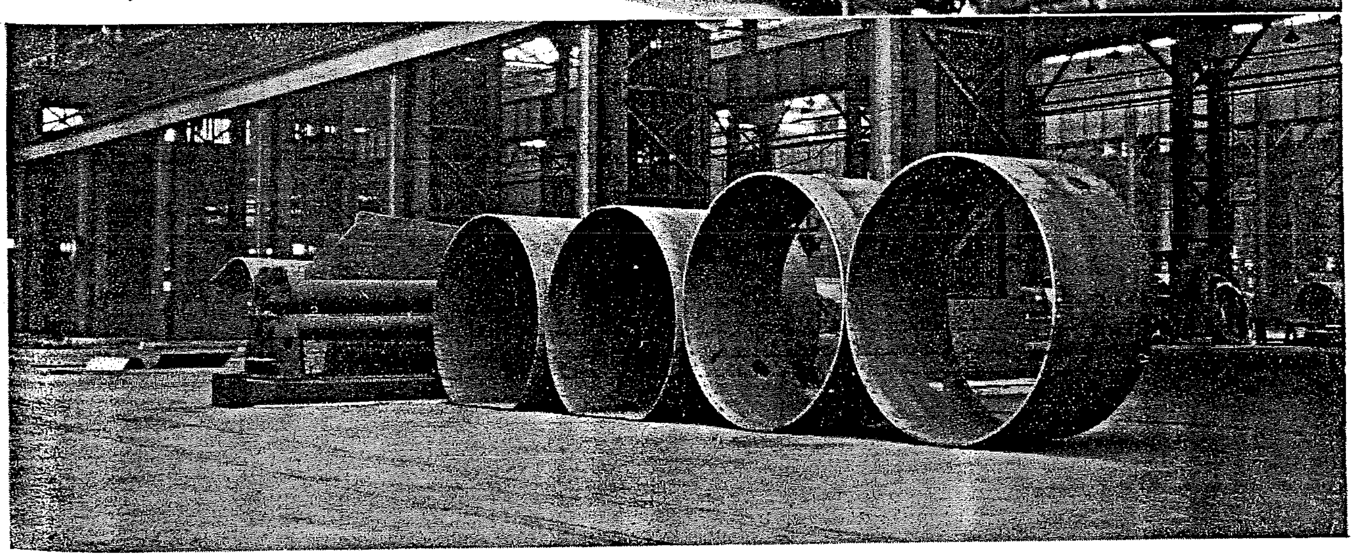


(Above) Group of planing machines at The Baldwin Locomotive Works boiler shop



(Right) Machining plate bevel

(Below) Storage of completely rolled rings



quired for the edges of all plates. After this is done the rolls alone are required to complete the curvature.

In ordinary cylindrical rolling, the upper roller is lowered after each passage of the plate through the rolls. This is continued until the proper radius is reached.

Completed cylindrically-rolled plates are taken from the machines by removing the housing at one end of the rolls. By this means the plate may be pulled from the machine and transferred to storage at the end of the bay.

In rolling plate to a radius as low as 2 inches, a T-bar is used. This is placed below the upper roll with the flange downward and a wooden block is placed between the T-bar and the roll. This is the smallest radius to which a plate may be bent in the rolling department. Smaller curves must be accomplished by flanging.

Plate Scarfing

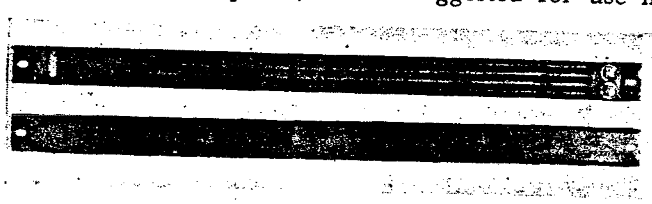
The scarfing of boiler courses and crown and sides sheet is done in the rolling department. A small air and oil-fired scarfing furnace, manufactured by The Baldwin Locomotive Works, is located in panel 7 of bay No. 10 and is served by a 6-ton hand jib crane having a 20-foot reach. In this furnace is inserted the corner of the plate to be scarfed and a hand-operated door of the balanced type is lowered on the plate which is heated to a red heat. The plate is then taken from the furnace by means of the hand crane and placed on the scarfing block located near the furnace. Here one man holds the plate on the block while three men work in the scarf by the use of hand sledges.

Four scarfs are generally required on crown and side sheets at the water space corners. Top and side sheets in one piece require no scarfing. Where they are in three pieces, the top sheet is scarfed at the corners where it is to join the side sheets. Other scarfing operations, with the possible exception of the lap on waist sheets, are done in other departments.

The June issue of THE BOILER MAKER will include descriptions of the equipment and methods employed in the water space frame or mud-ring fabrication department of the boiler shop of The Baldwin Locomotive Works.

Electric Strip Heater

A NEW electric strip heater developed by the General Electric Company, Schenectady, N Y., may be applied either as an air heater or as a "clamp-on" device. It is designed for general purposes where electric heat is required, and is suggested for use in cabs, valve houses, pump houses, process machines, drying ovens, compound tanks, warming tables, oil lines, etc.



General Electric Co. 500-watt strip heater

The device is 24 inches long, 1½ inches wide and ⅜-inch thick. It is rated 500 watts at 110 or 220 volts. Slots are provided in each end allowing the heater to be supported in air or clamped to a metal surface.

Both terminals are at one end of the unit and project from the same side. They are nickle-plated brass studs insulated from the sheath by mica washers and provided with screws and fittings for binding the connecting lead wires.

The current-carrying resistance wire inside the sheath is the usual nickle-chromium resistor wound in a helix in much the same manner as in standard G. E. sheath wire construction. The coil is supported at each end by a porcelain insulator and is stretched down the length of the unit four times, providing even distribution of heat over the entire surface of the unit.

The resistor is insulated from the sheath by magnesium oxide powder. After the heater is assembled and filled with magnesium oxide, the powder is compressed into a compact mass by a 250-ton press. At the same time four ridges are produced in the top side of the unit and these, together with depressions between, place each of the four heater windings in what is essentially individual half-tubes, adding strength and rigidity to the unit.

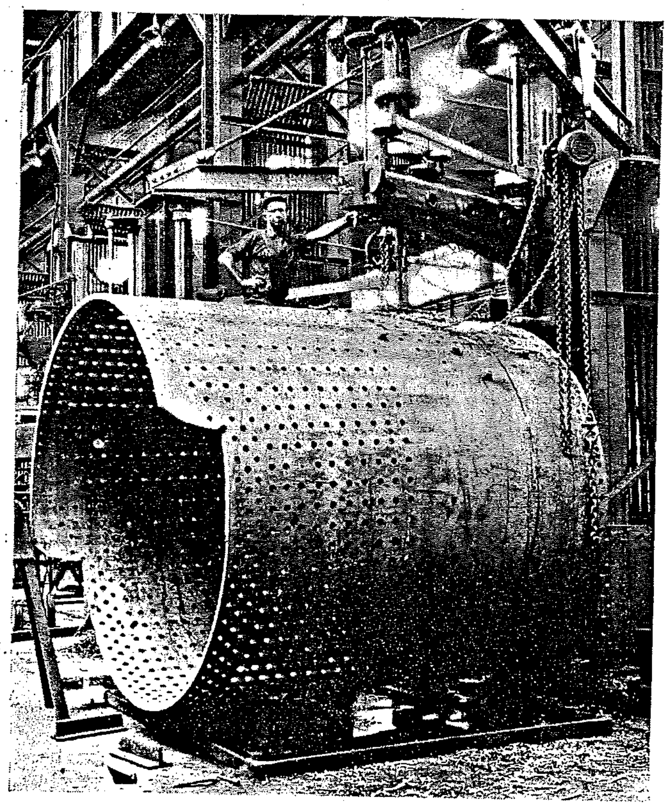
A Convenient Shop Cabinet

GREASY wooden tool boxes in the shop are always more or less of a fire hazard. For storing small tools and other materials, a cabinet, like the one illustrated, is easily made from light sheet metal and small angle sections. Scrap material may be used and then painted. The drawers are cut out and welded

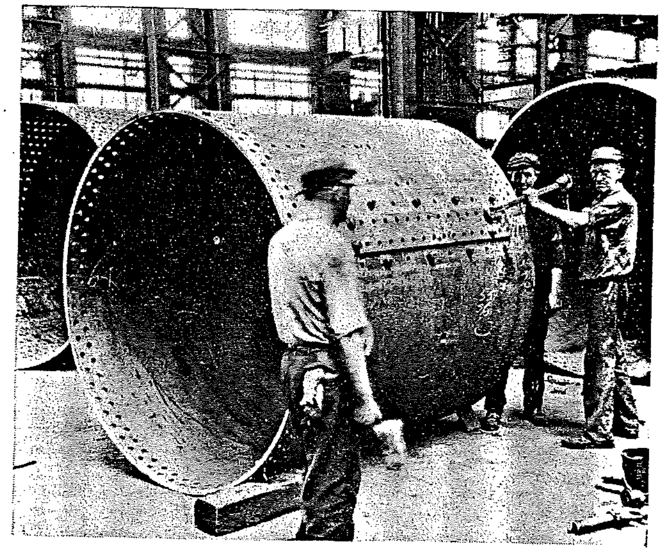
A cabinet in which tools can be kept in an orderly and systematic fashion

at the corners and small handles are welded on the front end. Partitions may be made in the drawers for various stock small parts by cutting sheet metal in strips of the proper length and then welding them in crosswise. One-inch angles are used for the framework, supported by sections of strap iron, to which they are welded or bolted with small flat headed bolts.

Dome course set up in a radial column drill



Bolting up the butt straps of a cylindrical course



Fabricating Boiler

Drilling and riveting plant of The Baldwin

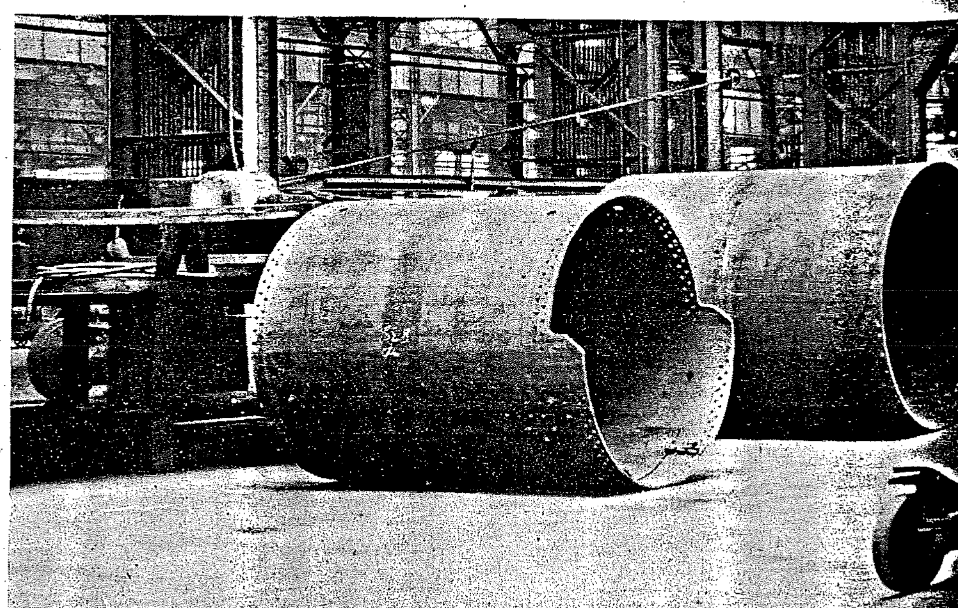
IN following the processes of boiler construction employed at the plant of The Baldwin Locomotive Works, Eddystone, Pa., the methods employed in the assembly of the boiler courses may be observed in the upper section of bay No. 8. It is in this area that the rims are drilled and welded and the butt straps shaped and fitted. The various courses are assembled from the sheets rolled in bay No. 10 and these rims, from the smokebox to the dome course, are joined, forming the barrel of the boiler.

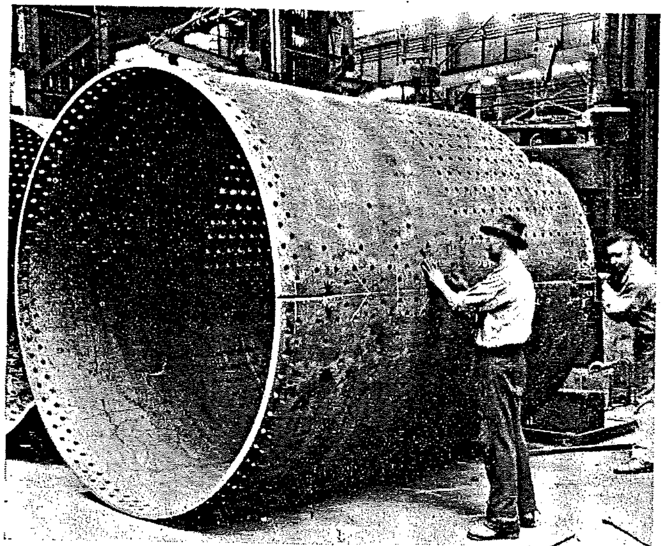
The two departments that prepare the rings for assembly occupy an area of 32,640 square feet extending between panels one and seventeen. The equipment which includes machinery of the latest type, consists of 24 machine tools, a tabulation of which is given together with the layout of the department on page 258.

At the upper end of the bay which is served by two 25-ton Niles-Sellers overhead cranes, assembly is begun by fitting the butt straps to the first course. The inside butt strap is rolled to the correct curvature of the course while the outside strap is shaped to the radius of the boiler on a 100-ton hydraulic buttstrap press located in panel 1.

Prior to fitting the butt strap, holes in the course adjacent to the joint are lined up and checked for lap and pitch. The longitudinal seam edges of the course are fastened together by a number of small steel straps held by bolts. The boiler course is then taken to a welding booth located in panel 12 where the beveled edges of the joint are arc welded to prevent leakage along the butt strap joint. These welded joints are located at each end of the course.

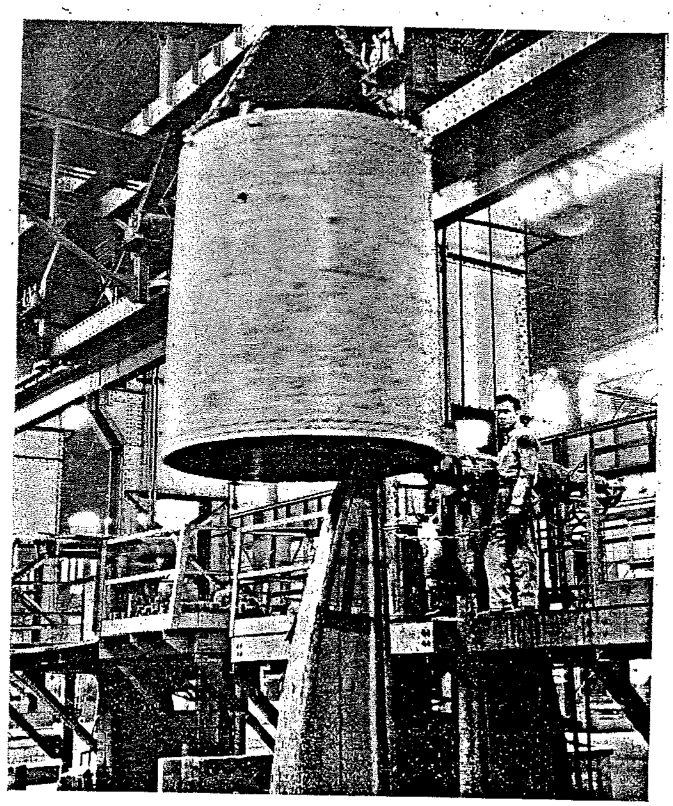
After the weld has been made, the joint is chipped and





Lining up the rivet holes at a butt joint prior to welding

Riveting the butt straps in a 68-ton hydraulic bull riveter



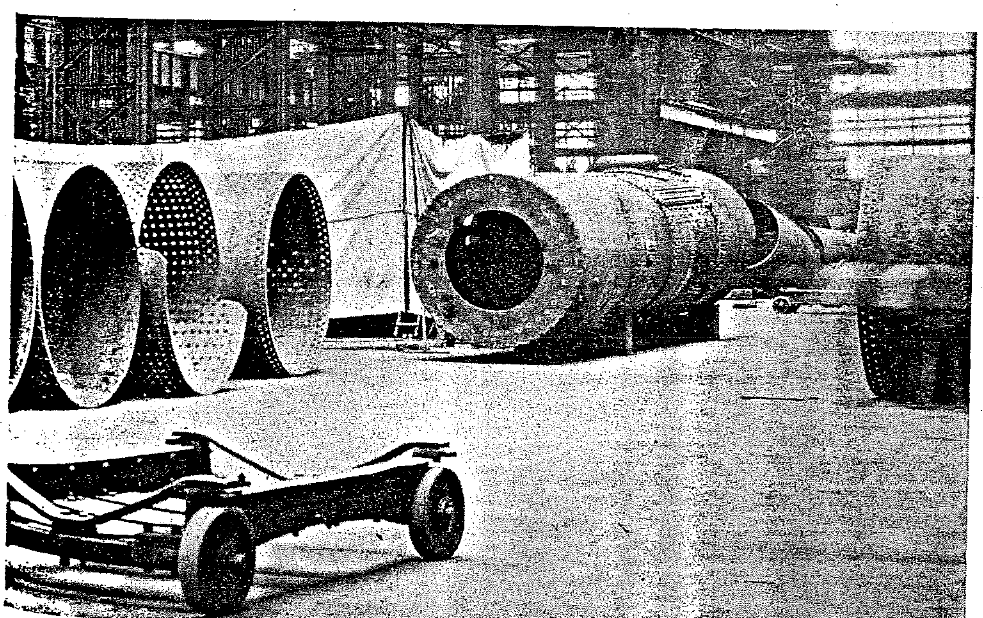
and Fitting Shells

rings at the Eddystone Locomotive Works

ground to remove burrs and projections on both the joint and rivet holes. The straps are bolted in place, reamed and then riveted by means of the hydraulic bull riveters.

The tube sheet is next assembled to the first course. This consists of bolting up the plates, reaming and riveting. It is the custom in bolting up all parts of the boiler to bolt up every other hole so that the sheets will be knife-tight before reaming and riveting.

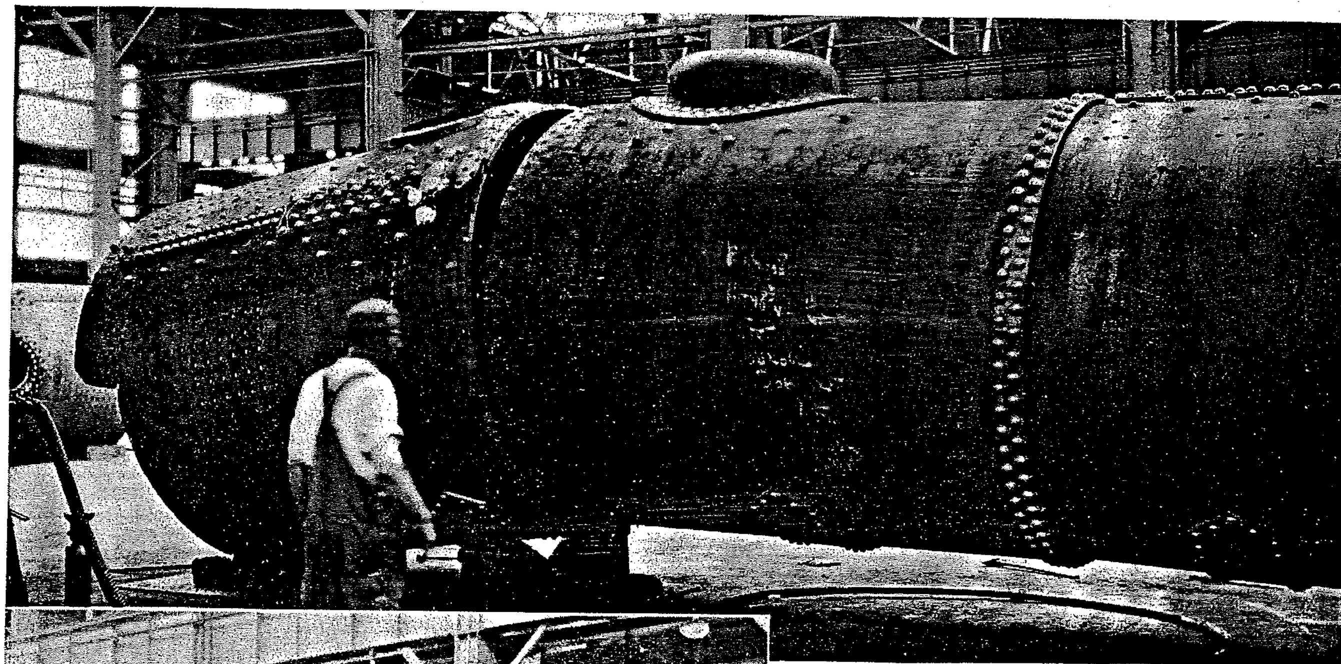
Prior to its assembly in the boiler, the smokebox is fabricated. The smokebox ring, a forging manufactured outside the boiler shop, is laid out on the assembly floor; the outside holes are drilled to size on a radial column drill and the holes on the flat portion are drilled on a regular radial drill. This ring is bolted, reamed and riveted to the smokebox sheet, after which the entire length of the longitudinal smokebox seam is arc welded.

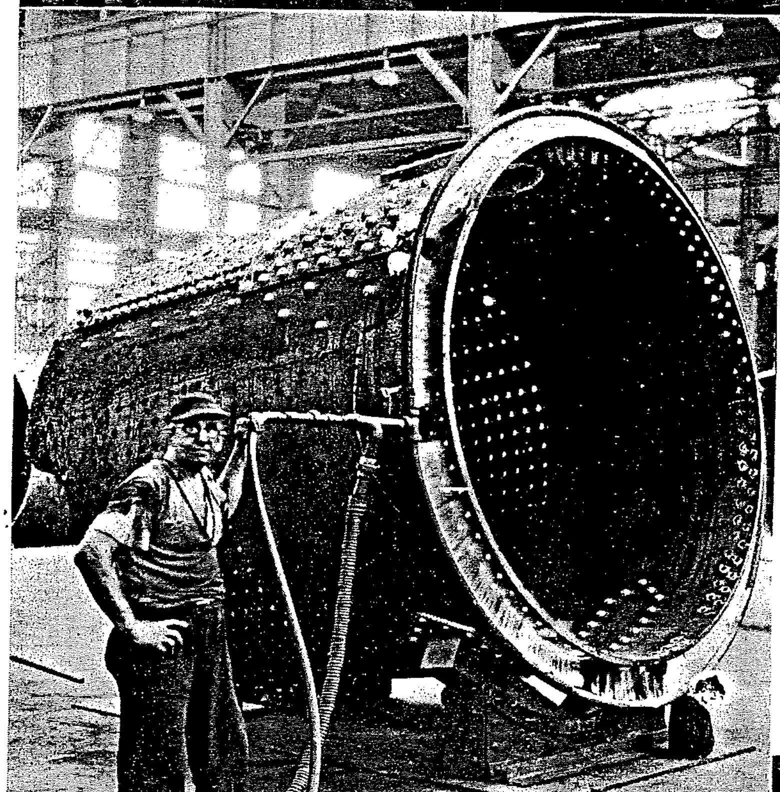


General view of the rim welding and butt strap fitting floor

The liner in the bottom of the smokebox course is riveted, then the course is ready for assembly. The smokebox is applied after the tube sheet is in place.

For ease in assembling tube sheets in the boiler courses as well as for assembling one rim upon another, a ring heater consisting of a circular piece of 1½-inch diameter gas pipe is used. This pipe is about 6 inches larger in diameter than the boiler course and is placed around the course at the circumferential lap. Along the inner circumference of the gas-pipe ring are innumerable holes through which a mixture of gas and air are emitted. The gas is ignited and the flame is allowed to play on the plate for about 10 minutes. When





the lap is in a heated state, it is slid on over the adjacent course. The rim contracts due to cooling and a tight joint results.

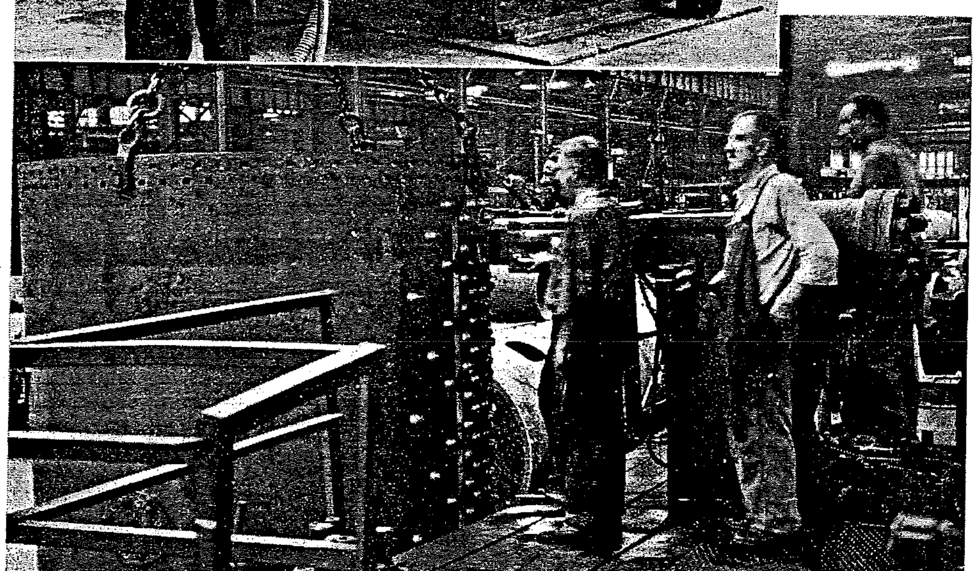
The second course is fabricated similar to the first course and is riveted to that member.

(Above) — Fitting the courses to the boiler barrel

(Left) — Preheating the lap of a course prior to fitting to the barrel

(Below) — Riveting butt straps on a 123-ton hydraulic riveter

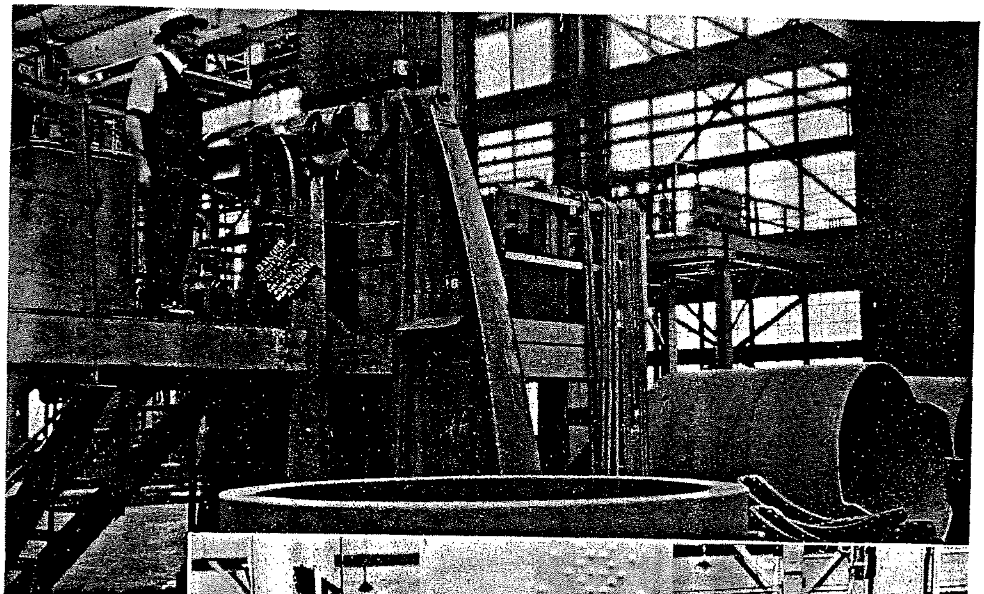
The dome ring is fabricated similar to the first course up to the point where the dome is installed. The dome liner is clamped to the inside of the course and the course is transferred to a radial column drill where the holes in the liner and shell are drilled before the dome is put on. When this is done, the dome is set up and two holes on the front and back center line are marked off; the dome is slid back and the holes are drilled. The dome is put back in place and bolted. With the dome as a template, the remaining holes are drilled.



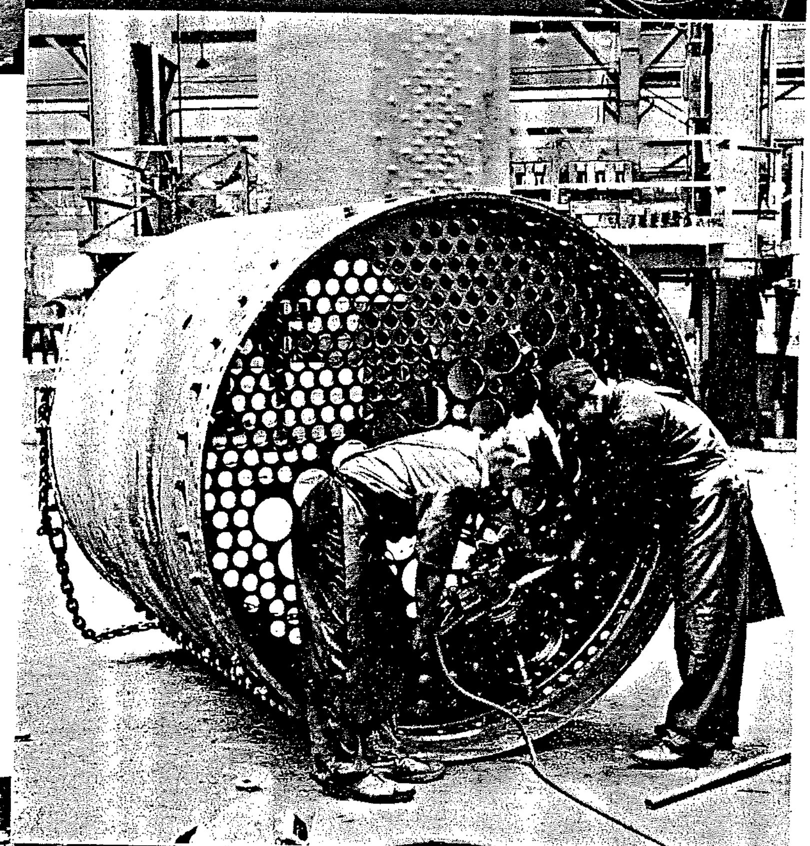
The dome and liner are next removed, dirt and burrs being eliminated by grinding. The hole is burned through the course and liner into the dome chamber. The dome, liner, and course are then reassembled and bolted up, reamed and bull riveted. When the dome is bolted up, every other hole is fastened to draw the work up tight before riveting as is done with the other sections.

The radial column drills are each served by two hand-jib cranes. Below each drill and mounted on two tee bars are two frames each of which support two rollers, four in all. The boiler course is placed in the rollers and chain falls from each jib crane are attached to the course at either side. By the use of the falls, the course can be rotated in any position to facilitate the work. A platform at the side of the course serves as a workman's stand.

The flanges on taper courses are set by the use of tire steel rings over which the course is placed for a flange at the large end of the taper and inside of which the course is placed for a flange at the small end of the taper. The ring and course are placed in a hydraulic bull riveter with the proper die and the course is pressed against the ring. By moving the ring step by step around the circumference the flange is formed cold. Many rings of various sizes are available; each ring handling courses of six inches diameter variance. After the various rims of the boiler are finally applied and the boiler barrel is finished, it is delivered to bay No. 5 for back head application.



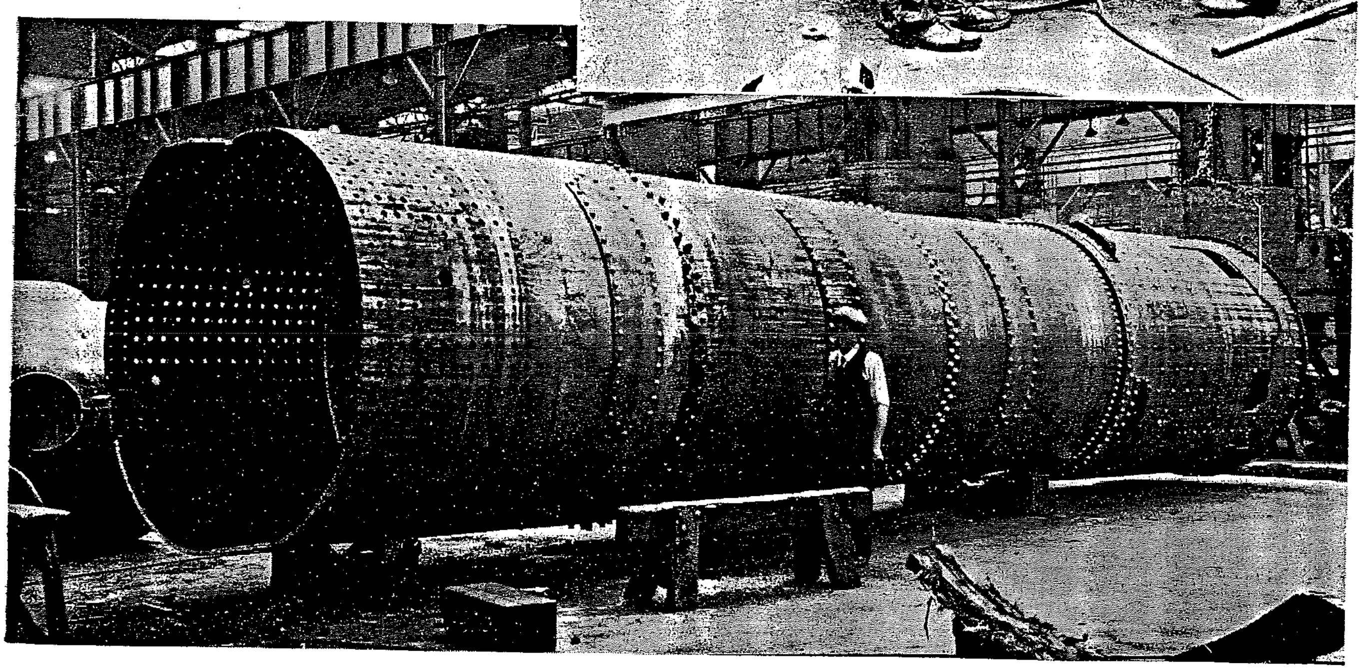
(Above)—Bull riveter set up for flanging conical courses

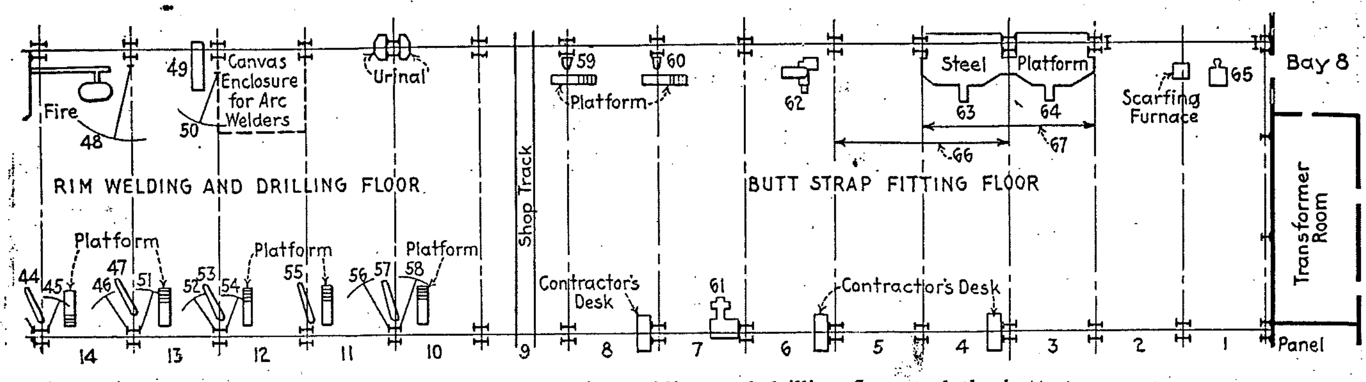


(Right) — Countersinking the rivet holes in a tube sheet flange

(Below)—The assembled barrel ready for transportation to bay No. 5 for fitting

The methods employed at The Baldwin Locomotive Works represent the results of the most modern ideas in regard to flow of materials. In the case of this plant, materials move in a constant direction, eliminating unnecessary transportation.





Machinery located on the rim welding and drilling floor and the butt-strap fitting floor in the upper section of bay No. 8

44 Sellers 72-inch radial column drill motor on bracket on building column, belt drive.

45 Baldwin 1½-ton hand jib crane having an 8-foot reach.

46 Baldwin ½-ton hand jib crane having a 10-foot 4-inch reach.

47 Harrington 84-inch radial column drill, motor on separate stand, belt drive.

48 Baldwin 3-ton hydraulic crane having a 20-foot 6-inch reach.

49 Baldwin 70 and 100 tons hydraulic gusset flattener, 15-inch gap.

50 Baldwin 6-ton hand jib crane having a 16-foot 9-inch reach.

51 Baldwin ½-ton hand jib crane having a 10-foot 4-inch reach.

52 Baldwin 1¼-ton hand jib crane having an 8-foot reach.

53 Sellers 72-inch radial column drill, motor on bracket on building column, belt drive.

54 Baldwin 1¼-ton hand jib crane having an 8-foot reach.

55 Sellers 70-inch radial column drill, motor on bracket on building column, belt drive.

56 Baldwin 3-ton hand jib crane having a 12-foot 6-inch reach.

57 Harrington 72-inch radial column drill, motor on bracket on building column, belt drive.

58 Baldwin 3-ton hand jib crane having a 12-foot 6-inch reach.

59 Sellers 1¼-inch hole column drill, motor on bracket on building column, belt drive.

60 Sellers 1¼-inch hole column drill, motor on bracket on building column, belt drive.

61 Hilles & Jones No. 3 shears, motor on machine, direct drive.

62 Harrington 48-inch radial drill, motor on separate stand, belt drive.

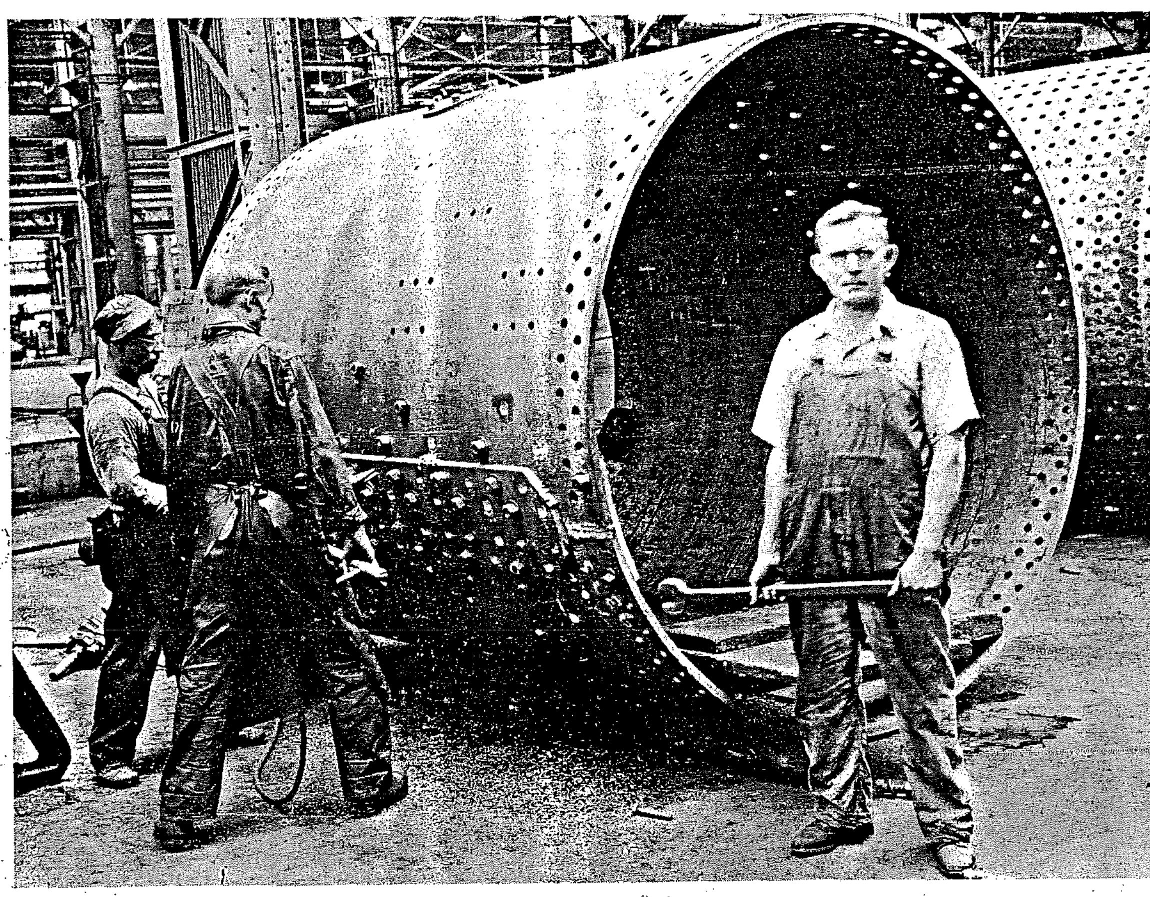
63 R. D. Wood 123 to 35-ton hydraulic bull riveter with 12-foot 3-inch stake.

64 Sellers 68-ton hydraulic bull riveter with 10-foot stake.

65 Southwark 100-ton hydraulic butt-strap press.

66 Milwaukee Type A 7½-ton wall crane with remote control, motor on machine, direct drive.

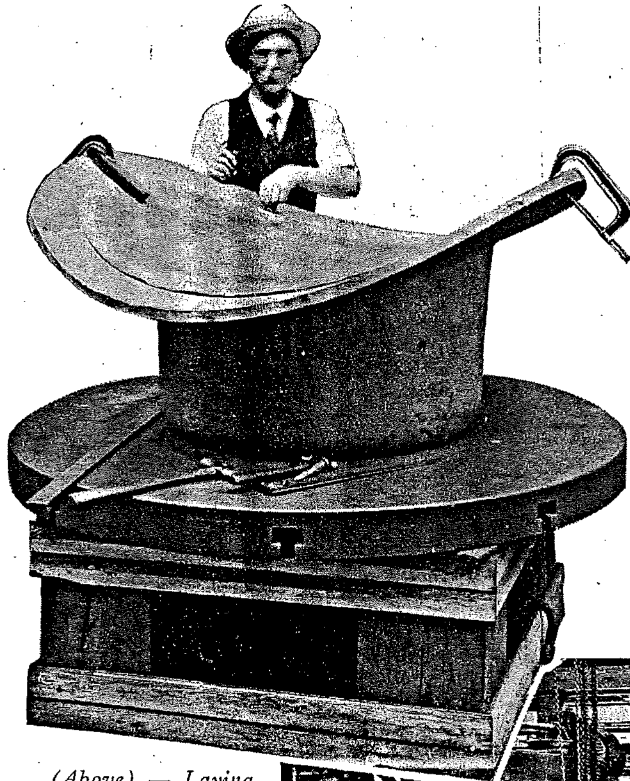
67 Milwaukee Type A 7½-ton wall crane with remote control, motor on machine, direct drive.



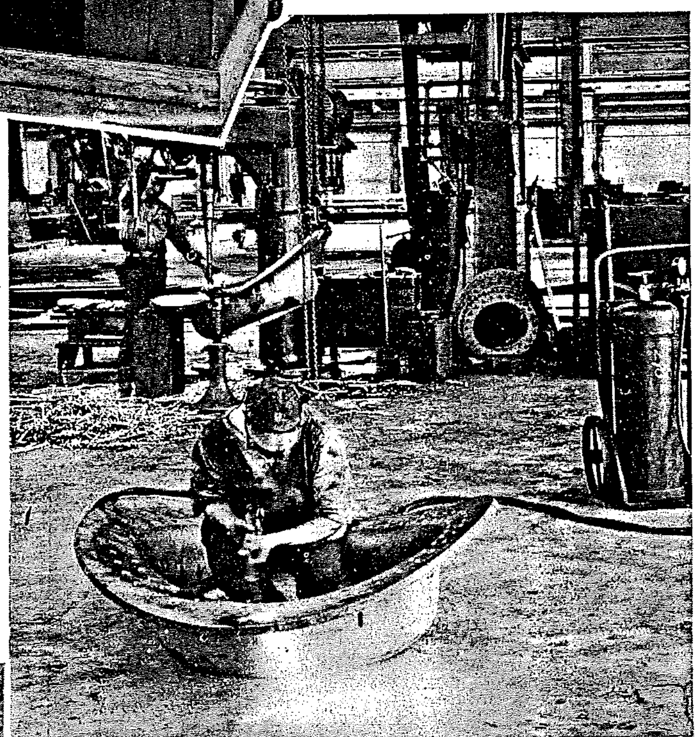
Reaming the butt strap rivet holes on a boiler course

Locomotive Work

Methods of fabricati[ng] at The Baldwi[n]



(Above) — Laying out the dome flange holes and edge

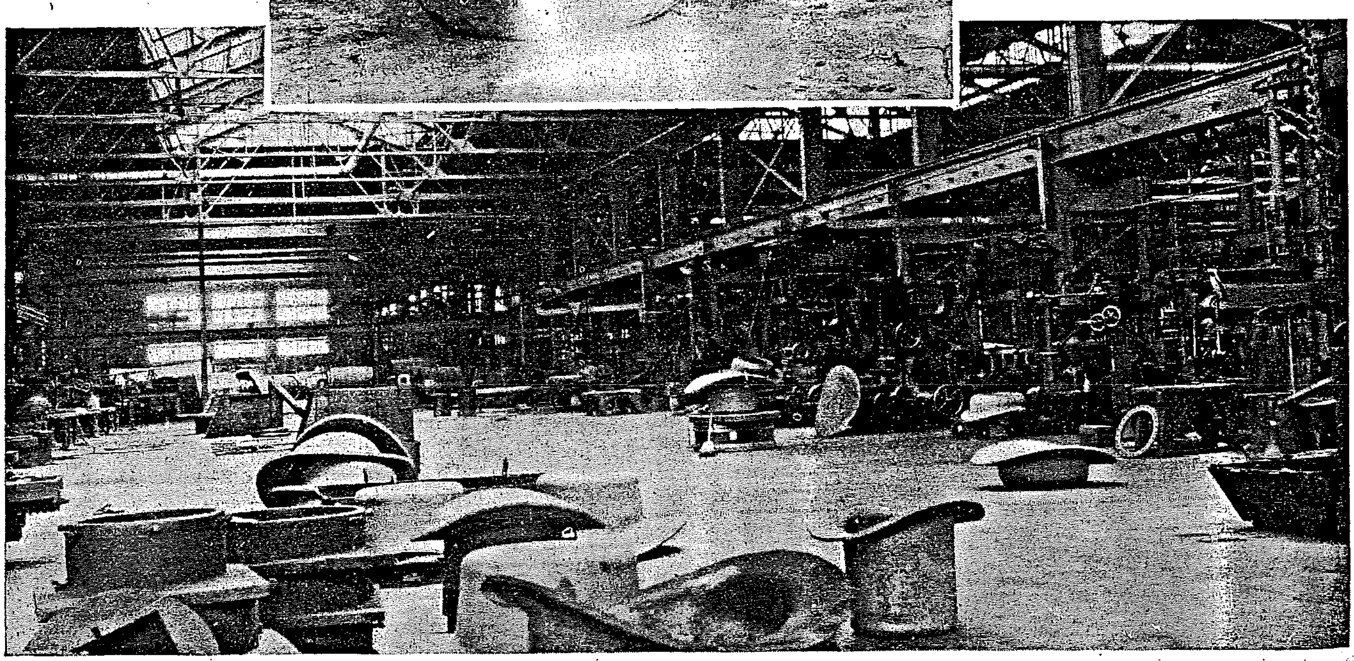


(Right) — Burning the edge of the dome flange

(Below) — General view of bay No. 8 showing battery of radial drills

IN following the logical flow of materials through the most economical channels at the boiler shop of The Baldwin Locomotive Works, Eddystone, Pa., we come to Bay No. 8 in which the front end of the boiler is assembled. It is here that domes are finished, tube sheets completed and the cylindrical and conical boiler courses fitted and riveted. In this bay the raw material begins to take a definite form and the boiler starts on its travel down the remaining bays towards completion before shipment to the erecting shop.

The dome machine shop occupies the extreme end of bay No. 8 between panels 24 and 29, inclusive. Panel 29 is occupied by a ladder track. This department together with the tube sheet shop, which extends between panels 18 and 23, inclusive, is served by a 10-ton Shepard overhead electric



Boiler
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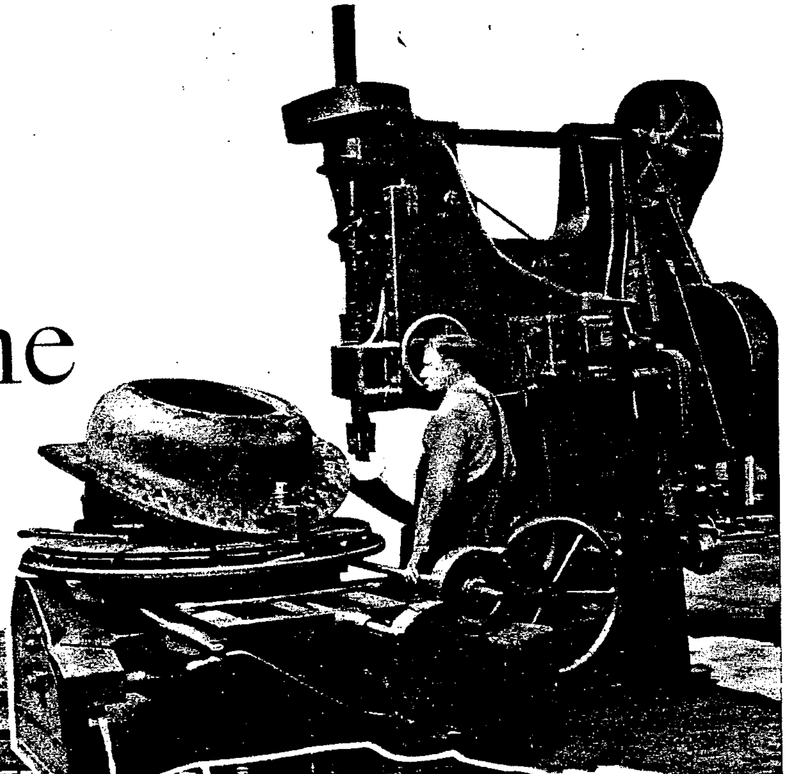
ocomotive Works

traveling crane. Four 1-ton hand-jib cranes serve the 60-inch radial drills and the 60-inch tapping machine in the dome machine shop.

Domes are transported from the flange shop in bay No. 13 by means of a tractor and trailer and are stored in the lower end of bay No. 8 adjacent to three radius planers.

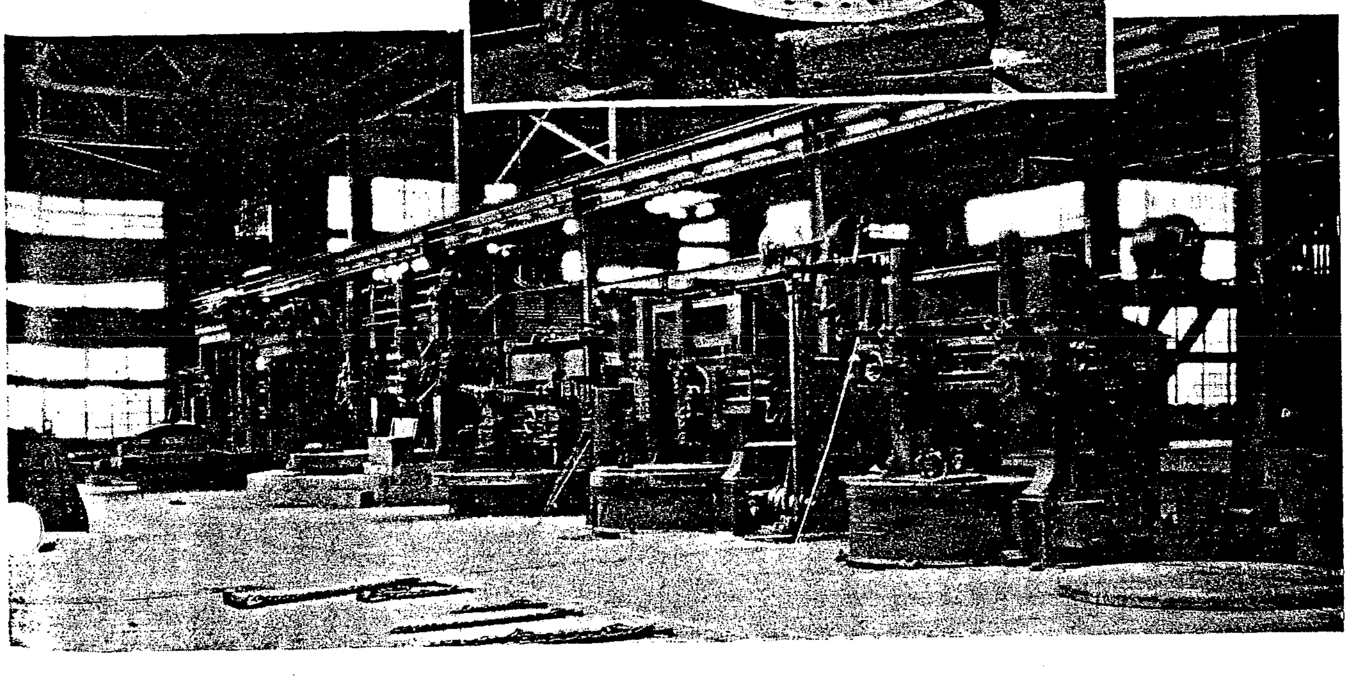
The first step toward finishing a dome is the machining of the inner flange of the dome in order to obtain a smooth surface for attachment to the boiler shell. The work is done on one of three radius planers which finished the inner dome surface to the curvature of the boiler shell.

These planers have a movable table similar to that on any ordinary surface planer; the tool arm, however, differs materially. Two horizontal columns are attached to two vertical columns and may be raised and lowered by hand-operated cranks. Attached to the two horizontal columns is the tool arm which

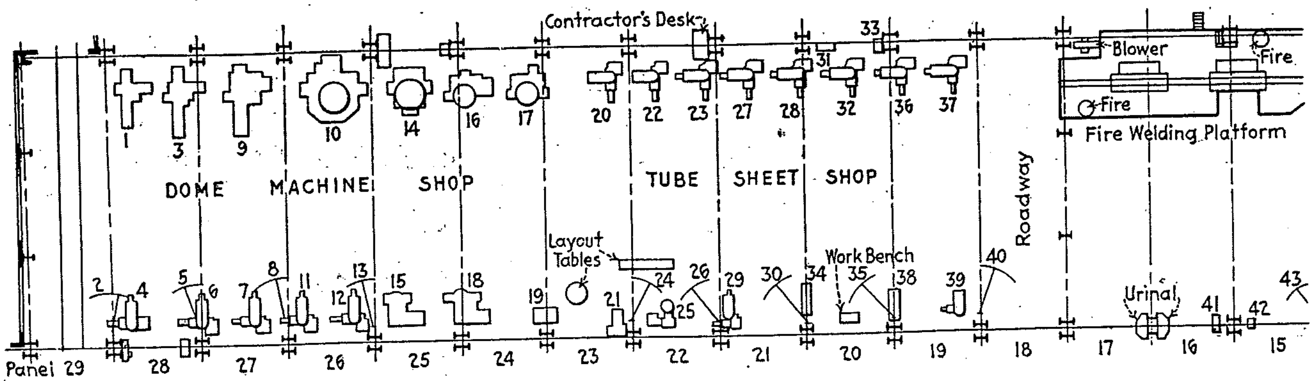


(Above)— Milling the flanges of a dome

(Left)—Dome set up with template for drilling top holes

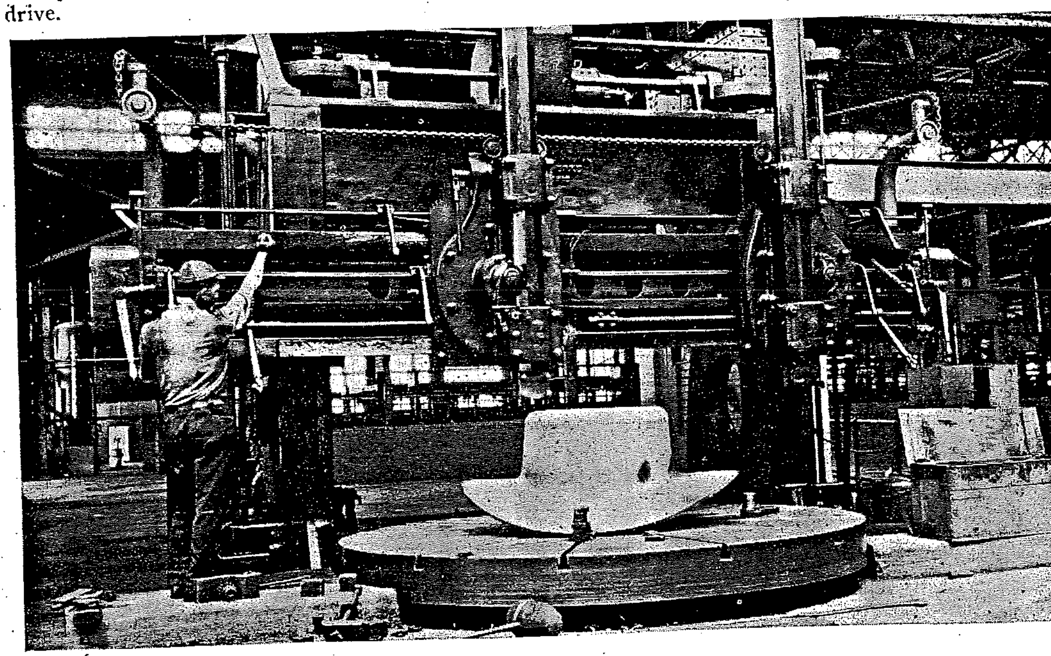


(Below)— Dome and tube sheet departments showing boring mills

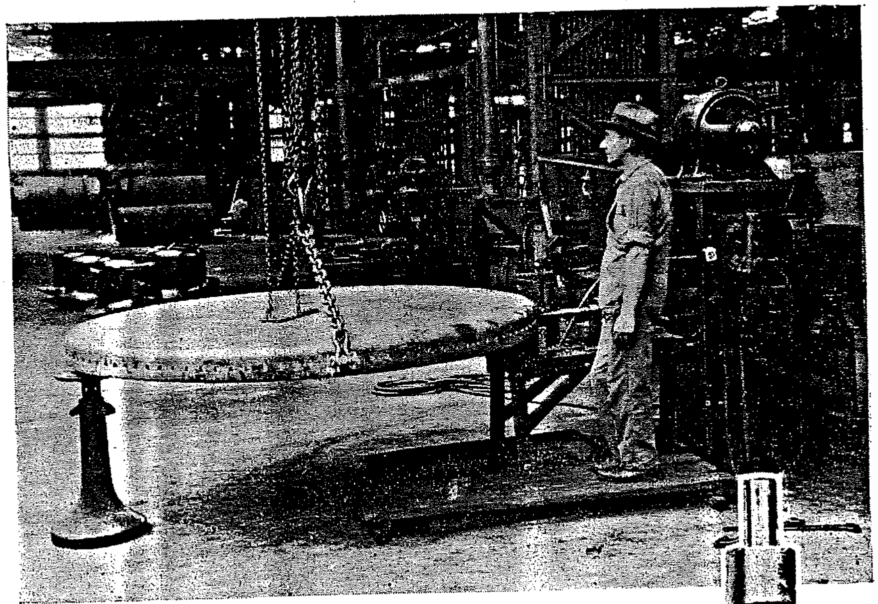


Machinery located in the dome machine shop and tube sheet shop in bay No. 8

1 Sellers 42-inch by 7-foot radius planer, motor on separate stand, belt drive.
2 Baldwin 1-ton hand jib crane having an 11-foot reach.
3 Sellers 40-inch radius planer, motor on separate stand, belt drive.
4 Harrington 60-inch radial drill, motor on machine, direct drive.
5 Baldwin 1-ton hand jib crane having a 13-foot reach.
6 Harrington 60-inch radial drill, motor on separate stand, belt drive.
7 Harrington 60-inch radial drill, motor on separate stand, belt drive.
8 Baldwin 1-ton hand jib crane having a 14-foot 6-inch reach.
9 Sellers 54-inch radius planer, motor on separate stand, belt drive.
10 Niles-Bement-Pond 120-inch boring mill, motor on machine, direct drive.
11 Harrington 60-inch radial drill, motor on separate stand, belt drive.
12 Harrington 60-inch tapping machine, motor on separate stand, belt drive.
13 Baldwin 1-ton hand jib crane having a 13-foot reach.
14 Sellers 100-inch boring mill, motor on bracket on building column, belt drive.
15 Bement-Niles No. 10, 60-inch vertical milling machine, motor on floor, belt drive.
16 J. M. Poole 76-inch boring mill, motor on machine, belt drive.
17 J. M. Poole 76-inch boring mill, motor on machine, belt drive.
18 Bement-Niles No. 10, 60-inch vertical milling machine, motor on floor, belt drive.
19 Bement 25-inch to 28-inch by 5-foot lathe, motor on bracket on building column.
20 Harrington 60-inch radial drill, motor on separate stand, belt drive.
21 James Moore shear for ⅝-inch plate, motor on floor, belt drive.
22 Harrington 60-inch radial drill, motor on machine, direct drive.
23 Harrington 60-inch radial drill, motor on machine, direct drive.
24 Baldwin 1-ton hand jib crane having a 13-foot reach.
25 Hilles & Jones 48-inch tapping machine, motor on separate stand, belt drive.
26 Baldwin 1-ton hand jib crane having a 12-foot reach.
27 Harrington 60-inch radial drill, motor on separate stand, belt drive.
28 Harrington 60-inch radial drill, motor on separate stand, belt drive.
29 Hilles & Jones 72-inch reaming machine, motor on separate stand, belt drive.
30 Baldwin 1½-ton hand jib crane having a 13-foot reach.
31 Baldwin 42-inch grindstone, motor on bracket on building column, belt drive.
32 Harrington 60-inch radial drill, motor on separate stand, belt drive.
33 Hisey-Wolf 6 WFA emery wheel, motor on machine, direct drive.
34 Baldwin 1¼-inch hole horizontal drill, motor on machine, belt drive.
35 Baldwin 1½-ton hand jib crane having a 14-foot reach
36 Harrington 60-inch radial drill, motor on separate stand, belt drive.
37 Harrington 60-inch radial drill, motor on separate stand, belt drive.
38 Baldwin 1¼-inch hole horizontal drill, motor on machine, belt drive.
39 Harrington 48-inch radial drill, motor on separate stand, belt drive.
40 Baldwin 1½-ton hand jib crane having a 14-foot reach.
41 Baldwin 42-inch grindstone, motor on bracket on building column, belt drive.
42 Baldwin 16-inch double emery wheel, motor on bracket on building column, belt drive.
43 Baldwin 1½-ton hand jib crane having an 8-foot reach.



Cutting the large dome top hole in a vertical boring mill



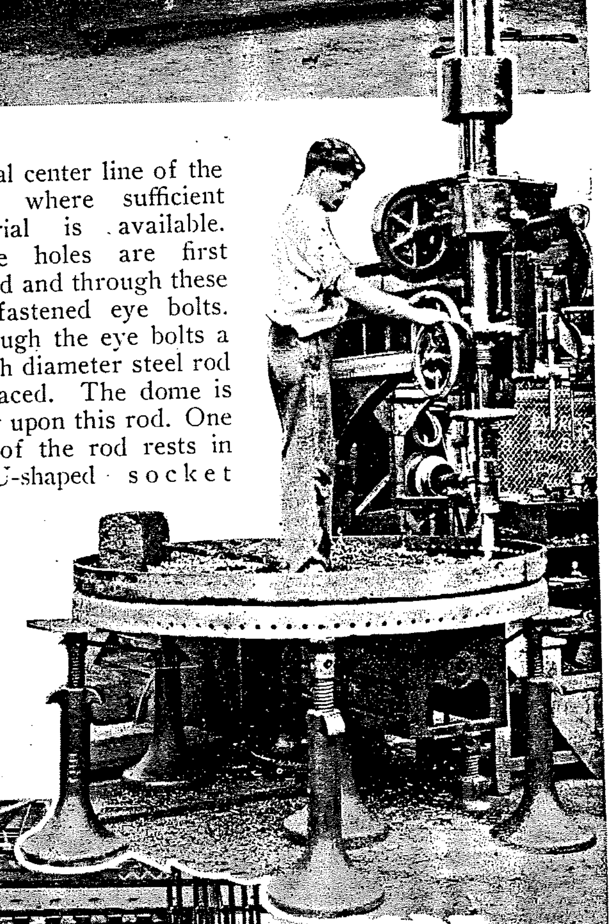
is allowed to pivot on the upper horizontal column when the distance between the tool and the pivot point conforms with the desired radius of the dome flange. The machine is fed automatically, the lower horizontal column being equipped with a machine-operated screw feed.

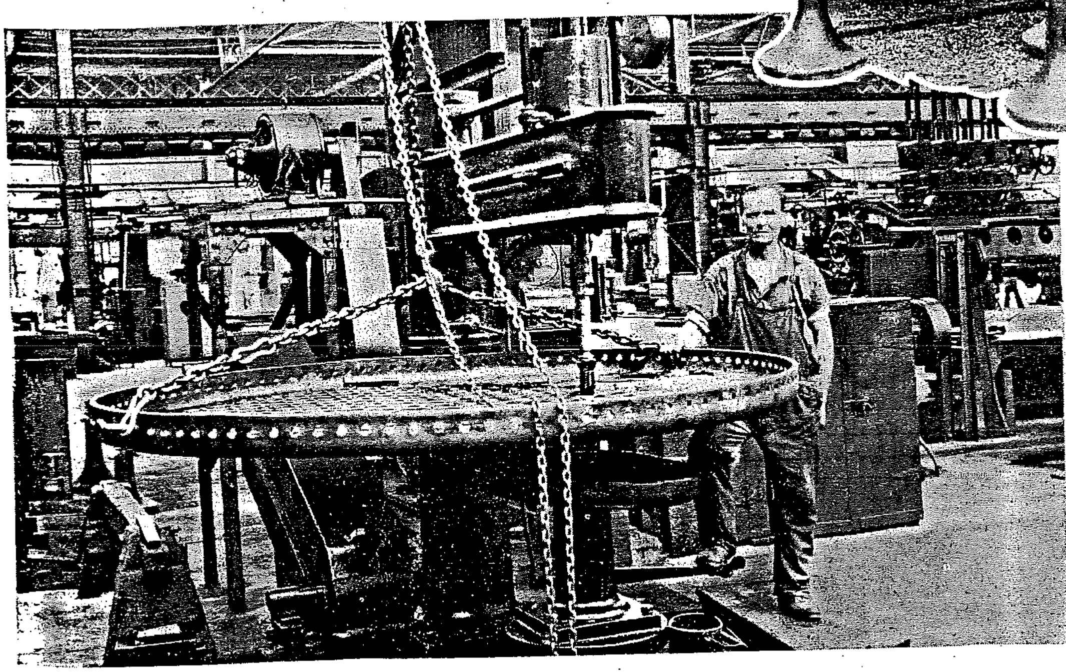
The dome is mounted in the machine by means of a collar dogged to the table and held to the dome by means of set bolts. Through the small hole in the top of the dome, left by the flanging department, a bolt is passed. To this is attached a bar of steel raised from the inner dome top by means of spacers. The device is clamped and the dome is held rigidly to the planer table. Once the machine is set up for a certain dome no attention is required due to the automatic feed. This allows one operator to run two or more machines.

Following the operation of inside planing the dome is set up in one of four boring mills for cutting the large hole in the top. In setting up the dome, the flange is fixed to the rotating table by means of dogs. The dome top is then lined up and a trial cut is taken. This is cut slightly smaller than the required diameter to allow sufficient material for a finish cut. When the rough cut is completed and the disk removed, a gasket groove, of about $\frac{1}{16}$-inch depth and of somewhat greater diameter than the hole, is cut with the same tool used for the rough cut. The finish cut on the inner edge of the hole is made with a tool with a side-cutting edge.

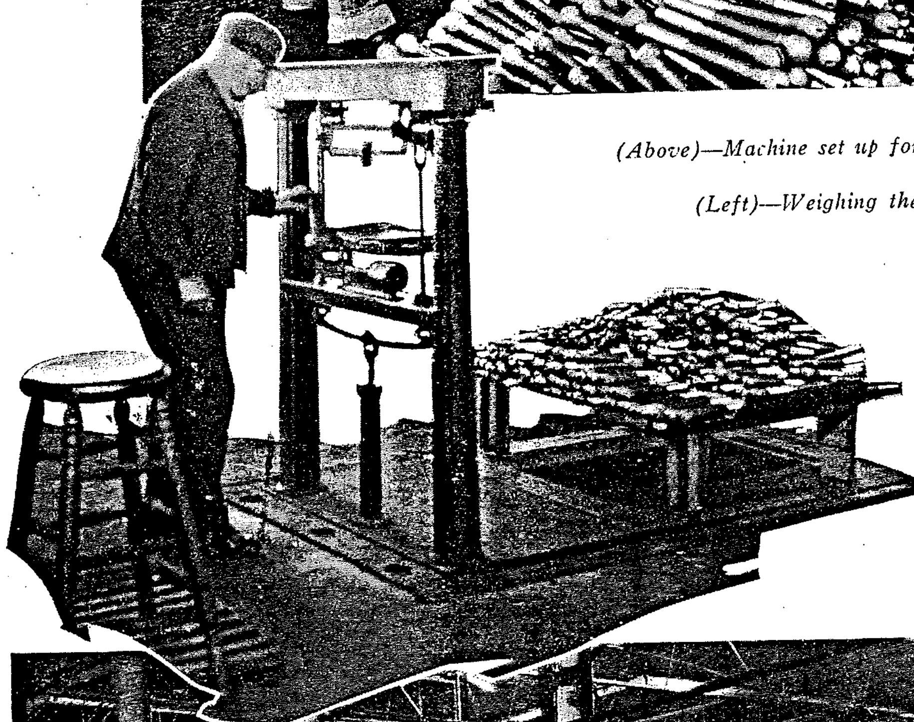
On completion of the hole-cutting process, the dome is handled by crane to a layout table in panel 26, where the dome is inverted with the flange uppermost. Here the dome flange is lined up and, with a template, the rivet holes are spotted, center punched, and the edge outlined with soapstone and center punched. The flange is then ready to be drilled and the edge burned off by means of an oxy-acetylene torch.

At the time of layout of the dome flange, two holes are spotted outside the cutting edge and on the longitudinal center line of the dome where sufficient material is available. These holes are first drilled and through these are fastened eye bolts. Through the eye bolts a 2-inch diameter steel rod is placed. The dome is hung upon this rod. One end of the rod rests in a U-shaped socket





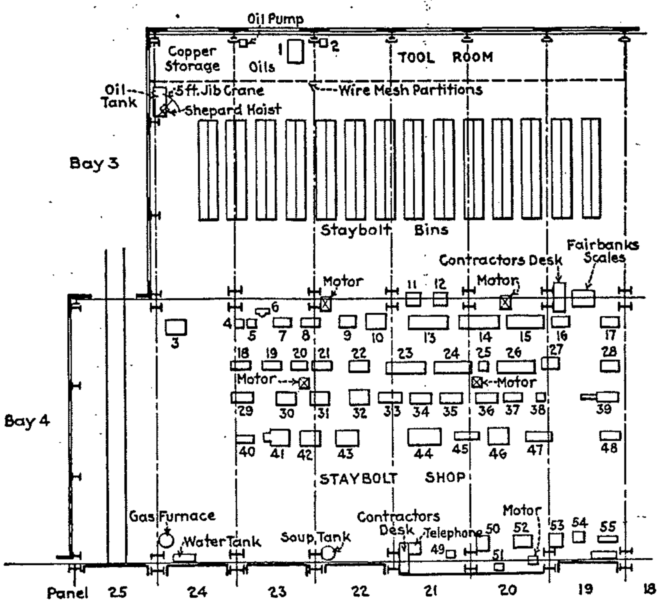
(Top)— Drilling the tube sheet flange holes
(Center)—Drilling the lead holes in two tube sheets
(Left) —Reaming the flue holes in a tube sheet



(Above)—Machine set up for threading flexible staybolts

(Left)—Weighing the department's output

(Below)—Crated flexible staybolts as received from the manufacturer



Machinery Located in the Staybolt Shop and Tool Room

1—Brown & Sharp No. 2—30-inch universal grinder, motor on steel work overhead, belt drive.
2—Willey 12-inch, double emery wheel, motor on machine, direct drive.
3—Hilles & Jones 1¼-inch bar shear, motor on machine, belt drive.
4—Harrington centering machine, belt drive from line shaft.
5—Baldwin ⅝ to 1¾-inch centering machine, belt drive from line shaft.
6—Baldwin double emery wheel, belt drive from line shaft.
7—Harrington 4-spindle drill press, belt drive from line shaft.
8—Harrington 4-spindle multiple drill, belt drive from line shaft.
9—Ferracute Machine Company special squaring press, belt drive from line shaft.
10—Ferracute Machine Company special squaring press, belt drive from line shaft.
11—Landis double-spindle, staybolt threading machine, motor on machine, direct drive.
12—Landis double spindle, staybolt threading machine, motor on machine, direct drive.
13—Harrington 6-spindle staybolt threader, belt drive from line shaft.
14—Harrington 6-spindle staybolt threader, belt drive from line shaft.
15—Baldwin 6-spindle staybolt threader, belt drive from line shaft.
16—Bement-Miles double staybolt cutter, belt drive from line shaft.
17—Bement-Miles double staybolt cutter, belt drive from line shaft.
18—Harrington 4-spindle multiple drill, belt drive from line shaft.
19—Harrington 4-spindle multiple drill, belt drive from line shaft.
20—Harrington 4-spindle multiple drill, belt drive from line shaft.
21—Harrington 2-spindle multiple drill, belt drive from line shaft.
22—Pratt & Whitney ⅝ to 1¼-inch double rounder, belt drive from line shaft.
23—Harrington 6-spindle staybolt threader, belt drive from line shaft.
24—Harrington 6-spindle staybolt threader, belt drive from line shaft.
25—Baldwin 10-inch emery wheel, belt drive from line shaft.
26—Harrington 6-spindle staybolt threader, belt drive from line shaft.
27—Bement-Miles staybolt cutter, belt drive from line shaft.
28—Bement-Miles staybolt cutter, belt drive from line shaft.
29—Harrington 16-inch by 3-foot rounder, belt drive from line shaft.
30—Acme staybolt turner, belt drive from line shaft.
31—Acme 1½-inch double staybolt cutter, belt drive from line shaft.
32—Acme 1½-inch double staybolt cutter, belt drive from line shaft.
33—Harrington 16-inch crown-bolt lathe, belt drive from line shaft.
34—Harrington 16-inch by 30-inch crown-bolt lathe, belt drive from line shaft.
35—Harrington 19-inch crown-bolt lathe, belt drive from line shaft.
36—Harrington 16-inch by 36-inch crown-bolt lathe, belt drive from line shaft.
37—Acme single staybolt cutter, belt drive from line shaft.
38—Baldwin 8-inch emery wheel, belt drive from line shaft.
39—Warner-Swasey No. 6 turret lathe, motor on machine, direct drive.
40—Acme 1-inch rounder, belt drive from line shaft.
41—Acme 1½-inch staybolt turner, belt drive from line shaft.
42—Baldwin double staybolt cutter, belt drive from line shaft.
43—Acme double staybolt cutter, belt drive from line shaft.
44—Hartness (Jones & Lamson) 3-inch by 36-inch turret lathe, motor on machine, direct drive.
45—Lodge & Davis 16-inch lathe, belt drive from line shaft.
46—Acme 1½-inch double staybolt cutter, belt drive from line shaft.
47—Cregar 2-inch single staybolt cutter, belt drive from line shaft.
48—Cooper, Jones & Company forming lathe, motor on machine, direct drive.
49—Baldwin single staybolt saw, motor on building column, belt drive.
50—Hilles & Jones No. 0 staybolt shear, belt drive from line shaft.
51—J. G. Blount, 6-inch twist drill grinder, motor drive.
52—Baldwin double, circular staybolt saw, belt drive from line shaft.
53—Hendey shaper, belt drive from line shaft.
54—Landis chaser grinder, motor on machine, direct drive.
55—Bradford 16 by 72-inch lathe for radial staybolts, belt drive from line shaft.

smith shop located elsewhere in the plant. The bar is formed by heating and shaping the ends in upsetting machines. The head end is formed with a rough button or curved head, straight or tapered throat and a square lug. The other end has a straight upset for the length of the thread.

The first operation after receipt from the blacksmith shop is the rounding of the point. This is done in one of two rounders located in panel 23 and designated as Nos. 29 and 40 on the shop layout plan on this page. These machines are similar to that used for waterspace staybolts except that the bolt is gripped in the mid-length by double-V clamps.

High skids are located between these machines and staybolt-turning machines located adjacent to the rounders in the same panel. These skids serve as a table on which the bolts are passed between one machine and another.

The staybolt cutters involved in the second operation are used for roughing. They are double-spindle machines fitted with a special-shaped cutter ground to the proper throat taper and underside of head. Stops are set on the machine to ensure the proper diameter of staybolt at the throat and to limit the travel of the cutter in way of the head. By this means production is increased, each machine being operated by one or two operators, each operating one spindle.

The bolts are transferred by skid to one of two special lathes located in panel 21. These lathes, developed by The Baldwin Locomotive Works, have a special die head attached to the carriage so that when the bolt is once in the lathe, it is not removed until all of the operations, turning, grooving and threading are completed. This method ensures the thread and groove being concentric with the turning, while the facing of the heads are always at right angles to the axis of the bolt.

These machines, similar to those used in roughing, finish under the head, cut grooves in the head or cut a recess in bolts when specified and thread taper ends at one setting. The head is fitted with a square hole to take the head of the staybolt. The bolt revolves and the underside of the head and the groove is first cut. The taper thread cutter, a group of four blades mounted in a fixed head, is allowed to move horizontally and is brought up to the work, the limit being set by stops.

Still moving toward the upper bay, the bolts are transferred to the double-headed staybolt cutters in panel 20 where the straight end of the staybolt is threaded. In these machines, the body of the bolt is gripped by means of a double-V clamp. The cutter is movable and located in the head, the clamp being on a carriage which is power fed toward the head, thus cutting the threads. Four Landis thread chasers of high-speed steel are used.

Flexible staybolts are received from the makers as a forged blank with the head rounded and a slot cut in the head. The work on this type of bolt consists of threading.

These bolts are first rounded at the point on any one of the rounding machines. In the machines generally used for radial staybolts a double-V grip is used to hold the bolts, but in machine No. 22 the vise grip is specially made with screwdriver head to hold the bolts. The process is otherwise the same as for other bolts. Threading is done on one of the double-head threaders, the piece being held in a double-V grip.

Brace rods, brace pins, stem rivets, patch bolts and fitting up bolts are fabricated in this department. Throat stays and slotted or pinned brace pins are machined on the Cooper, Jones & Company forming lathe, located in panel 19.

The Baldwin expansion staybolts, a three-piece assembly consisting of a regular radial staybolt, nut and shaped forging, are made in this bay. The forging referred to consists of a threaded rod and eye with a drilled hole for passing the staybolt. The forging hole is drilled and faced on a Warner-Swasey turret lathe located in panel 19 and the complete assembly is formed in this department.

With the exception of eight machines, all are driven by belts. The power is received from 5 line shafts raised about 14 feet above the floor of the bay and supported from a frame work of girders extending over the major portion of the bay. Five electric motors supply the line-shaft power.

A completely equipped tool room is located between panels 19 and 24 of bay No. 3. This room, having a width of over 14 feet, is separated from the main bay by a wire mesh partition and is divided into a tool room, oil room and copper storage.

Throughout the manufacture of staybolts, every effort is made to save time, labor and transportation. Production methods and specialization of labor enable The Baldwin Locomotive Works to obtain the maximum output at the maximum efficiency, consistent with the equipment available. Every effort is made to specialize the operation of each machine in order to eliminate the necessity of setting up the tools for each operation. Through these methods that characterize the operations of the entire boiler shop, staybolt manufacturing costs are reduced to a minimum.

Air Filter for Pipe Lines

A NEW type air filter for removing dust, water, oil, rust, scale and other foreign matter from air passing through pipes has been placed on the market by the Staynew Filter Corporation, Rochester, N. Y.

This filter consists of an aluminum housing, enclosed in a pressed steel housing which, it is claimed, will withstand a working pressure of 125 pounds per square inch. The filter which is mounted inside consists of a felt filter medium formed in pockets over radial wire screen fins grouped around a central outlet. This form permits mounting a relatively large area of felt in a compact space and allows the use of the entire available area of felt with a minimum restriction. The large

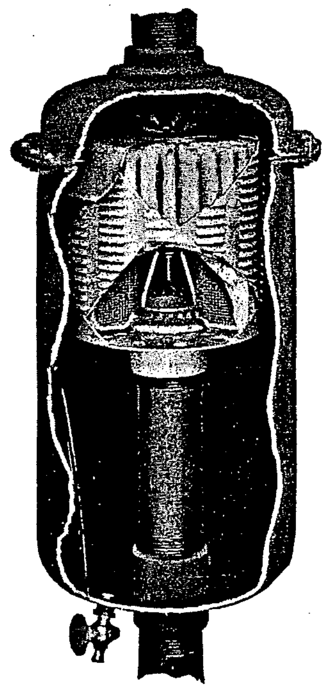


Fig. 1.—Sectional view of Staynew air filter

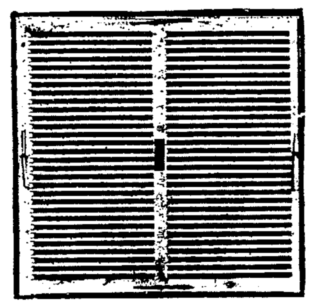


Fig. 2.—Panel filter unit

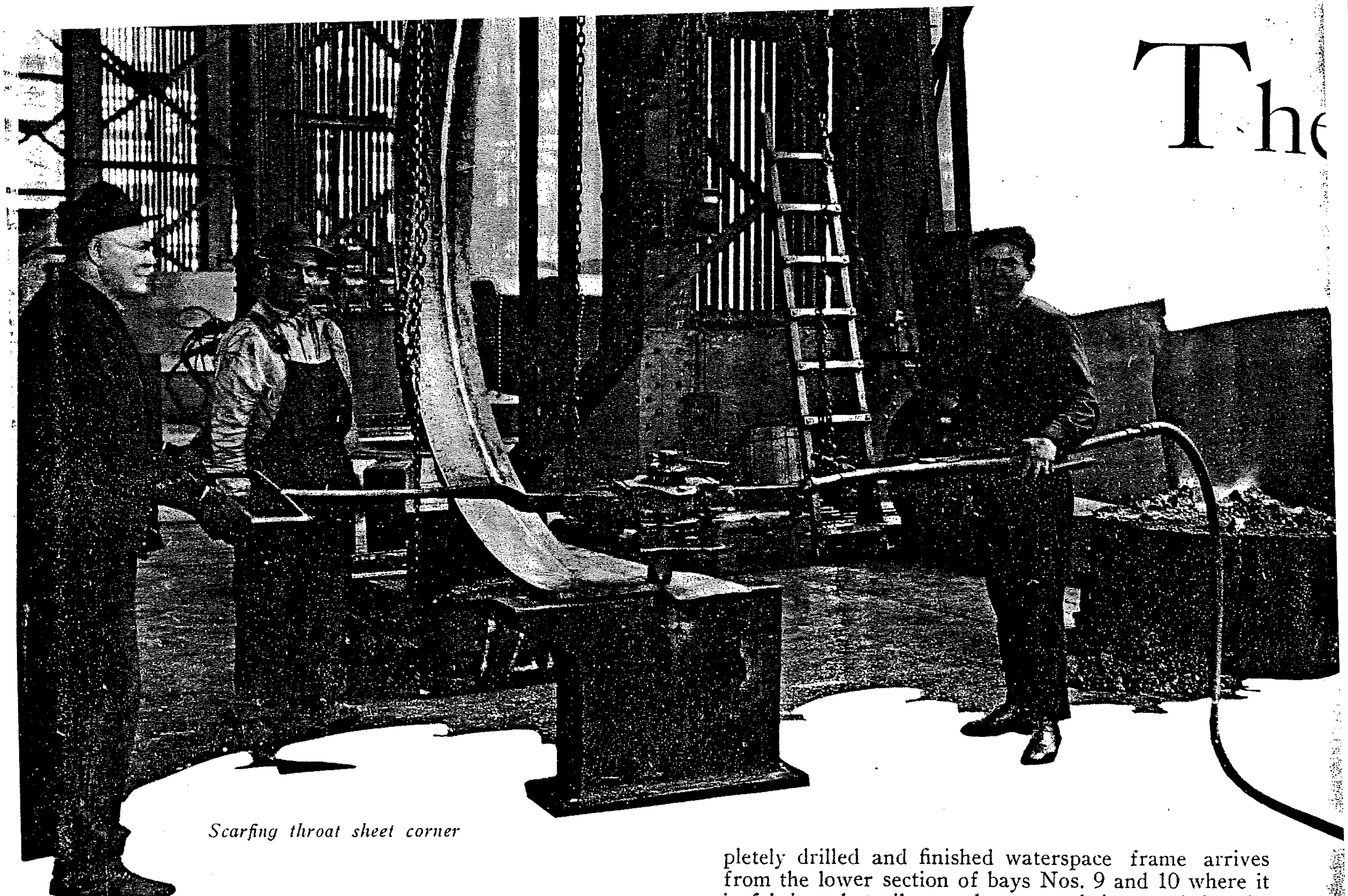
capacity inserts are designed to pass 250 cubic feet of free air per minute and contain 20 square feet of felt within a volume slightly smaller than a cubic foot.

As air enters the top of the filter it is drawn against the inner wall of the steel housing by a shield over the top, the downward velocity carrying water, oil and most of the grit to the bottom of the shell. All remaining water, oil, dust and grit are caught by the filter. A drain cock is provided at the bottom to remove water, oil, etc.

By closing a valve to shut off the air going into the filter housing and opening the drain cock the air in the outlet pipes or hose is blown back through the filter proper, removing all material on the filter surface. In this way the filter can be cleaned in about 10 minutes while it is in operation. Under ordinary conditions, the filter requires cleaning only about twice a year.

A second type of filter made by this same company, which is used in filtering large volumes of air for ventilation, is shown in Fig. 2. This type, known as the panel filter, is supported in a heavy pressed steel frame capable of being mounted in any convenient formation to suit the space available for installation.

The panel consists of two pressed steel or aluminum frames which support a series of hollow fins or pockets formed of wire cloth and arranged in two rows. Each row of fins is covered with a single piece of an extremely fine texture filter material.



The

Scarfing throat sheet corner

BACK ends for locomotive boilers built at the boiler shop of The Baldwin Locomotive Works, Eddystone, Pa., are applied to the barrel or waist of the boiler by what is known locally as the shell gang. While the back end of the boiler may be taken to include not only the shell but the firebox as well, only the shell of the back end, consisting of the outside throat sheet, top and side sheets, backhead and mudring is installed by this department. Thus the shell gang assembles and checks the outer section of the back end and attaches this portion of the boiler to the barrel before it is delivered to the finishing floor.

This department is located in the upper section of bay No. 5 of the boiler shop at Eddystone and extends between panels 2 and 17 covering a floor area of 30,720 square feet. Thirty-five machine tools are served by seven overhead cranes, including one 50-ton Niles and one 70-ton Pawling & Harnischfeger traveling crane serving nearly the entire length of the department. One 50-ton Niles traveling crane arranged to travel across the bay serves panels 2 and 3 while a 50-ton Pawling & Harnischfeger and a 50-ton Morgan crane serve panels 16 and 17; two 7½-ton Milwaukee wall cranes serve bull riveters located in panels 14 and 15.

Material to be fabricated in this department arrives in bay No. 5 from five sources. The completed waist or barrel is received from bay No. 8, after being riveted and checked ready for application to the back end. The flanged throat sheet with the holes laid out but not trimmed or drilled is forwarded to this department from the layout gang located in bay No. 12. The completely drilled and finished waterspace frame arrives from the lower section of bays Nos. 9 and 10 where it is fabricated, trailers and tractors being used for the purpose of transportation. The wrapper sheet, sometimes received in more than one piece, comes directly from the plate rolls located in the upper section of bay No. 10 while the backhead, laid out and drilled with the exception of the flange line, is received from the drill presses in the upper section of bay No. 12.

The throat sheet is the first material required by the shell gang for fabrication, as prior to its application to the back end, it is necessary to be trimmed, drilled and scarfed in this department. On receipt, the work is taken to one of the 48-inch or 60-inch radial drills where the staybolt holes are cut, after which the rivet holes in the flanges are drilled in one of two horizontal drills located in panels 12 and 13. After drilling, the plate is trimmed by means of hand-operated pneumatic chipping hammers, cutting the material to the proper distance from the line of rivet holes.

The scarfing operation is done in panel 11 where a pneumatic hammer and coal fires are located. The plate is heated to a yellow heat successively at each waterspace corner and the top of each wing and the sheet is raised by means of a differential hoist and the hot section is laid metal to metal against an anvil where the corners are drawn to a fine taper by means of a specially-designed pneumatic hammer. This hammer, shown in the illustration, was designed and constructed at The Baldwin Locomotive Works. Being suspended from a jib crane, two men operate the hammer by means of long handles while the third member of the gang controls the sheet which is suspended from a second jib crane. After scarfing, the flange of the throat sheet is chipped to the line of the lap and is then ready for application.

Installation of Back Ends

Methods employed by the shell gang in fitting outside throat sheets and wrapper sheets at The Baldwin Locomotive Works

The waterspace frame is checked to make sure that it is square before the top and side is applied.

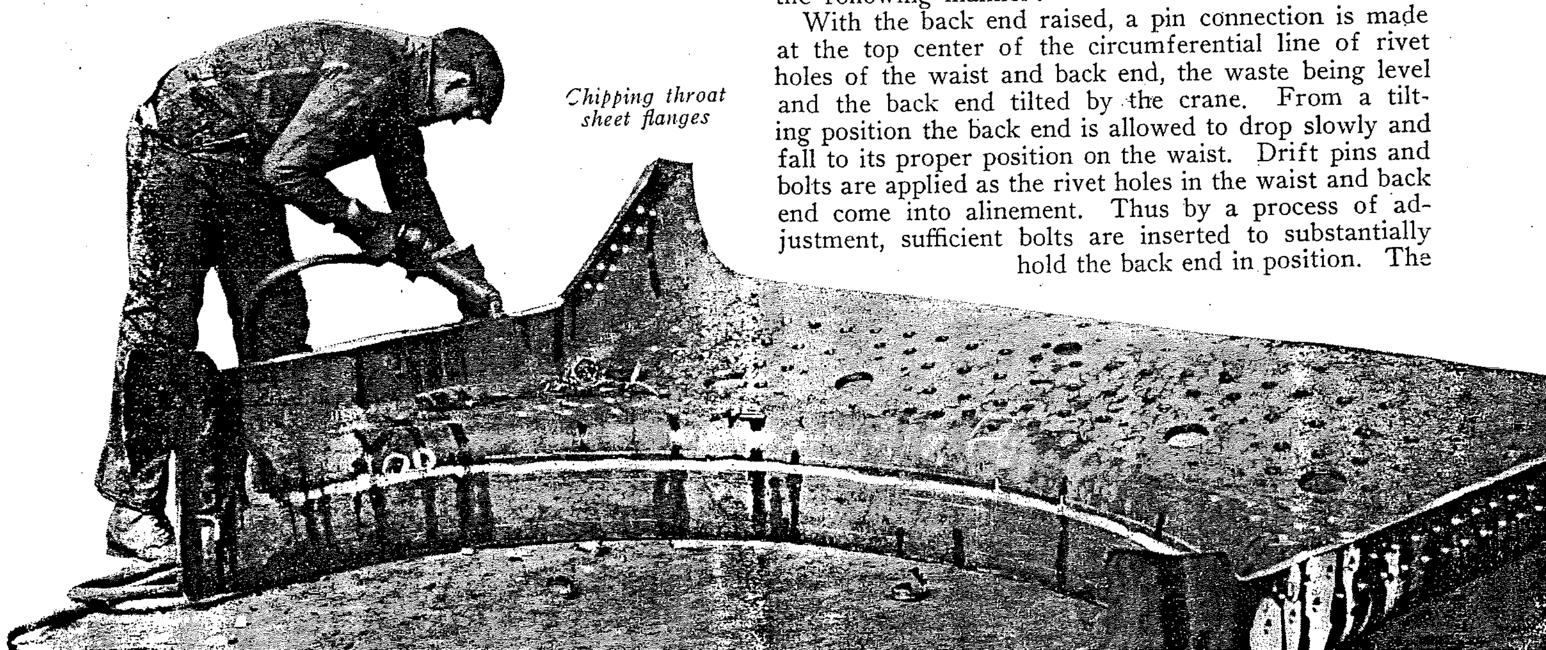
Before applying the throat sheet, the wrapper sheet or top and sides sheet is first fastened to the waterspace frame or mudring by means of bolts and dowel-pins. To properly secure the mudring and the wrapper sheet, selected tack holes in each piece of material have been previously drilled full size, the same template being used for laying out the location of the holes in both cases. These sheets are set up with full size dowel-pins and full size bolts, care being taken at this time to obtain a perfect fit in order to insure the additional holes being correctly located. This care is necessary in order to obtain the correct alinement of staybolt holes later on when the firebox, which is also supplied with tack holes located in the same way and with the same template, is applied.

In the case of three-piece top and sides sheets, the plates are bolted, reamed and bull riveted before the application of the throat. In fitting the top and sides sheets, and in order to insure the proper spacing of staybolt holes, a tram center punch mark is placed on the sheet on a line 6 inches from the center of the line of rivet holes. This line is placed on each sheet so that a total of 12 inches lies between the lines when fitted up. This distance is checked the entire length of the sheet by means of a trammel iron. Thus by a simple means, the staybolt holes are properly spaced.

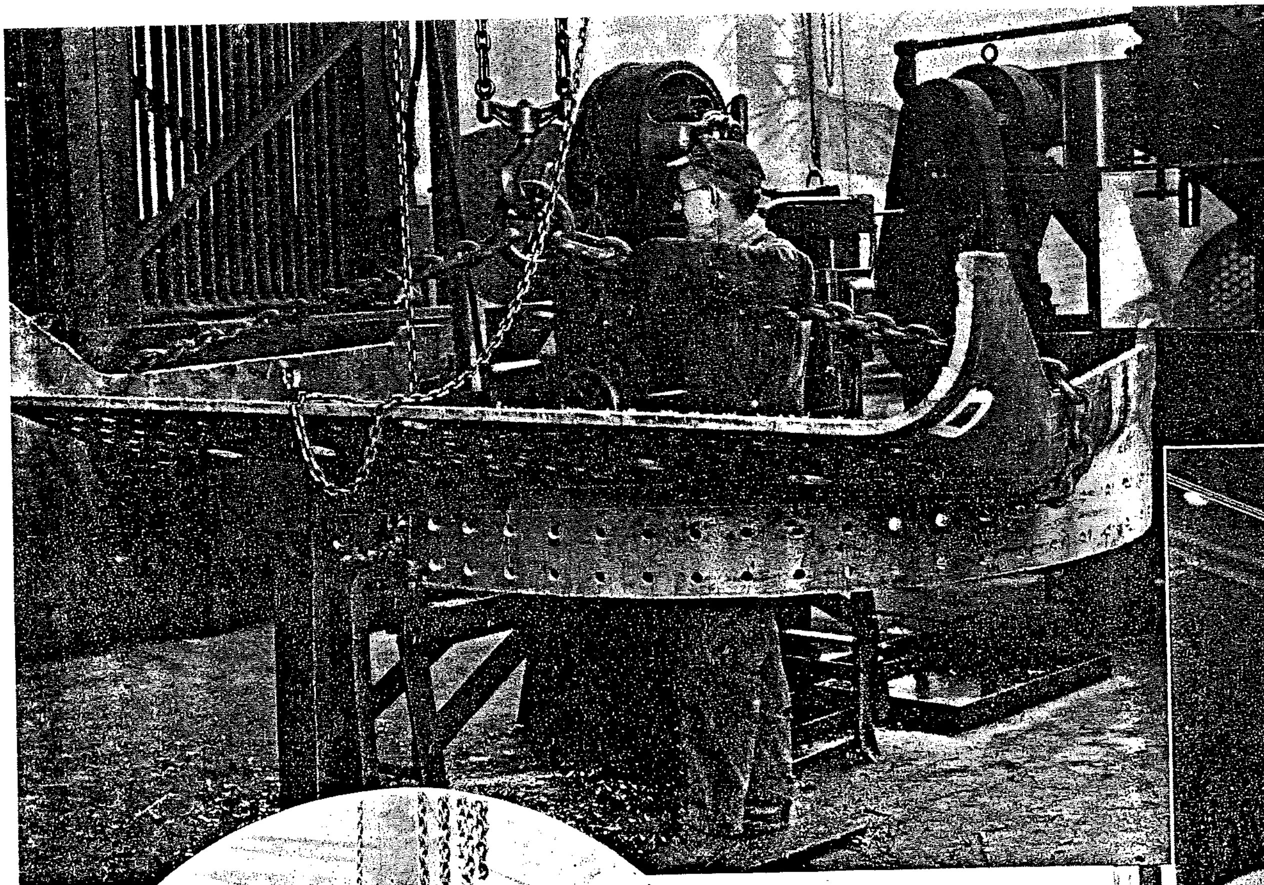
After the wrapper sheet is bolted to the mudring, the throat sheet is applied and bolted in place to the wrapper sheet and mudring. To provide a tight fit at the corners where these three pieces meet, corners are heated and shaped. For this purpose oil torches are used which burn fuel oil vaporized by a compressed-air line. The torch as developed at The Baldwin Locomotive Works has a special suction burner and operates in conjunction with a portable oil tank. In time past this tank was used under direct air pressure, but due to the hazard accompanying such practice, this was discontinued; so at the present time, a suction system is used with the burner so designed that heavy fuel oil is continually sucked through the nozzle. Fitted to the torch is a short combustion chamber to enable the concentration of heat at the desired point. This sort of torch is used throughout the shop for fitting up all heavy plate work, the heat being retained at the back of the work by various means.

After the corners have been raised to a temperature indicated by an orange heat, the plates are set up tight against the mudring by means of flatters and hammers manipulated by two or more men. The throat sheet is then unbolted, removed from the back end and bolted directly into place on the barrel or waist. The barrel has been previously transported to a position directly in line with the back end, the waist being raised from the floor to a height of about two feet by means of two metal horses. In this position, the throat sheet is fitted to the waist with bolts placed every two holes to guarantee a tight fit of the plates. This is the final bolting job for the waist sheet and throat sheet seam. After the throat sheet is completely bolted, the back end is lifted by means of cranes and applied to the waist in the following manner:

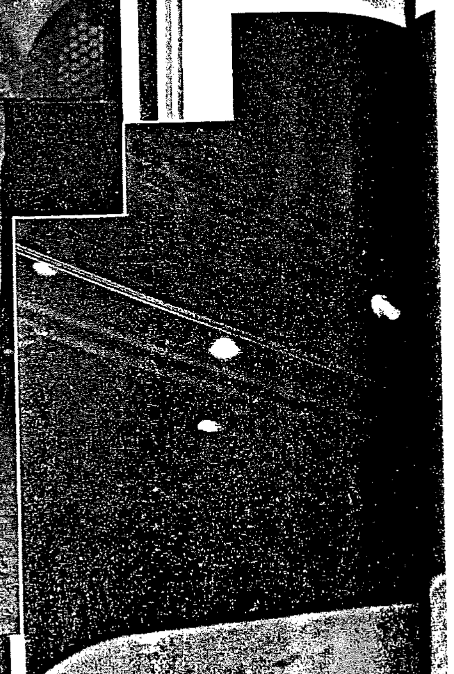
With the back end raised, a pin connection is made at the top center of the circumferential line of rivet holes of the waist and back end, the waste being level and the back end tilted by the crane. From a tilting position the back end is allowed to drop slowly and fall to its proper position on the waist. Drift pins and bolts are applied as the rivet holes in the waist and back end come into alinement. Thus by a process of adjustment, sufficient bolts are inserted to substantially hold the back end in position. The



Chipping throat sheet flanges

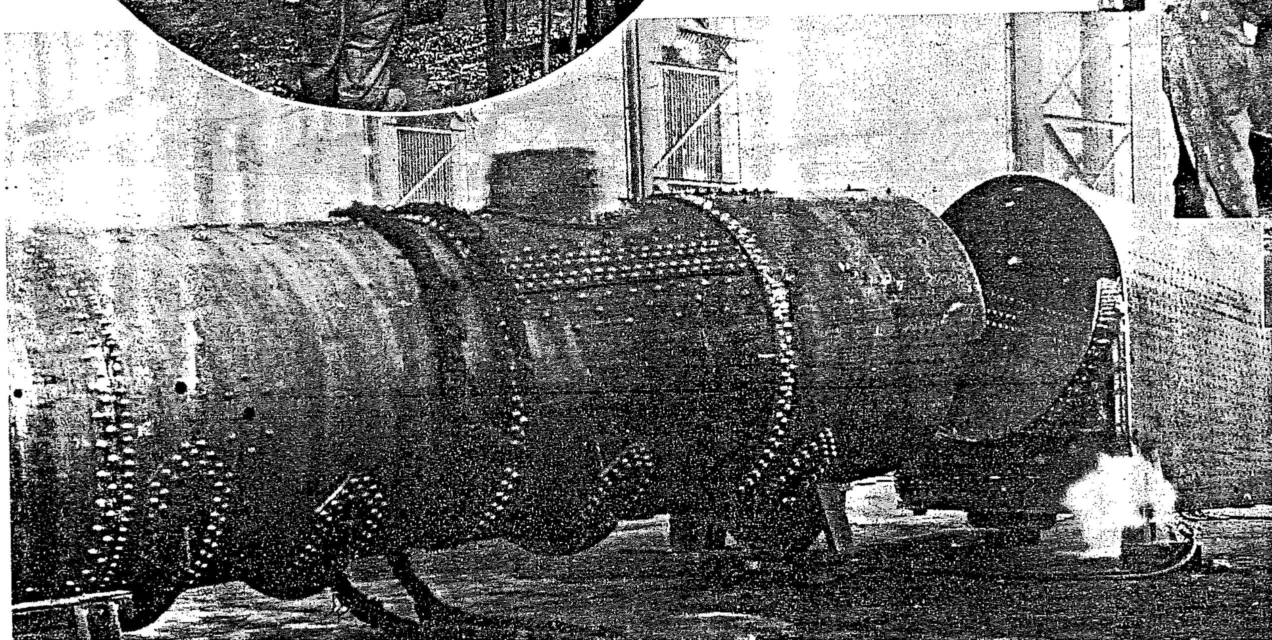


(Left) — Throat sheet flanges are drilled with a special holding jig



(Left) — Drilling throat sheet rivet holes on a horizontal drill

(Below) — Heating the throat sheet corners for fitting to mudring



(Above) — Bolting the throat to the boiler barrel

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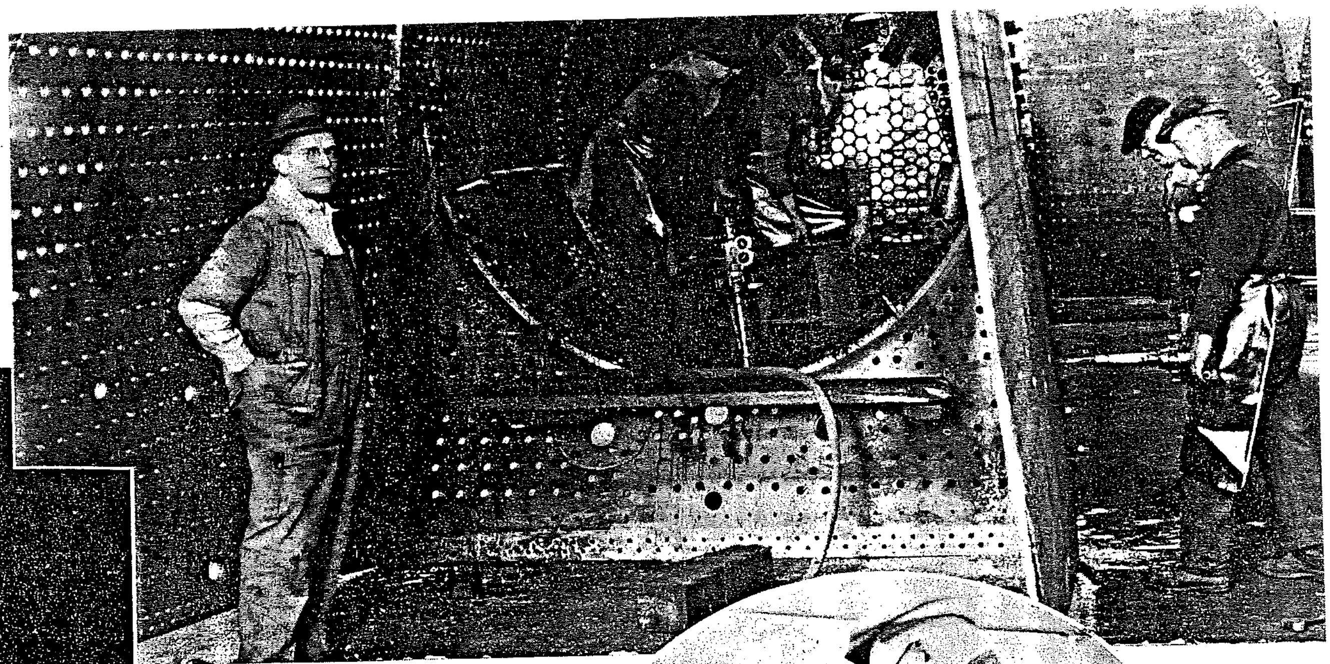
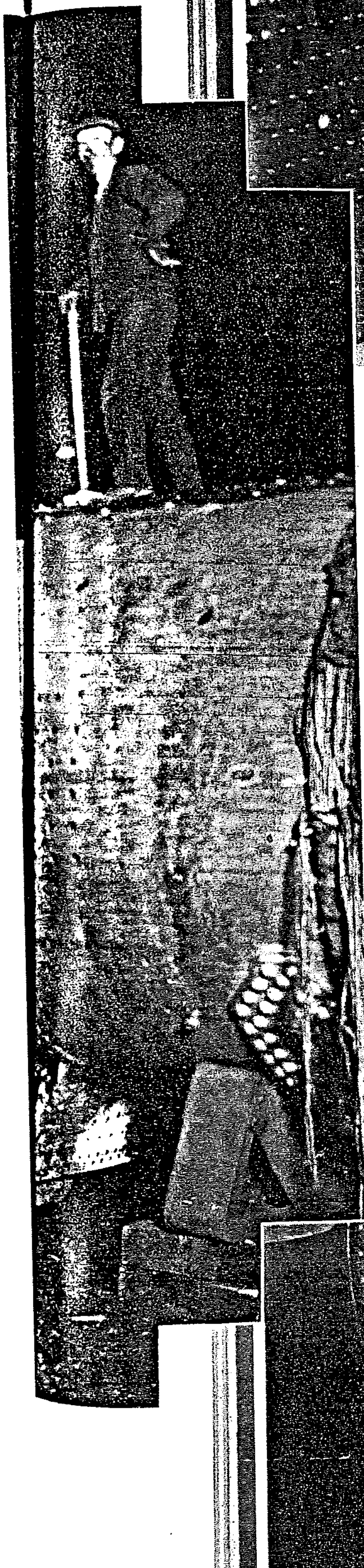
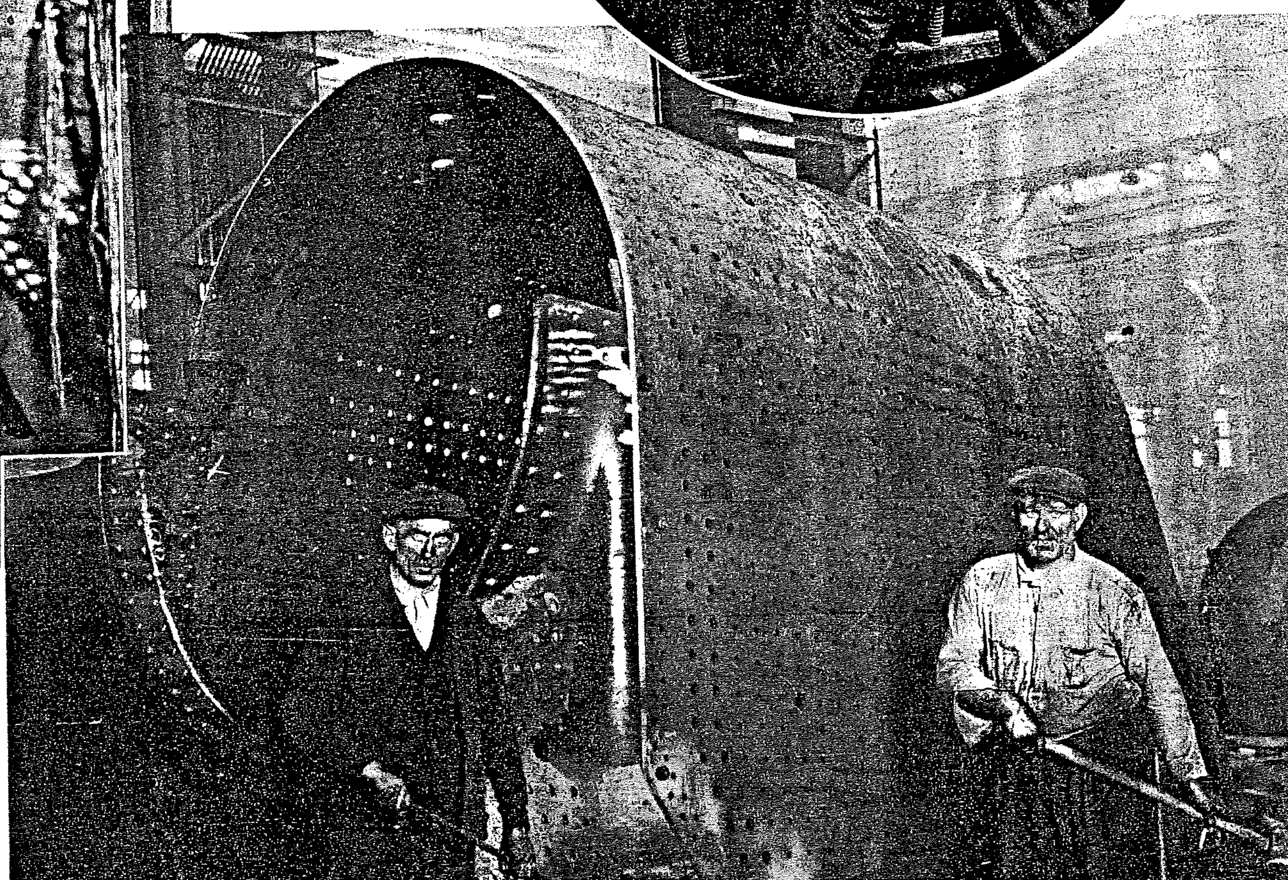
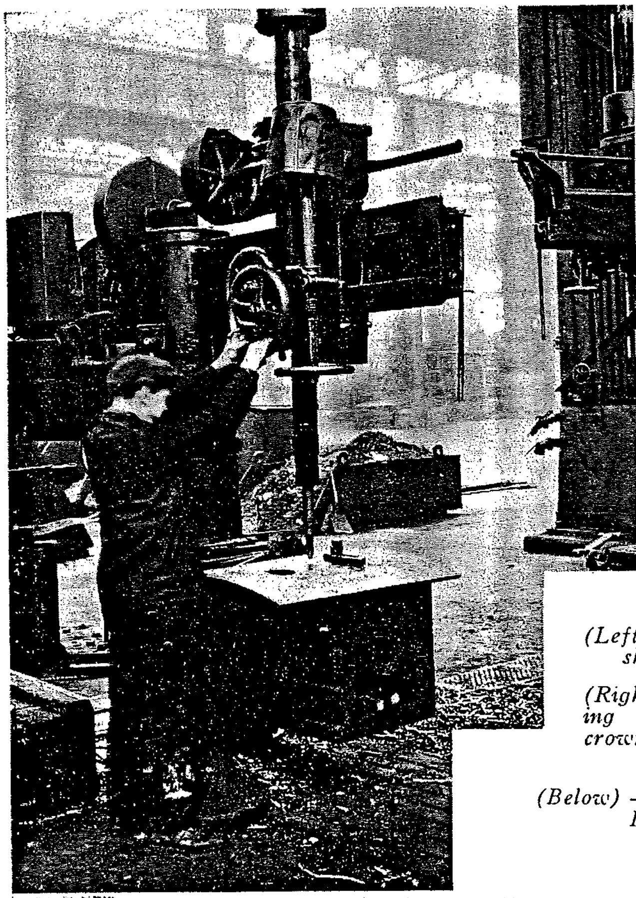


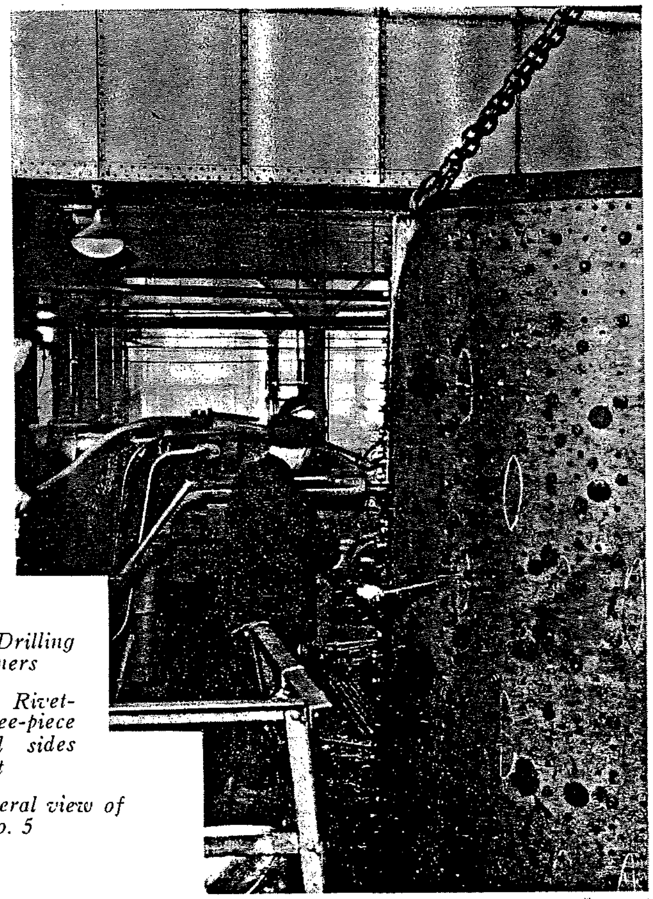


(Right) — Each bull riveter is equipped with a Berwick electric rivet heater

(Below) — Drawing up the throat sheet corners with sledges and flatter tools



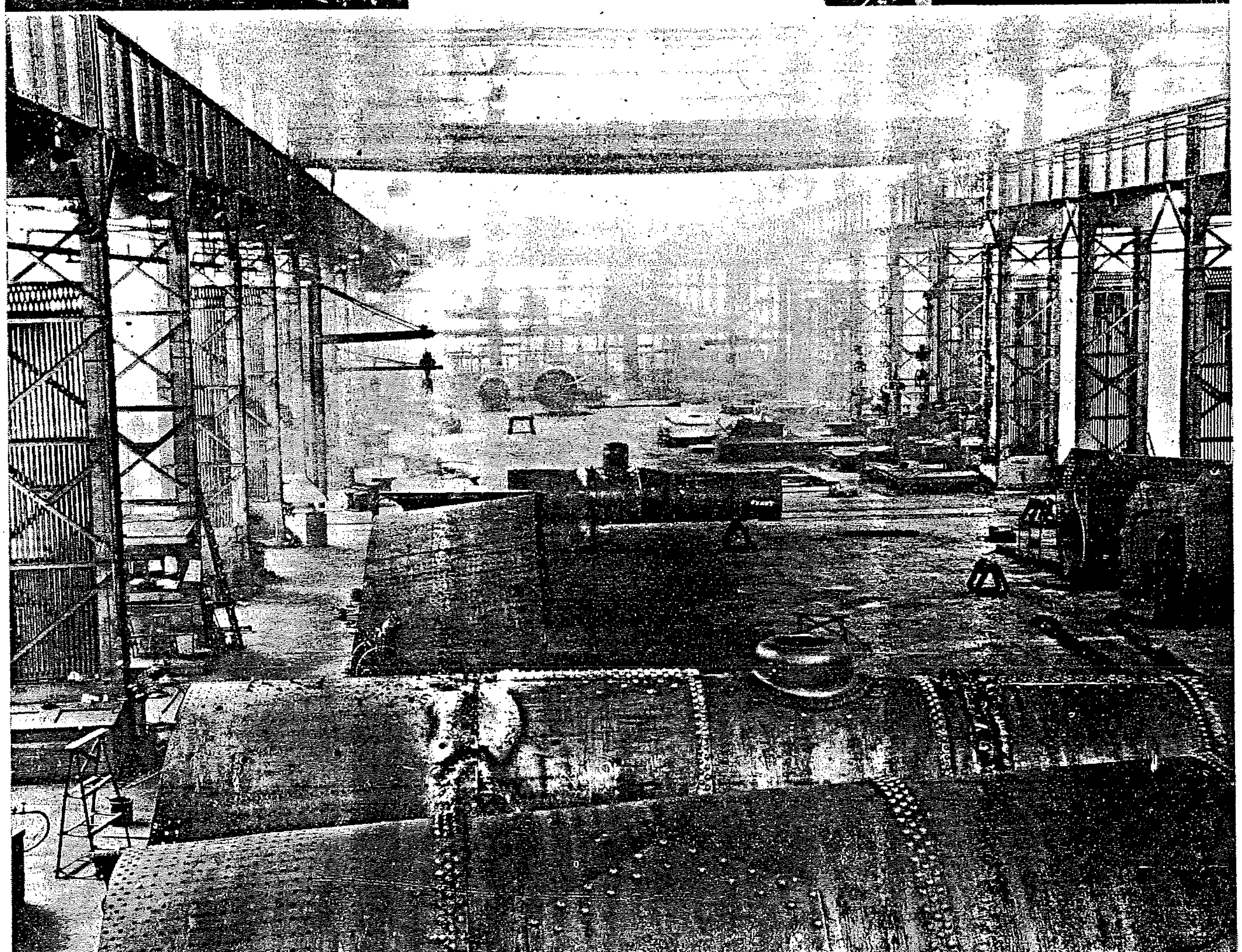




(Left) — Drilling shell liners

(Right) — Riveting a three-piece crown and sides sheet

(Below) — General view of Bay No. 5



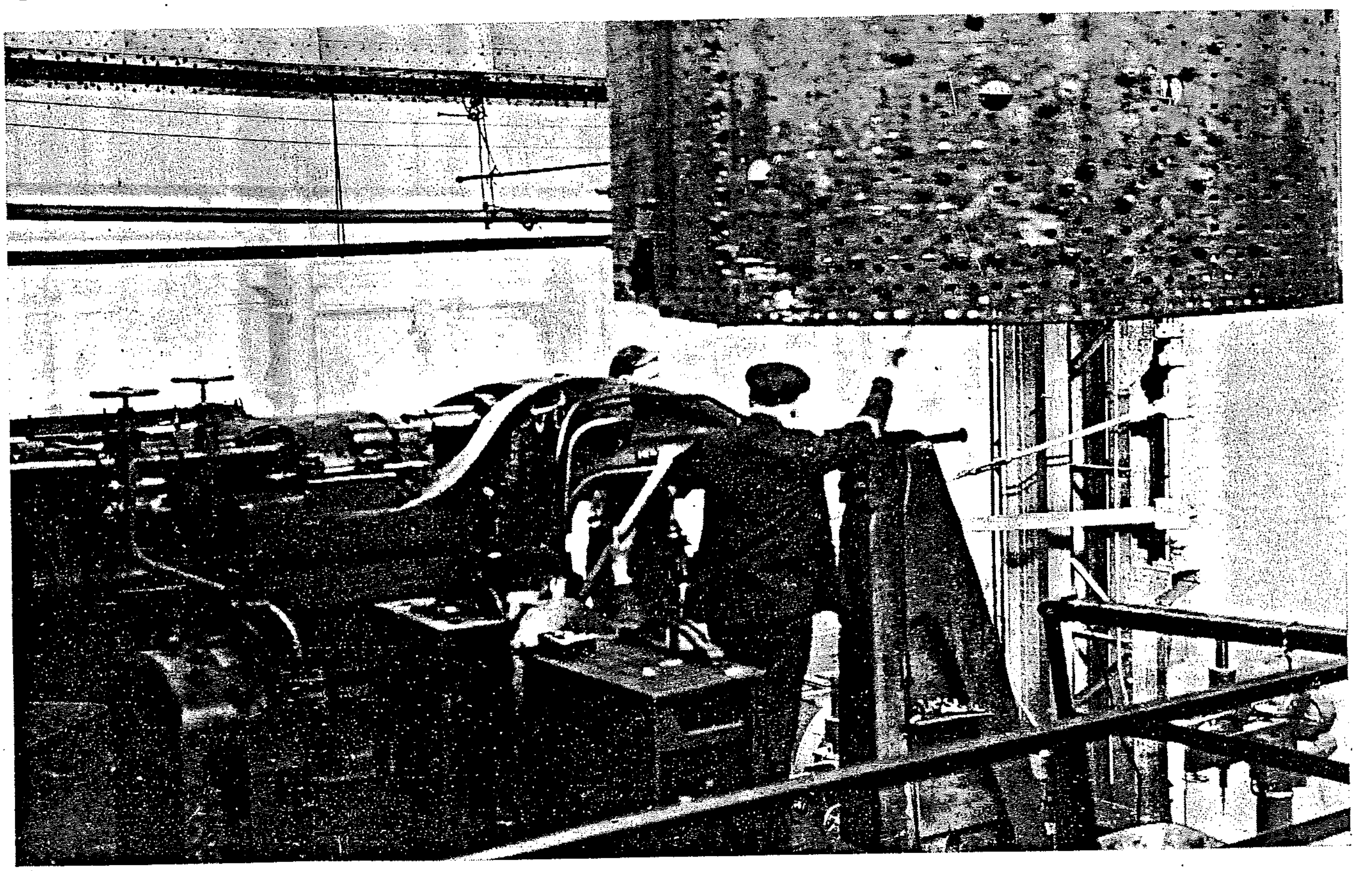
backhead is applied when this work is completed.

As previously mentioned, the backhead comes to bay No. 5 completely drilled with the exception of the flange rivet line. In this department the backhead is scarfed by the shell gang at the waterspace corners in a similar manner to the throat sheet and several tack holes are drilled on the flange rivet line to permit fitting in the shell. When fitted in place the whole shell is given a preliminary line-up to determine any deviation from the boiler card or drawing. Any deviation noted at this time must be taken care of and corrected in the final fitting-up process.

The boiler is now ready for the detailed setting up of the sheets. The laps on the middle of the sides between the waist, throat and back end, are first fired, as it is here that three sheets come together and the most slack is likely to occur at this point. The sheets are set up closely and are bolted in every other hole in such the boiler and measurements are taken to determine the vertical alinement of the waist and shell. Lines are then stretched from the corners of the backhead parallel to the sides of the waterspace frame and forward past the smokebox. Measurements from these side lines to the lines dropped over the smokebox are made to determine the side alinement of the shell. The smokebox ring and also the last rim on the waist are tested for roundness.

After the final line-up about a dozen selected rivet holes, located around the throat and wrapper sheet seam, are reamed full size. Into these are fitted full-size hard-steel dowel-pins which are kept in the boiler until sufficient rivets have been applied in the boiler or until the bull riveting is partially completed.

The backhead is again removed and the backhead brace tee irons are marked off, bolted, reamed and bull riveted to the backhead. The backhead and mudring



Lowering the boiler shell into the jaws of the bull riveter

a manner that the plates are tight enough to prevent the entrance of a thin feeler gage at the point of lap. This assembly is continued down both sides after which the boiler is turned on its side and the top seam is bolted. Any internal liners in the back end are installed in this department; they are laid out, drilled and assembled at this time.

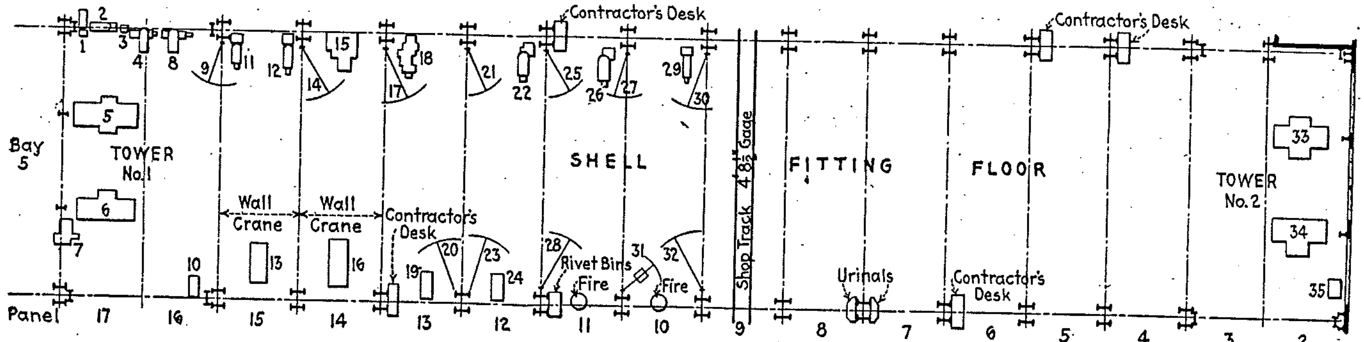
After the entire seam between the throat and wrapper sheet has been tightly bolted, the boiler is again placed erect and the backhead, which has had its flange rivet holes marked off during the preliminary line-up and subsequently drilled, is put in place ready for the final line-up. The line-up proceeds as follows.

Plumb lines first are hung down the vertical center of the front tube sheet and outside the backhead and smokebox for comparison to insure no twist in the courses. A line is stretched underneath the bottom of the assembled shell parallel to the longitudinal axis of are then sent back to the firebox gang to enable that department to complete the firebox, the backhead being used to line up the door hole of the firebox after the mudring is bolted to the firebox. In this position the mudring permits the setting up of the firebox corners by the firebox gang, after which it goes to the finishing floor as part of the firebox assembly.

The backhead is shipped separately to the finishing floor where it is later riveted to the shell by the hand pneumatic riveting process. Bull riveting of the backhead is prevented due to the awkwardness of the rivet locations.

Following the line-up of the boiler and the removal of the backhead and mudring, the shell rivet holes are reamed out and bull riveted in bay No. 5. Reaming is done by hand pneumatic reaming machines, two men being included in each gang.

The bull riveters in bay No. 5 are six in number, two



Machinery located on the shell-fitting floor in the upper section of bay No. 5

1.—Harrington 48-inch radial drill, motor on machine, direct drive.
2.—Harrington 48-inch radial drill, motor on machine, direct drive.
3.—Hisey-Wolf 4-LA double emery wheel, motor on machine, direct drive.
4.—Harrington 48-inch radial drill, motor on machine, direct drive.
5.—R. D. Wood hydraulic bull riveter, pressure range 154 to 37 tons, having an 18-foot 6-inch stake.
6.—Southwark hydraulic bull riveter, pressure range 154 to 37 tons.
7.—Hilles & Jones rivet shear, motor on building column, belt drive.
8.—Harrington 48-inch radial drill, motor on machine, direct drive.
9.—Baldwin 1-ton hand jib crane with a 12-foot 6-inch reach.
10.—Bement & Dougherty 48-inch post goose-neck drill, motor on floor, belt drive.
11.—Harrington 48-inch radial drill, motor on machine, direct drive.
12.—Harrington 60-inch radial drill, motor on machine, direct drive.
13.—Bement 50-ton hydraulic bull riveter having a 6-foot stake.
14.—Baldwin 4-ton hand jib crane with a 15-foot 9-inch reach.
15.—Sellers 1¼-inch hole, 1-inch plate punch, motor on machine, direct drive.
16.—Bement 50-ton hydraulic bull riveter having an 8-foot stake.
17.—Baldwin 3-ton hand jib crane with a 16-foot 2-inch reach.
18.—Hilles & Jones No. 3 punch, motor on machine.
19.—Baldwin 1¼-inch hole, horizontal drill press, motor on separate base, belt drive.
20.—Baldwin 2-ton hand jib crane with a 15-foot 10-inch reach.
21.—Baldwin 4-ton hand jib crane with a 13-foot 5-inch reach.
22.—Harrington 60-inch radial drill, motor on separate base, belt drive.
23.—Baldwin 3-ton hand jib crane with a 17-foot 5-inch reach.
24.—Baldwin 1¼-inch hole, horizontal drill press, motor on separate base, belt drive.
25.—Baldwin 1-ton hand jib crane with a 13-foot 3-inch reach.
26.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
27.—Baldwin 3-ton hand jib crane with a 13-foot 5-inch reach.
28.—Baldwin 2-ton hand jib crane with a 17-foot 3-inch reach.
29.—Harrington 48-inch radial drill, motor on machine, direct drive.
30.—Baldwin 1-ton hand jib crane with a 17-foot reach.
31.—Baldwin 2-ton hand jib crane with pneumatic hammer and a 12-foot reach.
32.—Baldwin 3-ton hand jib crane with a 17-foot 10-inch reach.
33.—Chambersburg hydraulic bull riveter, pressure range 177 to 38 tons, having a 17-foot, 1-inch stake.
34.—Southwark hydraulic bull riveter, pressure range 154 to 37 tons, having a 20 foot stake.
35.—Hilles & Jones No. 1 rivet shear, motor on machine, direct drive.

of which have a total gap of 20 feet. These operate at 2000 pounds per square inch hydraulic pressure and have from three to six pressure changes, varying from 25 to 175 tons' pressure. Any pressure between these limits within small limitations may be obtained on one machine or another. The bull riveters throughout the shop are equipped with Berwick rivet heaters which act on the resistance principle. Low voltage and high amperage act to heat the rivet to a yellow heat when placed between the terminals of this machine. Foot levers release the tension between the terminals and allow the rivets to be placed in or removed from the machine. Several of the larger bull riveters are equipped with electric holding-on devices to insure the rivet being held under pressure a sufficient length of time before release. This device provides a uniformity of work in riveting and enables consistent results to be turned out by these machines.

From five sources of supply, the various fabricated parts making up the back end of the boiler are received in bay No. 5. Here the shell gang takes the boiler barrel, completely fabricates the back end and rivets the outside throat sheet and wrapper sheet to the barrel. Then following the predetermined method of routing material at The Baldwin Locomotive Works, the boiler, by means of a car on the shop track in panel 9, is transported to the finishing floor in bays Nos. 2, 3, and 4, where the boiler is completed ready for assembly on the locomotive chassis in the erection shop.

The boiler shop at The Baldwin Locomotive Works is one of the largest in the world, being equipped with modern machine tools and employing the most up-to-date production methods adaptable to locomotive boiler construction. Predetermined routing of material along one direct line of transportation and the employment of highly skilled mechanics serve to insure efficient boiler manufacture.

Ryerson Appointments

Arthur C. Allshul, formerly manager of the Buffalo, N. Y., plant of Joseph T. Ryerson & Son, Inc. has been appointed manager of the company's new unit in the Philadelphia district.

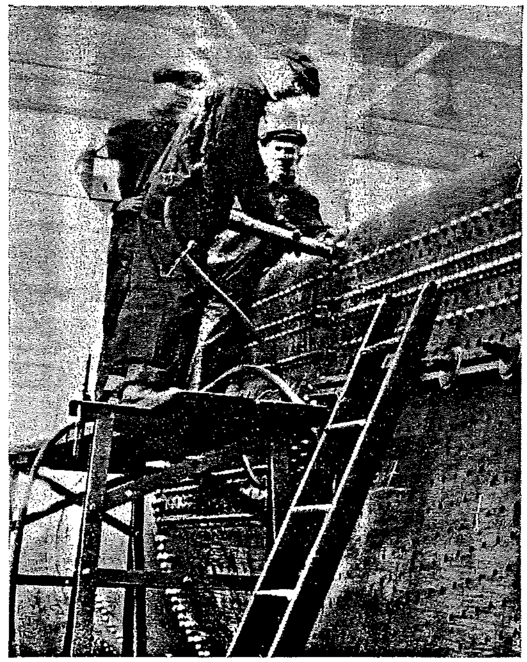
As previously announced, the Ryerson Company has purchased the business, equipment, and good will of the Penn-Jersey Steel Company at Camden, New Jersey and is also making other arrangements to provide adequate facilities for a comprehensive stock to meet the requirements of the trade in the Philadelphia metropolitan district.

Clarence S. Gedney has been appointed manager of the Buffalo plant succeeding Arthur C. Allshul. Mr. Gedney has been connected for many years with the specialty sales division of the Ryerson business in the Chicago territory.

work which is done in the boiler shop consists mainly of welding the various pieces making up the brace and drilling the ends. This work is performed in panels 16 and 17 of bays No. 3 and 4, a department which is equipped with four Nazel hammers, seven radial drills, four shears, one punch and six fires.

Forgings for the various types of brace ends, pads, eyes and jaws are made in the blacksmith shop and are transported to bay No. 4 where the ends are welded as required. Following the welding, the rivet holes, pin holes and bolt holes are drilled on one of the seven hammer sets. This type of machine is similar to the usual radial drills.

Welding as performed in one of the four Nazel-forging hammer is a self contained unit. A motor mounted on the machine drives an air compressor which in turn supplies air for the pneumatic operation of the hammer. Two men operate this machine and the accompanying fire, which is an oil burning furnace with two openings for the insertion of work. Welding consists principally of operations done in two heats. The forged end and the wrought-iron rod are placed in the furnace where the metal is raised to a welding heat. Where required the rod is first removed from the fire and upset by means of striking the end of the rod against a steel block firmly imbedded in the floor. On the second heat the welder takes the rod, the helper the forged end and the two pieces are welded together under the pneumatic Nazel hammer. This hammer has jaws or dies designed according to the desired radius of weld and the weld is finished to a smooth surface under this hammer.



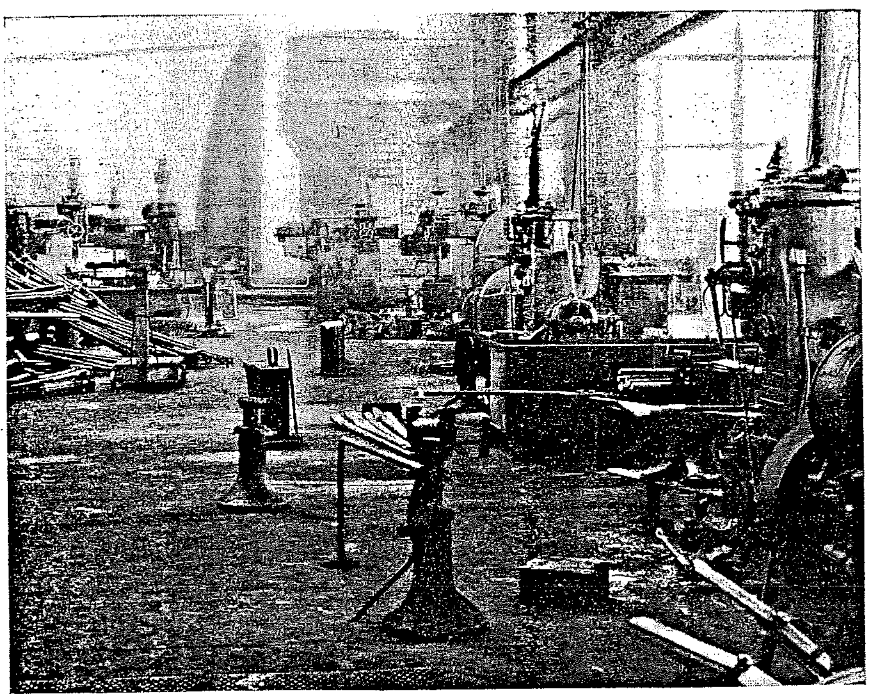
On receipt of the boiler, the odd rivets, which can not be fitted on the bull riveters, are driven by hand

This finishes the operations necessary for the manufacture of two-piece braces. Three-piece braces require four heats as the opposite end of the rod is joined to another forging in a similar manner to that described above. Following the welding operation, the pin, bolt or rivet holes are drilled.

This department handles, in addition to the Baldwin-type brace rod, any that is specified by the various railroads. This gives the brace gang a wide variety of work.

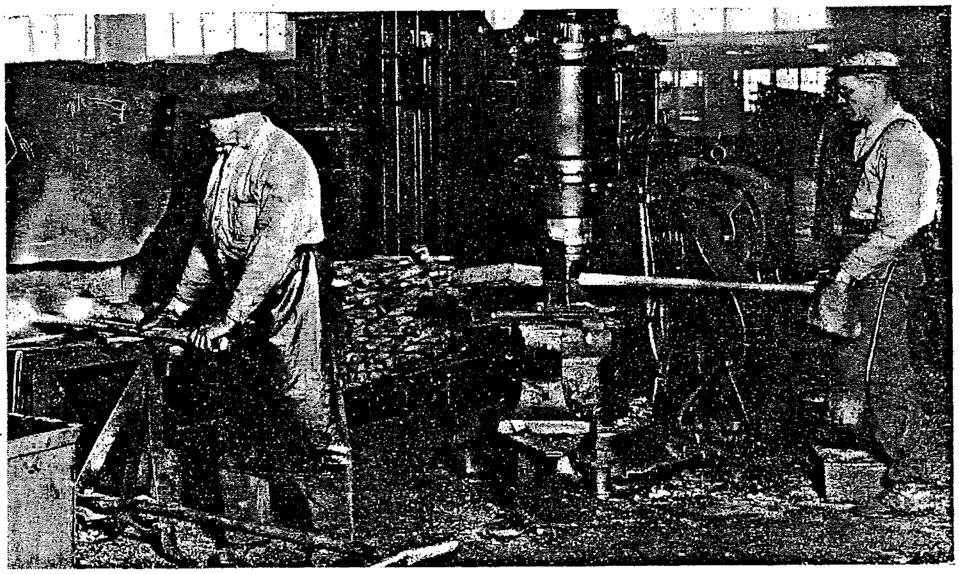
The application of the Baldwin-type boiler brace is accomplished by a gang of three men. The boiler is placed on its side and, with the rivet holes drilled, the braces are ready for application.

In order to secure a perfect fit of the brace all parts which fit to the shell are heated to a red heat and are applied to the boiler. The heating is done in a special oil-burning furnace developed at the Baldwin Works and shown in the accompanying illustration. After heating, the heater-man passes the brace to one of the men inside the boiler who applies the jaw to the brace-tee iron in the backhead or tube sheet, and fits the bolt through the jaws and the tee iron. The other man on the inside fits the heated end of the brace to the shell, inserts the bolts through two of the rivet holes and drives the brace against the shell. The heater-man applies the nut to the shell-brace bolts and heats another brace for application. After bolting the backhead or tube-sheet end of the brace, a cotton pin is inserted in the bolt to



General view of brace welding department showing Nazel hammers at right and radial drills in the background. This department welds, drills and applies braces.

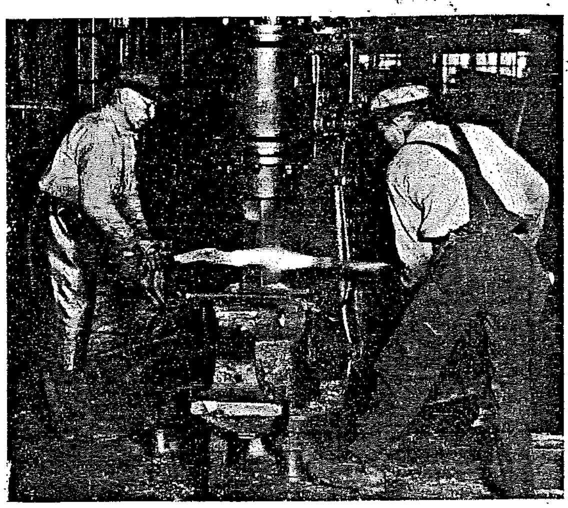
Installing Locomotive Boiler Braces



IN the construction of locomotive boilers, similar methods of procedure are generally followed in American boiler shops, but, depending upon the equipment of each shop and the plant layout, production methods require the most effective use of the machinery or skill available to insure economical and speedy manufacture. Such is the case at The Baldwin Locomotive Works, Eddystone, Pa., where among other buildings is located the world's largest boiler shop. For the past several months, THE BOILER MAKER has published a number of articles describing the layout of the boiler shop at Eddystone, and following the flow of materials through the shop, has given a general outline of the methods employed in the various departments contributing to the manufacture of locomotive boilers.

In the December, 1929, issue, the functions of the shell gang in bay No. 5 were outlined and the boiler barrel with the outside throat sheet and the crown and sides sheet attached was transferred to the finishing floor for completion.

The finishing floor occupies a space in the upper section of the boiler shop and covers three bays, Nos. 2, 3 and 4, and extends between panels 3 and 17 covering an area of 84,480 square feet. At the present time, only bays No. 3 and 4 are utilized for actual production work, bay No. 2 being held for reserve and used for the storage of finished boilers.

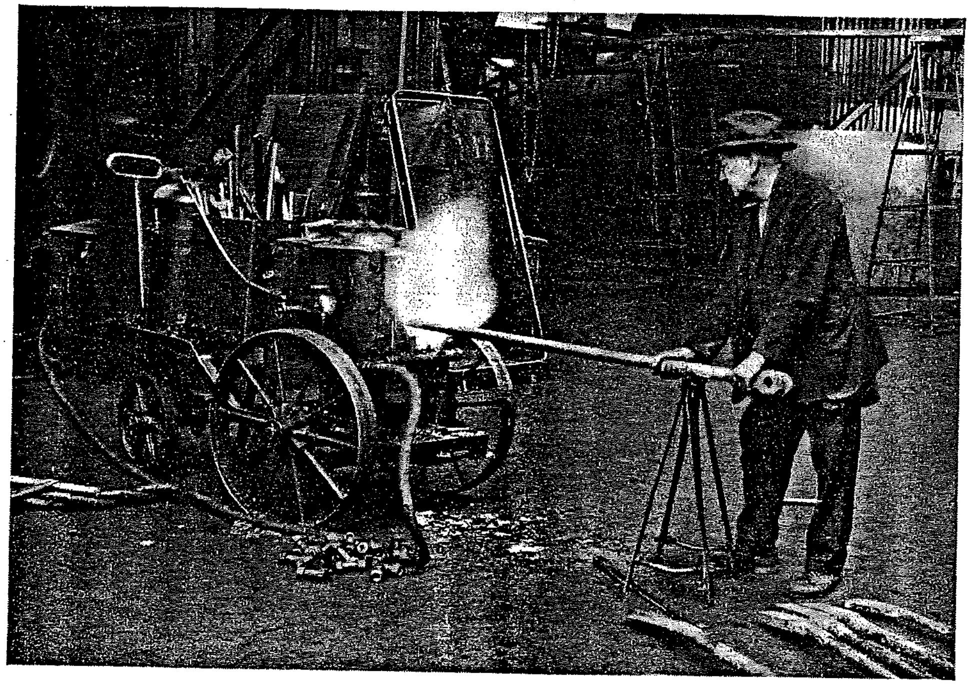


Welding brace ends

Material handling facilities for the finishing floor is of the extremely rugged type to handle the great loads that are required to be moved from place to place. Bays Nos. 2, 3 and 4 are each served by one 70-ton Morgan overhead traveling crane and one 120 to 80-ton Pawling & Harnischfeger crane.

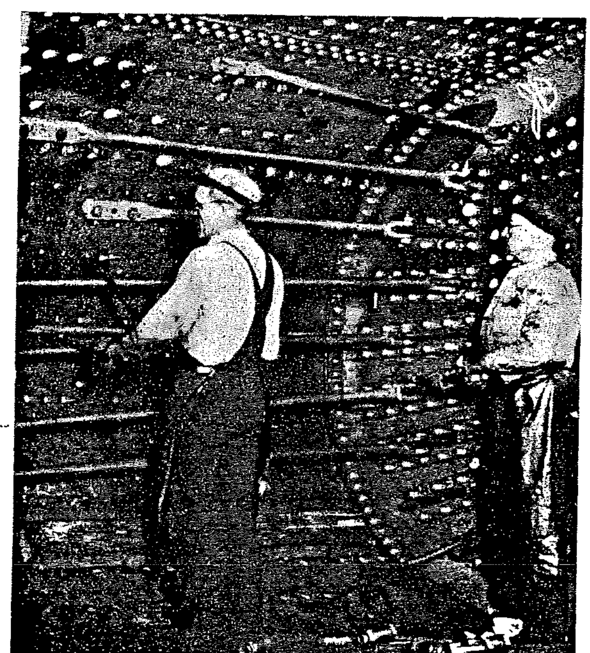
When the boiler barrel arrives on the finishing floor, it is placed upright on steel and wooden horses in such a position that odd rivets in the boiler may be inserted by hand. Although it is desirable to insert all rivets with the aid of hydraulic bull riveters, these riveters have their limitations due to the depth of stake and the awkward locations of some rivets, particularly adjacent to butt straps. For this reason the rivets not applied by the previous departments are inserted by riveters employing hand-operated, pneumatic riveting hammers.

A gang of riveters on this work consists of three men; namely, a riveter, a holder-on and a heater boy. Generally, both the riveter and the holder-on use pneumatic guns but in some cases the solid dolly bar is held by the holder-on. The heater boy, heats the rivets to the proper heat and passes the rivet to the holder-on who inserts the rivet into the hole.



Heating brace ends in a portable oil furnace to facilitate fitting the braces to the shell or top sheet of the boiler. The opposite end of the brace is bolted

The type of rivet-heating furnace employed is of the oil-burning type which may be transported from one place to another. A small furnace of about two feet square and one foot high of refractory brick is mounted on a portable carriage. This carriage is made of angle iron and is mounted with two large wheels in the back and a small wheel in the front. A draw bar is fitted to the front axle to permit transportation. Compressed air from the main shop line is fed to a burner at the side of the furnace by means of the hose and the oil is sucked to the burner from a tank on the carriage beneath the furnace, by means of the compressed air. The oil is vaporized and mixed with sufficient air to cause good combustion.



In fitting backhead braces, two men work on the inside of the boiler and one on the outside applying assembly bolts

Prior to the application of the odd rivets, all rivet holes are reamed by means of pneumatic reamers operated by two men.

The staging employed in riveting and finishing work consists of steel plate, angle and rod horses over which planks are placed.

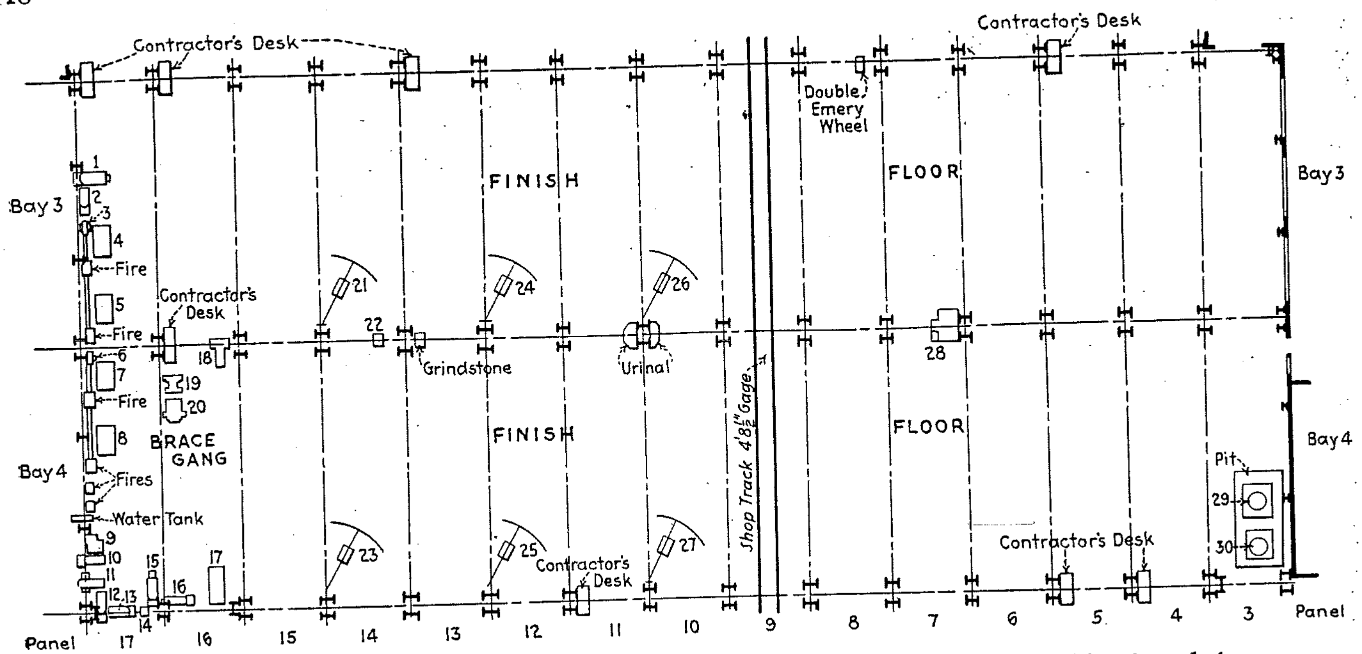
After the application of the odd rivets, all seams in the barrel and shell connections are calked both on the inside and outside. Round nosed tools in pneumatic calking hammers are employed for this purpose. Butt-straps, however, are not calked with a round nosed tool on the inside but are treated with a flatter tool to prevent the raising of the lap.

After calking, the backhead is installed; this is bolted in place to the top and sides sheet, reamed, riveted and calked. The riveting is done by hand as in the case of odd rivets and the calking is done on the inside flange only. The outside flange is calked after the mud ring is installed.

On completion of the backhead installation, the boiler is ready for the application of braces both to the backhead and front tube sheet. The backhead brace tie irons were previously fitted by the shell gang in bay No. 5 and the crown sheet brace rivet holes, having been previously laid out and drilled by the layout department and the multiple drillers in bay No. 12, are reamed to the required size by the finishing gang. Tee irons on the front tube sheet were fitted by the tube-sheet gang and the front-brace-shell rivet holes, having been laid out and drilled, are reamed by the finishing gang.

Braces, as installed at The Baldwin Locomotive works, are forgings, generally of wrought iron and are made in one, two or three pieces. In the case of the one piece brace or weldless brace, the wrought iron rod is forged in the blacksmith shop in one piece. This type of brace consists of a rod flattened at both ends and drilled with one hole at each end to take a rivet at one end and a pin at the other.

The greater part of the work of manufacturing braces is performed in the blacksmith shop and does not come under the direct control of the boiler maker. That



Machinery located on the finishing floor in the upper section of bays No. 3 and 4

1—Sellers 60-inch radial drill, motor on machine, direct drive.
2—Harrington 48-inch radial drill, motor on machine, direct drive.
3—No. 5 Sturtevant blower.
4—Nazel Engine & Tool Company No. 2 hammer, air drive, motor on machine.
5—Nazel Engine & Tool Company No. 2 hammer, air drive, motor on machine.
6—Sturtevant No. 6 blower, motor on machine direct drive.
7—Nazel Engine & Tool Company No. 2 hammer, air drive, motor on machine.
8—Nazel Engine & Tool Company No. 2B hammer, air drive, motor on machine.
9—Hilles & Jones No. 2 special shear, motor on machine, direct drive.
10—Harrington 48-inch radial drill, motor on machine, direct drive.
11—Harrington 48-inch radial drill, motor on separate stand, belt drive.
12—Harrington 48-inch radial drill, motor on machine, direct drive.
13—Harrington 48-inch radial drill, motor on machine, direct drive.
14—Hisey-Wolf 4-LA double emery wheel, motor on machine, direct drive.
15—Harrington 48-inch radial drill, motor on machine, direct drive.
16—Harrington 48-inch radial drill, motor on machine, direct drive.
17—Hilles & Jones No. 5, 54-inch punch, motor on machine, belt drive.
18—Hilles & Jones No. 2, 26-inch plate shear, motor on floor, belt drive.
19—Hilles & Jones No. 1 bar shear, motor on separate base, belt drive.
20—Hilles & Jones No. 2 bar shear, motor on machine, direct drive.
21—Baldwin 3-ton hand jib crane with Sellers hydraulic riveter, 21-foot reach.
22—Hisey-Wolf 6-LA emery wheel, motor on machine, direct drive.
23—Baldwin 3-ton hand jib crane with Sellers hydraulic riveter, 21-foot reach.
24—Baldwin 3-ton hand jib crane with Sellers hydraulic riveter, 21-foot reach.
25—Baldwin 3-ton hand jib crane with Baldwin hydraulic riveter, 21-foot reach.
26—Baldwin 3-ton hand jib crane with Baldwin hydraulic riveter, 21-foot reach.
27—Baldwin 3-ton hand jib crane with Baldwin hydraulic riveter, 21-foot reach.
28—Hilles & Jones special rivet shear, motor on machine.
29—R. D. Wood 14-inch by 14-foot hydraulic accumulator.
30—Baldwin 2000-pound hydraulic accumulator.

prevent the nut from loosening. On the shell end, the holes are reamed to size, burrs removed and the pieces riveted. This end is rigidly fitted and the snugness of the fit is such that a feeler gage can not be inserted between the brace and the shell.

Special braces are installed in various manners depending on the type of brace. Some railroads in this country often require the use of a gusset plate with angle connections to the shell and backhead instead of the usual brace rod.

Both fitting and manufacturing braces, with the exception of the blacksmith work, are under the charge of one contractor who orders material for each lot of boilers.

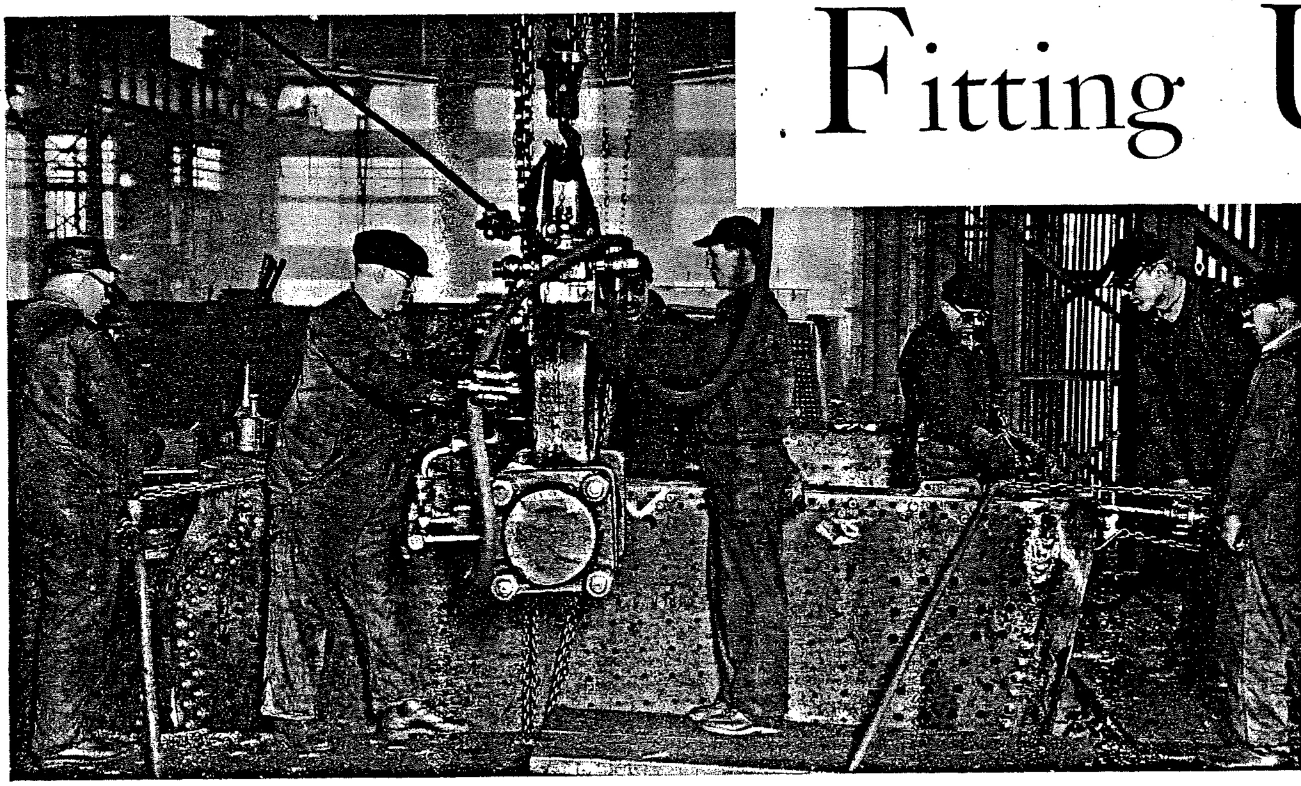
On completion of the installation of braces, the boiler is ready for the installation of the firebox, this process together with the application of staybolts and the smokebox will be outlined in the February issue of The Boiler Maker.

Scrubbing Acetylene Gas

"CANNED" acetylene gas comes fully cleaned and ready for use, but the shop-made article should be well washed before it is used in a welding torch. In some shops, the home-made gas is piped to the point of use and is there passed through a washing device before being permitted to go to the welding or cutting torches. This method requires the use of as many washing, or scrubbing devices as there are torches in operation and it is not a very economical method. It is far better to put in one larger washing device and cleanse the gas before it flows to the storage tank.

The Chicago headquarters of the American Cable Company have been moved to the recently completed Chicago Daily News Building, 400 West Madison street, Chicago, Ill.

Fitting U

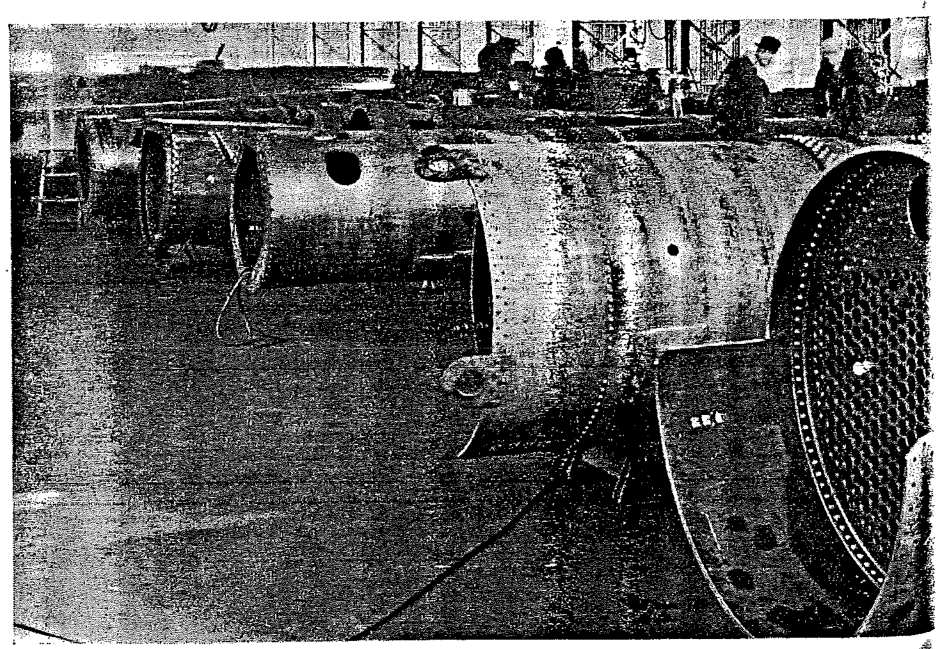


THE greatest economy in locomotive boiler construction is derived through systematic handling of materials and through the subdivision of labor into groups of skilled mechanics, each group specializing in one branch of the work. Each process in the manufacture of boilers should be handled by that group of workmen whose training and skill best suits the case. Throughout the entire boiler shop of The Baldwin Locomotive Works, Eddystone, Pa., this method of subdividing the work and fixing the responsibility of each department is in practice.

The finishing floor, as described in the January issue of The Boiler Maker, occupies bays Nos. 2, 3 and 4 and the personnel employed on completing the locomotive boiler prior to its delivery to the erection shop, is made up generally of eight gangs, each with its leader, and under the direct supervision of a foreman. These gangs or departments are responsible for the manufacture of staybolts, fitting of braces, pneumatic riveting, chipping and calking, air drilling and reaming, applying staybolts, hammering staybolts and the final assembling of the boiler. The manufacture of staybolts and the fitting of braces have been described in foregoing articles so that at the present time we find the partially completed boiler on the finishing floor. The boiler is complete with the exception of the firebox and the smokebox; the backhead is applied; the braces are fitted and the boiler is placed on its back in position for the application of the firebox.

Prior to applying the firebox to the boiler, the odd rivets in the boiler are pneumatically riveted. Only such rivets which cannot be driven on the hydraulic riveters are applied with hand-operated pneumatic hammers. The seams of the firebox on the water side are calked before the firebox is applied to the boiler. The inside or fire-side seams are flattered only before the application of the firebox to the boiler. When the staybolts have been applied and hammered, the fire-side seams are then calked with a round-nose tool.

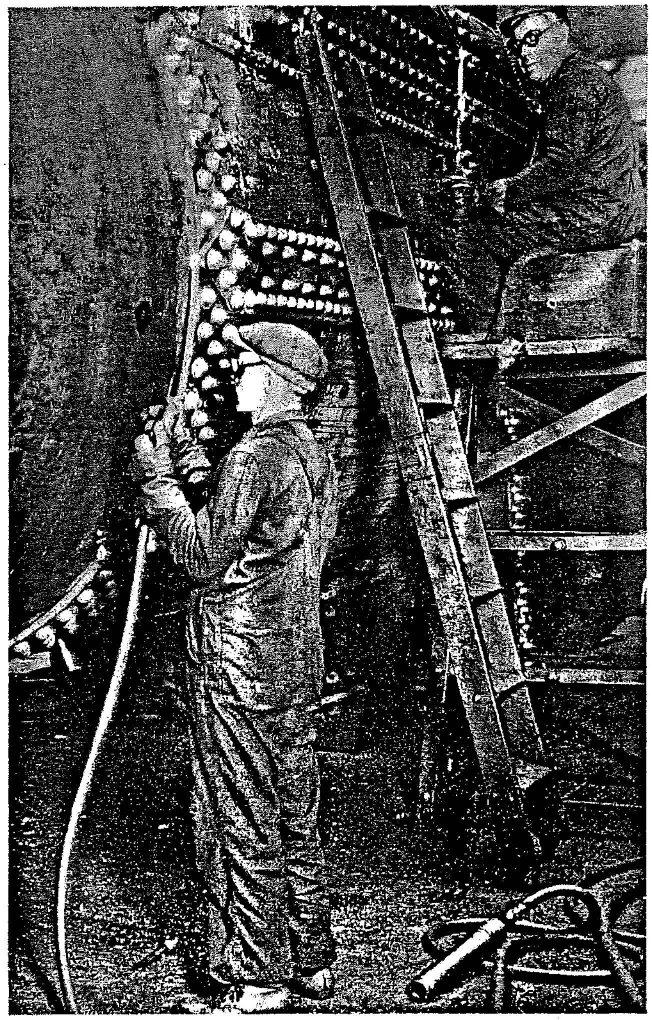
When the firebox is received from the firebox gang, the waterspace-frame rivet holes are not completely drilled. Only such tack holes as are necessary for the preliminary bolting and assembly of the mudring have



General view of finishing floor

Fireboxes

Assembling, lining up and riveting back ends of locomotive boilers at the Baldwin Works



Calking boiler seams

been previously inserted in place in the sides sheet.

The firebox is placed on its back, the mudring fitted in position to the firebox and held in place by means of bolts, and the whole assembly is lifted by crane to a position directly above the back end of the boiler. It is then lowered in place. Cranes with two hooks are generally employed, one hook being fastened to the back of the firebox, and the other to the front. This permits raising and lowering one end or the other in order to fit the box. This is of primary importance in the case of fitting fireboxes with combustion chambers where considerable maneuvering is required to lower the firebox in place. By means of pinch bars and hammers the firebox is fitted in place. Bolts are fitted in the tack holes of the firebox through the mudring and back end.

Before the remaining mudring rivet holes in the firebox are drilled, the staybolt holes in the crown and sides sheets are checked for alinement with the staybolt holes in the firebox. After this process, the boiler has its final line up. This line up is similar to the preliminary line up, discussed in the December, 1929, issue of The Boiler Maker. A notable difference between the two line-ups is that in the case of the preliminary line-up the boiler is upright, while the final line-up is taken with the boiler on its back.

Following the line up, the firebox, mudring and back end are bolted together through the tack holes, previously located.

The plates at the corners of the mudring are set up so that metal to metal condition exists. With the mudring as a template, the rivet holes in the firebox are drilled and reamed. The sheets are then bolted with bolts located every third hole in both rows of rivet holes. The mudring corner holes are drilled and reamed at this time. In the layout of corner holes, a template prepared by the layout department, located in bay No. 12, is employed for duplicate orders. In single or small orders, however, each boiler has its mudring corners laid out separately, the data or location of rivet holes being taken from the boiler drawing.

Drilling of all the rivet holes is accomplished by the use of pneumatic drilling machines operated by two men. The drills are equipped with a long handle, held by the two men and a chain-type old-man is used to maintain a sufficient pressure on the work to assure speed in drilling. This chain-type old-man is merely a length of link chain with a hook at each end, the hooks being fastened to the work through rivet holes and the chain passing over the adjusting screw which feeds the drill into the work. Following the drilling process, all holes are reamed full size; the burrs are removed from all holes and the plates are ready for riveting.

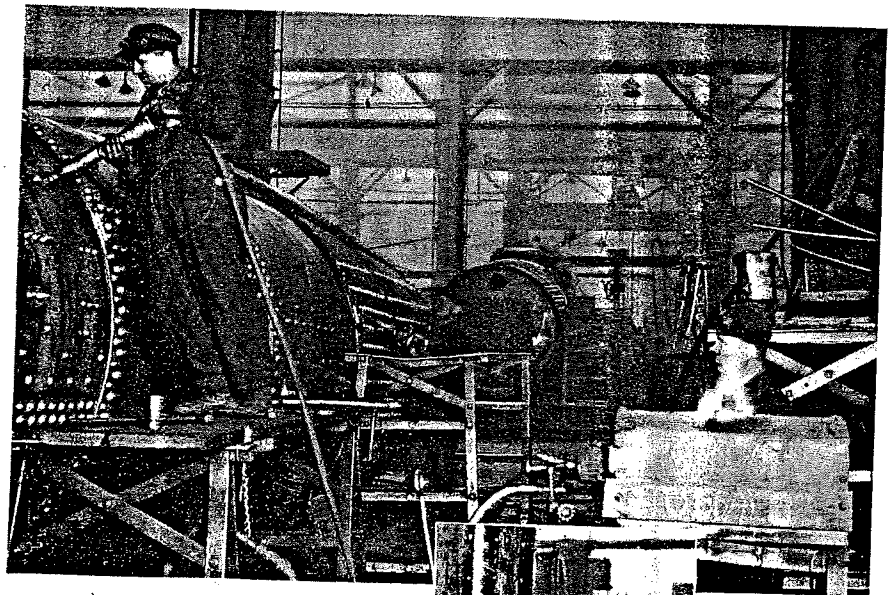
Prior to riveting, and with the plates firmly bolted to the waterspace frame, excess material on either the firebox or the back end, extending beyond the waterspace frame is removed by chipping. For this purpose, one man is employed using a pneumatic chipping hammer. For this work and other operations of a like character, safety at The Baldwin Locomotive Works, strictly requires the wearing of goggles. This precaution has been instrumental in saving the sight of many eyes, endangered by flying chips and other particles.

The mudring line of rivets are now ready to be applied and for this purpose a hydraulic portable riveter, shown in the illustration, is employed. This riveter is suspended from a hand jib crane with the jaws in position to take the plate vertically. These riveters, of which there are seven, were developed in most cases by The Baldwin Locomotive Works and are capable of exerting a pressure sufficient to drive one-inch diameter rivets. Three of the riveters are of Sellers make. Rivets are heated in a portable oil heater previously described and passed to the gang in the usual manner.

The rivet gang consists of three men (a rivet-passer and two bull riveters).

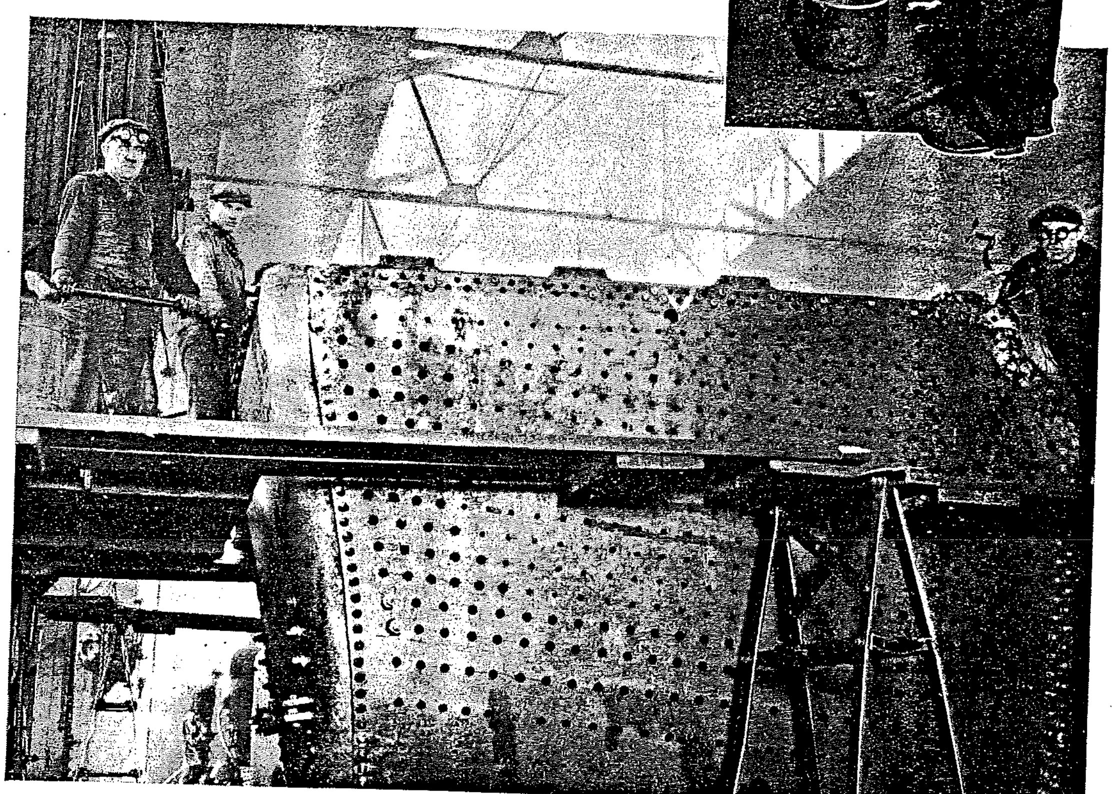
Following the completion of the waterspace-frame rivets, the waterspace-frame plate laps are calked, pneumatic tools being employed. In some cases, specifications call for welding of the seams at the corners of the waterspace frame. This practice assures tightness at points where leakage is likely to occur. Electric arc welding machines, of the single operator type are employed for this purpose.

The locomotive boiler is now ready for the application of staybolts, a description of which will appear in a later issue.

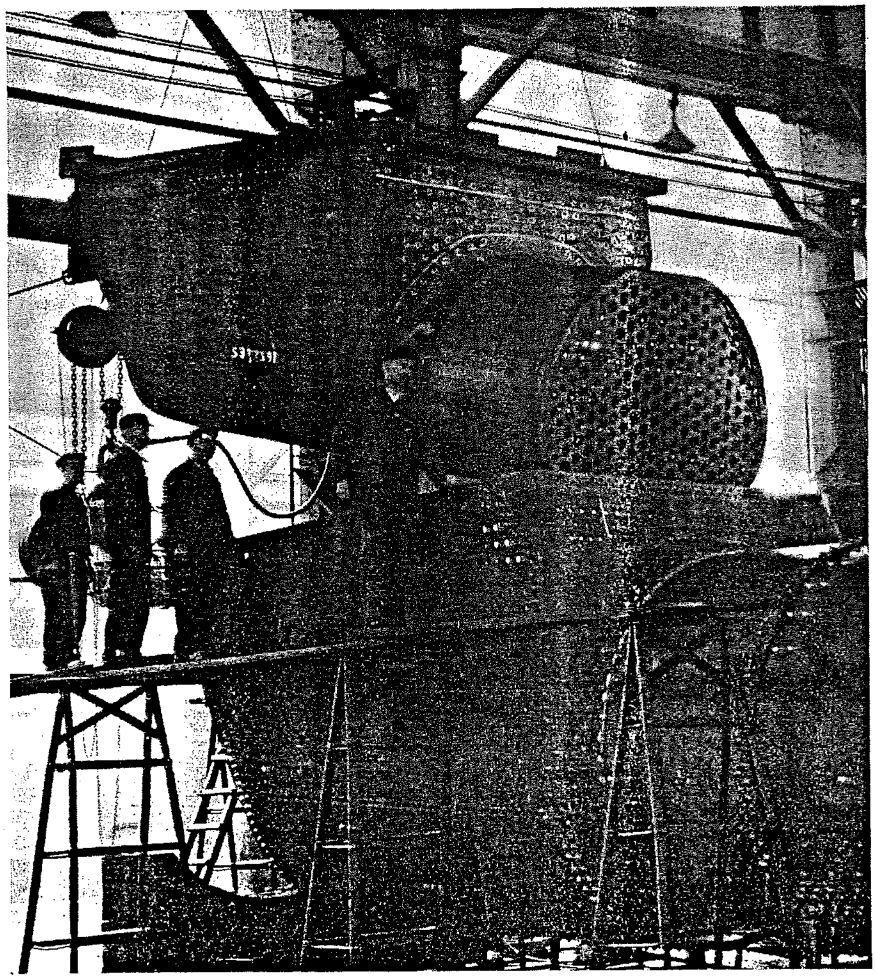


Inserting odd rivets in the barrel

Hand fitting odd firebox rivets

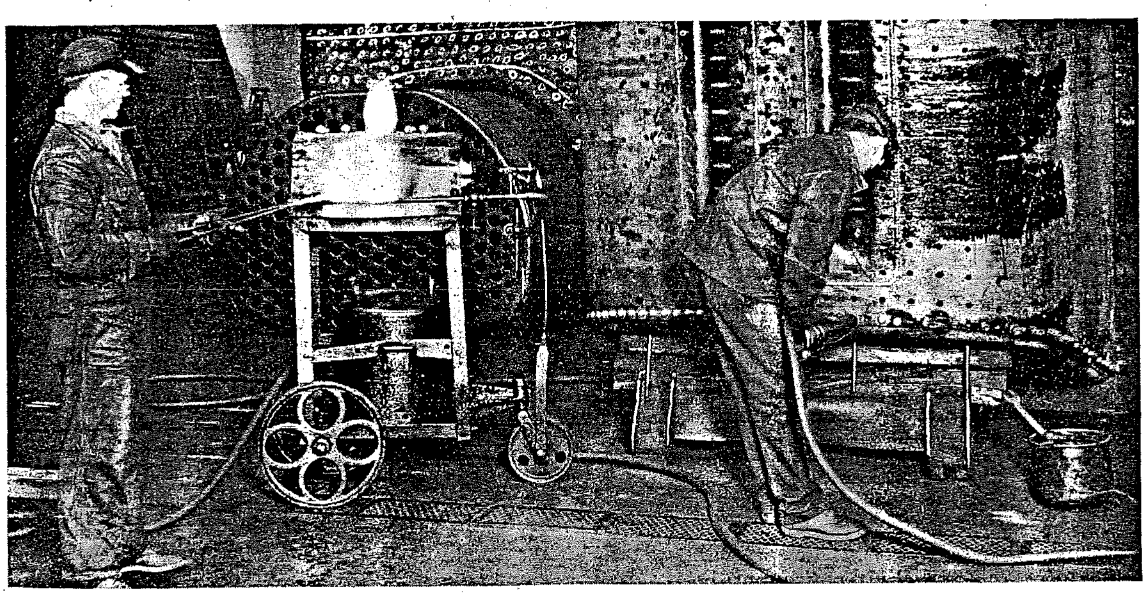


Setting-up plate at the mudring corners



Lowering the firebox with mud-ring attached into the backend

In the case of locomotive boilers having riveted fire doors, the riveting is done before the staybolts are applied. This practice is the exception rather than the rule today, welding being specified by most railroads at the present time. Riveted fire doors are generally of two types, having the lap either in the waterspace or in the form of a flange outside the hole. In the latter case, riveting may simply be accomplished by pneumatic riveters, but where the joint lies in the water-space, considerable awkwardness results. In this case, the door is riveted before the mudring is fitted, a long curved bar being used as a dolly and the boiler shifted



Fitting odd rivets

in position to facilitate the work. The riveter is generally of the pneumatic type and is operated from the fire door side, the dolly being applied on the water-space side. The door holes of the welded type are finished after the application of the backhead staybolts.

Constant inspection throughout the departments of The Baldwin Locomotive Works boiler shop serve to maintain a high standard of workmanship. Each operation is inspected, the contractor in charge being responsible for his own work. He insists on good work in his own department and does not accept work from a previous contractor until that work is correct. By this system, such mistakes that do occur are found in the preliminary stages of construction where such discovery prevents excessive loss of time, material and labor.

Plate Inspection at the Steel Mill

By E. N. Treat

THE inspection of plates is a matter in which all who are in any manner connected with such material should consider himself associated. The best place of course to inspect plates is at the steel mill where they are manufactured, and although the inspection of such material at the mills is considered very thorough, additional inspection by the boiler maker and shop inspector can be only to the benefit of all concerned.

Defective material is not often discovered until it is about to be used several months after it leaves the mill. This defect may be at the mill's fault or possibly the fault may be that of the transportation company due to the method of handling, but the general cry is for a replacement plate which is needed at once. This state of affairs leads us to believe that the material was not inspected when it reached the boiler shop. It was probably unloaded and stored until it was to be used.

In addition to a replacement plate being furnished, the manufacturer usually must stand the loss of the defective plate at a loss in profit. Thus it may be seen that it is the manufacturer's desire to furnish material of good quality.

To safeguard the interest of the manufacturer and his customer, the manufacturer has built up an inspection service of his own. This mill inspection staff comes under the physical testing department and their duty is to inspect material before the inspector representing the purchaser is called to examine that material.

It would be very costly to assemble an entire order of plates, and then have the inspector representing the purchaser reject those that are defective. Thus it may be seen that by the mill inspection force first examining the material, only such plates as in their opinion might be accepted are presented to the customer's inspector. This practice saves handling, checking, weighing and stamping.

Inspections at the mills are namely for metallurgical and mechanical defects. Of course, the inspection covers such errors as incorrect stamping, incorrect dimensions and accidents in handling through the various stages before arrival at the loading bank.

Metallurgical defects are those which originate in the metal while it is in the fluid state. The pipe and seam are metallurgical defects and their cause may be traced to the mould condition.

Mechanical defects are those produced during the working of the ingot. The most common of these defects are cracks, shear strain, lamination, roll marks, cinder spots and scabby surface.

Mechanical defects are often found on the surfaces while metallurgical defects are located internally. Surface defects are more common than internal defects, and especially so if the plate be of light gage. Heavier material, unless ferro-silicon or aluminum has been added to the steel, is more liable to contain gas occlusions than light gage material.

The inspector usually views the pipe and seam with much concern, for though it may to all appearances extend into the plate only a fraction of an inch; it may continue several inches. These defects cause the discard of many ingots.

The pipe originates in the ingot when gasses are hemmed in. The ingot is rolled into a plate and the gas cell is elongated. The plate is next laid out for the correct size and then sheared. At this time the pipe is discovered and if the plate cannot be cut down to a smaller size sufficiently to eliminate the pipe, the plate must be rejected.

The lamination is similar to the pipe though it is smaller and may be found at other than the centre top of the finished plate. It is caused by careless working when a part of the plate is folded over on itself. Worn rolls may cause this defect and no matter what the cause, the condition is serious.

Inspectors at the mills give much of their attention to surface defects. The scab and cinder spot are sometimes difficult to find. They may be only as deep as the thickness of tissue paper or they may be half an inch or more thick and tightly embedded in the plate.

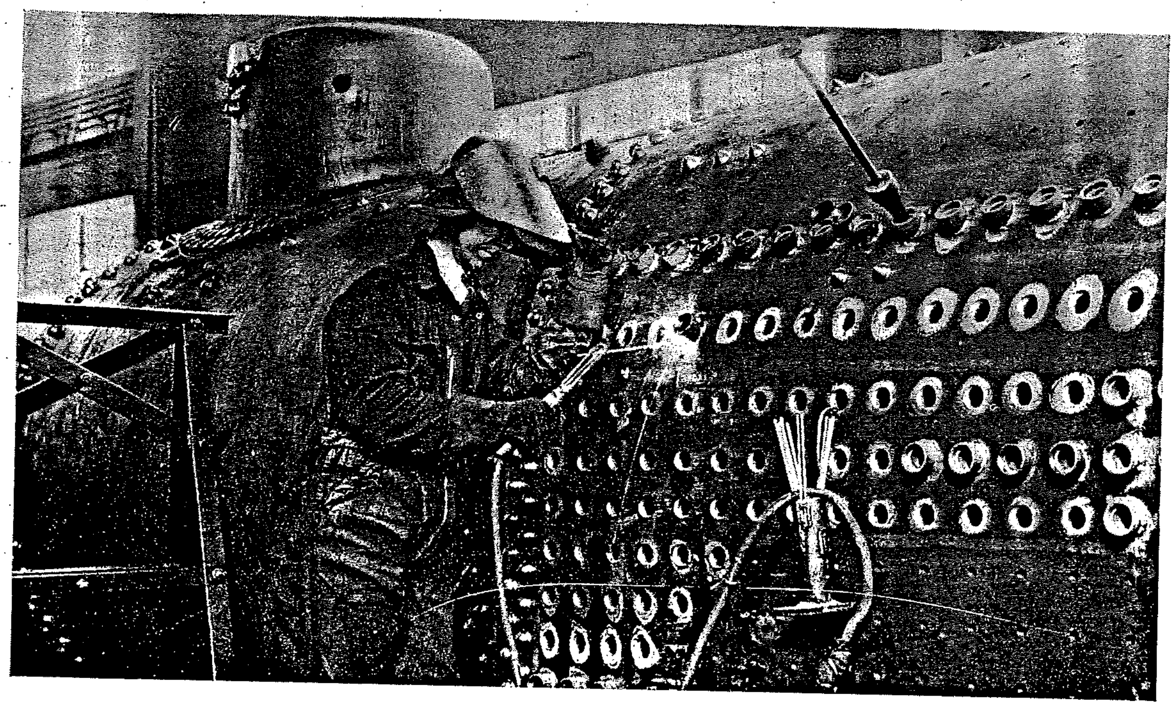
The inspector representing the purchaser is notified when the material is ready for inspection, and upon his arrival at the loading bank he first checks the heat and ingot number on the plate with those of his records. He next examines the top surface of the plate and when he has completed the examination of this part, the plate is raised so that he may examine the sides and ends. The plate is then kept suspended until he has examined the bottom surface. This examination is usually made with the aid of a flash light.

A special hammer test inspection is made of much material at the steel mills. This test is usually made by a man employed by the mill who does nothing but apply this test. The testing of plates in this manner requires considerable skill as the inspector strikes every inch of the plate's surface in order to detect an internal defect. This test requires considerable time and cannot be done hurriedly. There are few men qualified to make this test and say with any degree of certainty that there is an internal defect at a certain spot.

The conclusion is that the mill inspections are thought to be sufficient, but even though the mill has given all three inspections and the plate is accepted by all those inspectors, it is not always true that the plate will be found free from defects on arrival at the boiler works. Rough handling or a defect that has escaped the eyes of all the mill inspectors may be found by the boiler maker to seriously impair that plate for use.

Inspectors at the mills are human and as such are liable to make mistakes. For the benefit of the purchaser in securing a replacement plate as early as possible and for the benefit of the manufacturer and the inspectors at the mills, it is always desired that the boiler maker and the shop inspector give the final thorough inspection to that material both before it is used and during the process of fabrication.

Installing Locomotive Boi



Welding flexible staybolt sleeves

STAYBOLTS are of primary importance in the construction of locomotive boilers in an effort to support all surfaces that are not truly cylindrical, as well as firebox surfaces generally. Extreme care is necessary in the preparation and installation of staybolts in order that each staybolt will carry efficiently its portion of the load according to the design. In view of the precautions required in installing staybolts, it is interesting to review the procedure in staybolt application as carried out at The Baldwin Locomotive Works, Eddystone, Pa.

On page 316 of the November, 1929, issue of THE BOILER MAKER, the methods and equipment employed in fabricating staybolts at the Baldwin Works were outlined. From this article is seen the care taken in preparing staybolts for installation and also the methods used to accomplish high production in such fabrication may be noted.

The work of manufacturing staybolts consists mainly of performing the machining operations on blanks received either from the outside manufacturer or from the forge shop of the Baldwin plant. These bolts are ordered for each particular job, the length of bolt being specified for each type of work. Installation is performed in bay Nos. 3 and 4.

The installation of staybolts follows the completion of the riveted back end of the boiler; the methods employed in installing the mudring or waterspace frame having been outlined in the February issue. With the boiler in the condition as left by our previous article, staybolts are next applied.

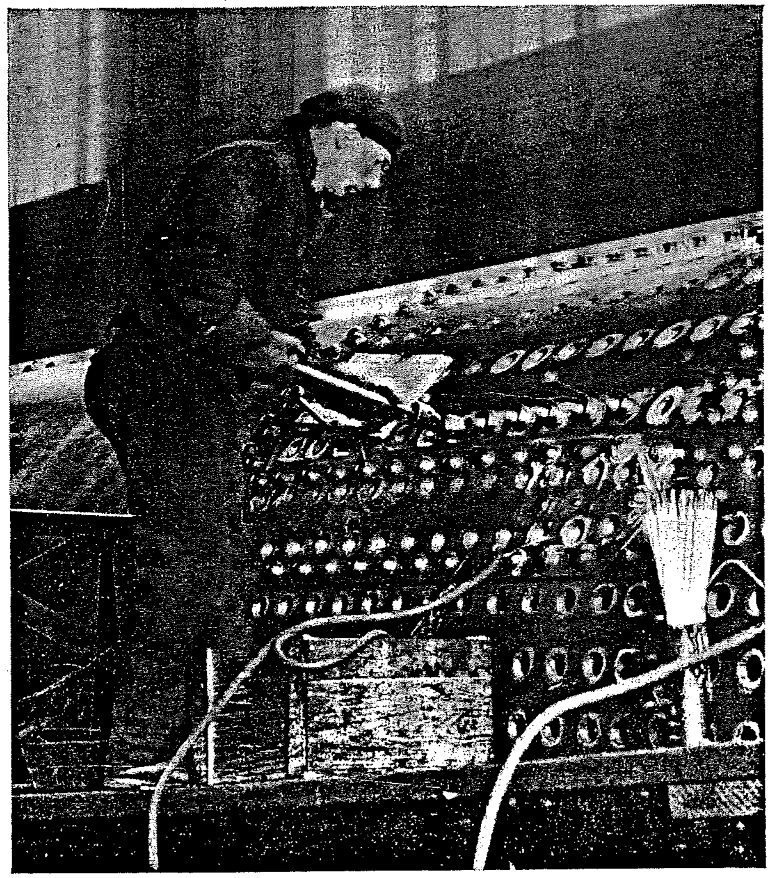
Procedure in applying staybolts depends largely on the type of staybolts called for by the design, but in general, the sleeve bushings used for flexible staybolts are first applied. These may be either of the screw or welded type: the method of application differing in each case.

Where welded sleeves are to be employed, it is particularly important to fit them before any rigid bolts are applied, because of the oil used in reaming or tapping, which would be detrimental to the welding operation. The holes in the wrapper sheet, into which the sleeves are to be fitted, are reamed and countersunk by pneumatic tools provided with pilots or leads running into the corresponding staybolt holes in the firebox sheet.

The lead thereby lines up the tool with the two holes in the waterspace so that on installation of the staybolt, perfect alinement will be attained. With the holes in the wrapper sheet reamed and countersunk, the surface of the plate in the vicinity of the holes is ground with a pneumatic hand-operated grinder. This procedure frees the surface of the plate from scale and dirt. With the holes thus prepared the sleeve, which is tapered at the base, is applied by means of a special applicator. This consists of a rod approximately 3 feet in length having a taper screw at one end to fit into the firebox sheet and a handle at the other end. A sliding cone so formed as to fit on the inside of the sleeve is fitted on the

Staybolts

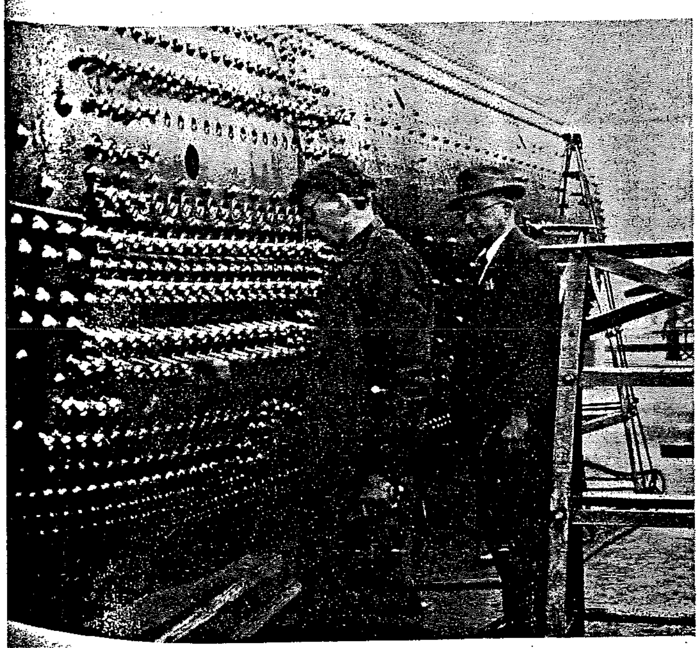
Preparing stayed surfaces and finishing boilers at the Baldwin Works



Fitting flexible staybolt sleeves prior to welding

rod. In application, the sleeve is placed on the cone, the rod applied through the hole in the wrapper sheet and fitted to the hole in the firebox sheet. Then the sleeve is pushed into the countersunk hole in the wrapper sheet, being held by the cone on the rod in perfect alinement for welding. In this position the sleeve is tack-welded to the plate. In like manner, all of the sleeves to be welded on the boiler are so fitted. Following the tack-welding of all the sleeves, the final welding is done, a continuous weld being employed in each case.

In the case of flexible staybolts in which the head seats directly into the wrapper sheet (so that no sleeve, but a welded covering cap is employed), the flexible staybolt holes in the entire back end are drilled, reamed, countersunk and faced before the bolt is applied. The facing of the plate consists of machining an area around the hole slightly larger in size than the diameter of the cap to be applied. The plate is thus slightly grooved and the cap fits into this groove assuring a tighter and more satisfactory joint. The firebox sheet is also reamed and tapped for the flexible staybolt, a lead tool being employed. The staybolt, which is generally of the round slotted-head type, is then applied and tightened from the outside of the boiler. The fireside end of the staybolt is allowed to project beyond the firebox sheet, which projection is removed at a later time and the staybolt hammered.



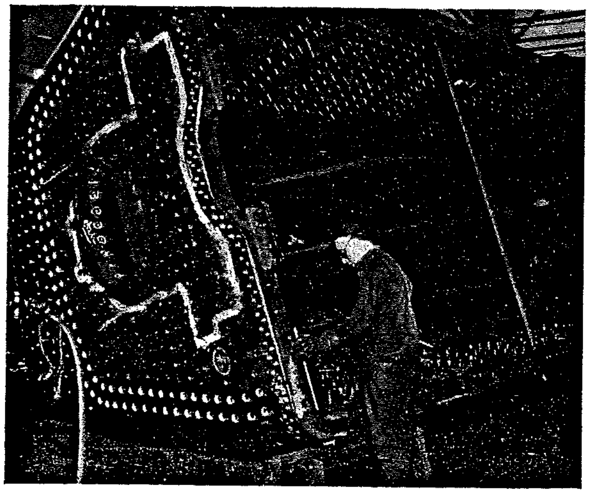
Inspecting staybolts during installation

We are ready to apply the caps, except that all oil is cleaned off the area with a soda solution. The caps are tacked and welded in place in the same manner as the welded sleeves except that no applicator is required.

In boilers employing screw sleeves, these are also applied in the boiler before any of the rigid bolts are fitted. The holes are first reamed and then taper tapped. For this work a reamer and tap having a lead mandrel suitable to engage in the firebox staybolt hole is employed as previously mentioned. Thus the holes in the outside throat sheet, wrapper sheet and back head are finished before the firebox holes are machined. The sleeve is applied to the back end side of the staybolt hole by a pneumatic machine which quickly tightens the sleeve in position. A lever is then employed to bring the sleeve up to maximum tightness.

When the sleeves are in place the firebox sheet is reamed and tapped. For this purpose a guide is fitted in the sleeve for holding the tap centered in tapping the firebox sheet. Following this process, the flexible staybolts are then applied. The firebox end of the staybolt is allowed, as before, to project on the fire side of the plate.

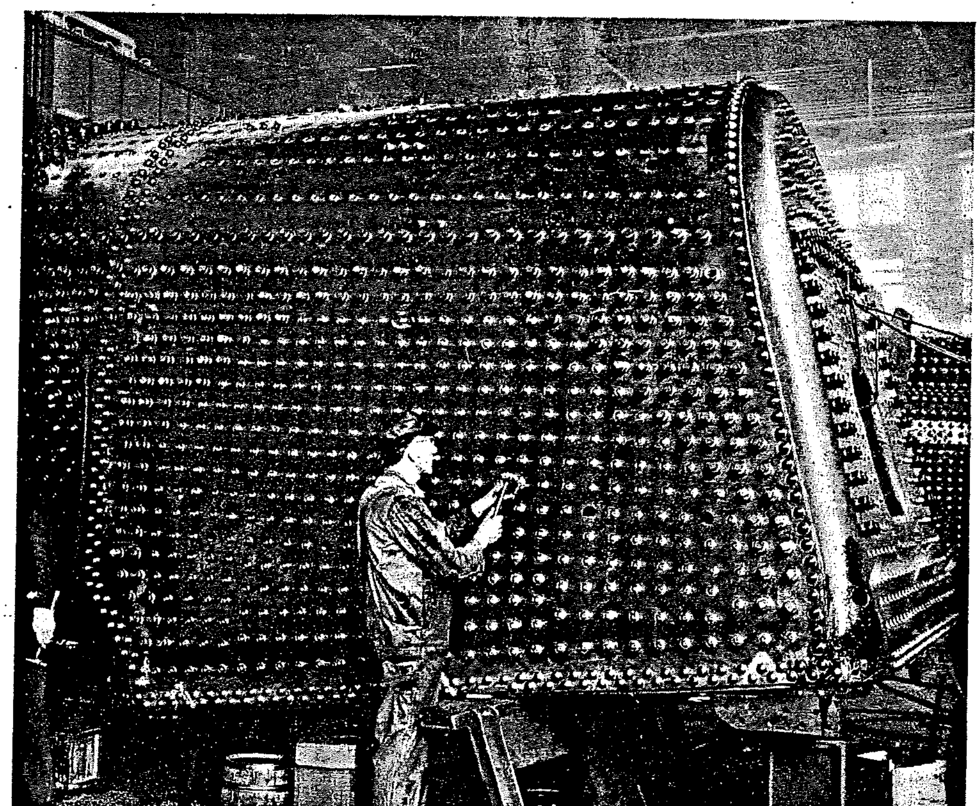
When all flexible staybolts are in place, the rigid bolts are applied. In this case the holes are reamed and tapped, as before mentioned, a straight reamer and a tap preparing the holes in the back, sides, throat sheet, and holes for drop bolts. Taper bolts, however, are fitted



cut by means of an oxy-acetylene torch provided with a gage on the tip of the torch to regulate the distance from the plate that the torch is held. This distance assures the maintenance of the required length of bolts projecting from the plate to allow for hammering. This projection is then hammered by means of a pneumatic hammer to form a slight head both inside and outside in the case of rigid bolts and on the inside in the case of flexible bolts. For flexible bolts a dolly bar is fitted over the head of the bolt, a cap with a hole being fitted over the sleeve to center the dolly on the staybolt head. The inner end of the bolt is hammered as are other bolts.

When all the staybolts have been hammered, it will be found that the telltale holes will have been partially filled with metal due to this process. It is then necessary to drill, by means of compressed air tools, the telltale holes, opening them to the required depth. The

Inspecting a five syphon locomotive boiler back end



Hammer testing rigid staybolts

in the center of the crown sheet. The taper bolt hole is prepared—first with a straight tap, the tool being inserted into the hole from the outside and machined through both inside and outside plates at once. Following this process, the hole is tapered from the inside, a taper reamer with a lead being used followed by a taper tap cutting through the firebox crown sheet only.

On completing the preparation of the holes, the rigid staybolts and tapered bolts are applied from the inside of the firebox. This procedure in applying staybolts from the inside in the case of straight bolts is necessary in order to assure a uniform depth of telltale hole in the bolt. The depth of the telltale hole is measured from the outside of the back end and by inserting the bolt from the inside and thereby providing a uniform projection of the bolt from the outside, the depth of the telltale hole can easily be judged and kept uniform.

When all stays, both flexible and rigid are fitted, the projecting ends of the bolts on inside and outside are ends of the staybolts, which were hammered, are then dressed to suit by removing the burr.

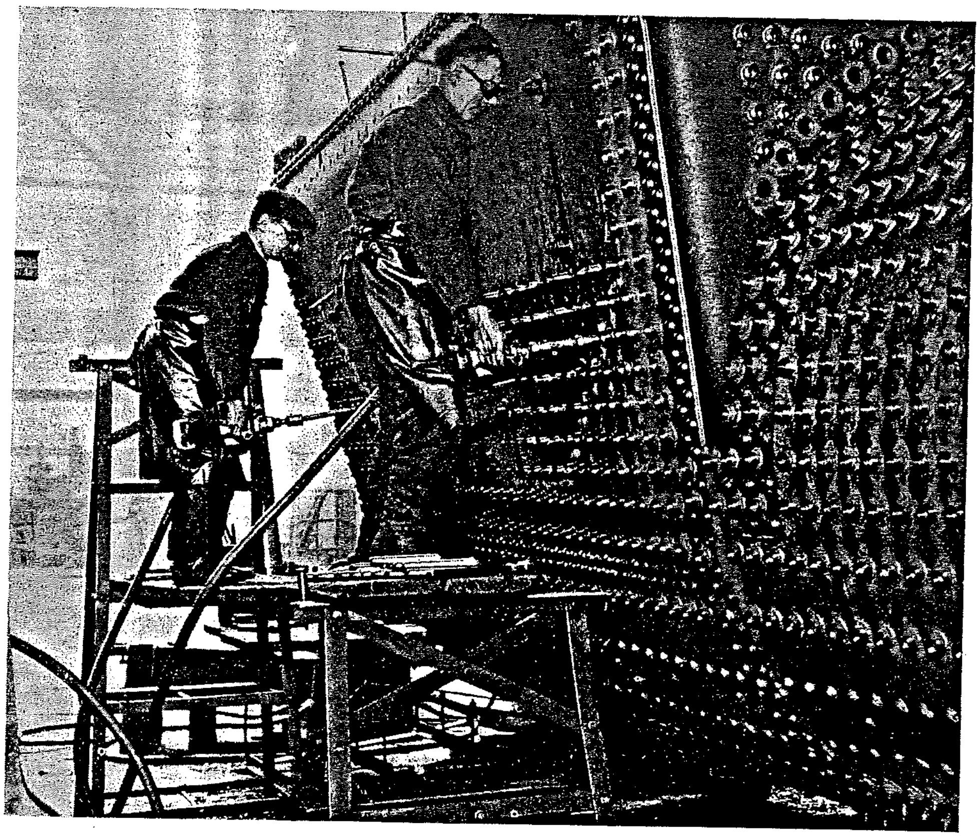
It is essential throughout the process of applying staybolts to see that all machined surfaces are free from cuttings or dirt before the application of any of the staybolts. The presence of foreign material between the surfaces of the staybolt and the sheet is apt to cause leakage and unsatisfactory results are sure to be obtained. To prevent such occurrence, all cuttings and dirt are blown with compressed air from the vicinity of the staybolt holes before such bolts are applied. The back end of the boiler is then completed with staybolts installed.

Most boilers come to the finishing floor with the smokebox applied, but where the smokebox is fitted with Coffin feedwater heaters it is not usually applied until the rest of the boiler is fitted. The smokebox is heated and shrunk on to the boiler in a manner similar to the practice employed in fitting rings in the waist department. The smokebox is fitted by means of bolts, after which the holes are reamed and riveted by hand-operated pneumatic tools. The holes for the multiple-throttle valves are burned out of the smokebox on the finishing floor by means of oxy-acetylene torches, and if a liner is required for this purpose as in the case where large holes are necessary, such liners are prepared, trimmed and fitted to the boiler. These liners are generally welded in place.

The boiler is then ready for the general finish which consists of a complete inspection of the boiler, and cleaning. Throughout the course of construction each operation is inspected, each contractor in charge of the various operations being responsible for his own work. In addition to inspecting his own work, he reviews that of the previous contractor and does not accept the boiler for his particular operation until the previous work is correct. Following the inspection, in which among other things, the flue sheets are carefully checked for straightness, the boiler is transferred to bay No. 2 where the measurements between the flue sheets are taken in order to obtain the proper dimensions for the tubes. The boiler is then shipped to the erection shop where the boiler is finished, including the installation of flues and superheaters.

At the Baldwin Locomotive Works, this completes the manufacture of the locomotive boiler so far as the boiler shop is concerned. In addition to the processes outlined in the last few months, which are performed in the boiler shop, the Baldwin management has recently installed in the boiler shop two new departments; namely, the flue shop and the superheater shop. These departments are manufacturing departments only and prepare the flues and superheaters which are applied to the boiler after it arrives in the erection shop. Descriptions of these departments will appear in The Boiler Maker at a later date.

In reviewing the methods of manufacturing locomotive boilers at Eddystone, it is interesting to note what can be done with modern equipment and with ample space in which it may be used. Electric equipment is employed as far as possible, individual motors being employed for the majority of machines. The plant, the largest of its kind in the world, is laid out to best advantage, being arranged to obtain a constant direction of material flow in order to reduce handling to a minimum and save time and energy. Manufacturing departments have been placed adjacent or as near to the installing departments as possible to reduce the distance of travel of manufactured parts and to bring about coordination between manufacturing and installing departments. These factors—modern production control, modern equipment and modern material handling, as well as effective layout, aid The Baldwin Works in the efficient production of locomotive boilers.



Applying flexible staybolts by machine

Clipping excess material from smokebox liners

Countersinking the dome flange rivet holes

fastened to the base of the radial drill at a convenient working height. The other rests on a screw jack, upon the top of which is bolted two angle clips to prevent the rod from falling off the jack. By means of wood blocks, the dome may be shifted to any angle to allow the drill to enter the flange normal to the surface.

Following the operation of drilling the flange holes the dome is reversed with the top up. In this position the flange holes are countersunk and reamed; the holes in the top of the dome are then drilled. For this purpose a steel drilling template is used, through which the drill is run, spotting the holes around the circumference. The template is then removed and the holes completely drilled. They are then tapped on a tapping machine located in panel 22.

The flange edges are burned off by means of an oxy-acetylene torch, after which the edge is machined in one of two milling machines. This process completing the fabrication of the dome, which is then transported to the upper portion of bay No. 8 where the dome is assembled to the boiler course.

Steam pipe rings are machined from castings in a lathe located in panel 24.

Tube sheets are completely fabricated in the remaining section of the lower portion of bay No. 8. These sheets, with the steam pipe ring attached, are completely drilled in this department.

When the tube sheet leaves the layout department in bay No. 12 the flange rivet holes and two tack holes on the tube sheet face are laid out. On receipt by the tube sheet department, the sheet is set up in either of two horizontal drill presses located in panel 20, and the flange rivet holes are drilled. These are drilled ⅛-inch undersize to allow for reaming during assembly. Following this procedure the tack holes in the tube sheet face are drilled on any one of eight 60-inch radial drills.

In cases where only one or two tube sheets are ordered according to one design, the tube sheet is laid out complete by the layout department. In that case, no tack holes are necessary.

But in cases where many sheets are to be drilled according to one design, a metal template made of ½-inch stock is employed, this being laid out by the layout department. The template is fastened to the tube sheet by means of tack bolts through the tack holes. The tube sheet with template attached is then set up in a 60-inch radial drill.

Where the right and left-hand sides of the tube sheet are similar, two sheets are bolted together for drilling at the same time. This practice speeds production.

With the template in place, a twist drill is guided by the template and run into the tube sheet only far enough to assure the hole being well centered. When this has been done for every hole in the plate the template is removed and the tube sheets rebolted together.

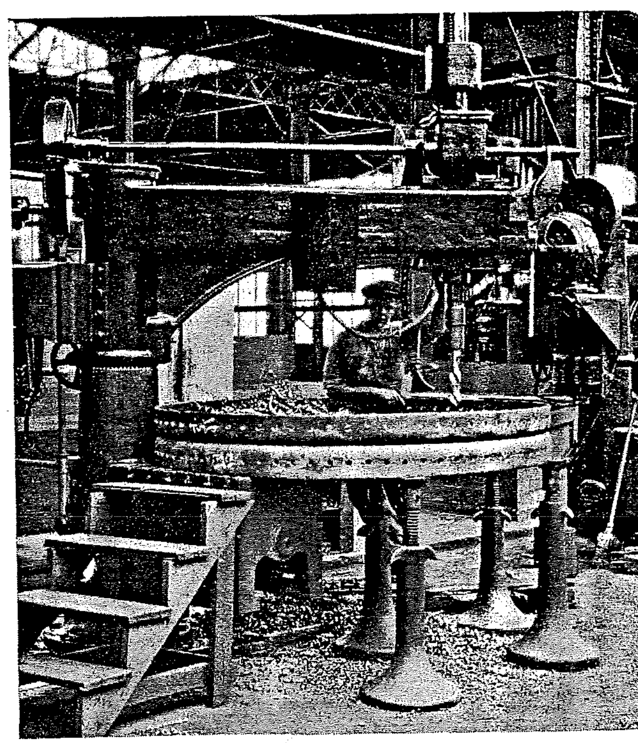
All holes 2½ inches and under in diameter are drilled with a twist drill. Holes over 2½ inches are machined with a cutting tool.

Rivet holes and stud holes are drilled ⅛-inch or more undersize, according to the pitch of the thread.

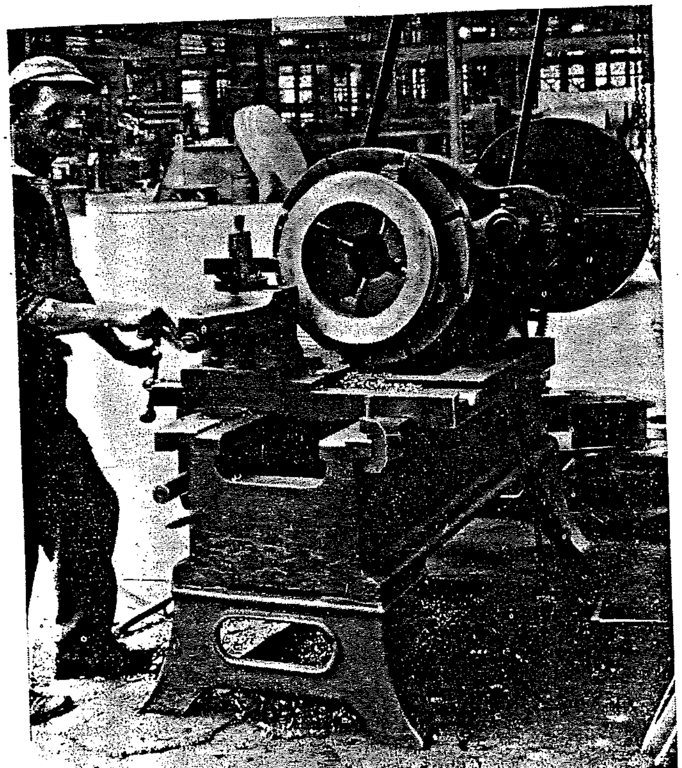
For all flue holes a 1-inch lead hole is drilled. This lead hole serves as a guide for the twist drill or the pilot of the cutter bar used in such cases. The tool used for cutting holes over 2½ inches in diameter consists of a cutter bar capable of holding one or more cutters. This tool holder allows the cutting tool to be adjusted to the diameter of the hole to be cut. Superheater tube holes, steam pipe holes and large tube holes are cut in this manner. All tubes are drilled and reamed. A special counterboring tool is used to bevel the hole edges on both sides of the plate. Tapping may be done in any of the radial drills.

When the holes have been cut, either by twist drill or cutter, the tube sheet is set up in one of four boring mills where the edge of the flange is machined to size and beveled.

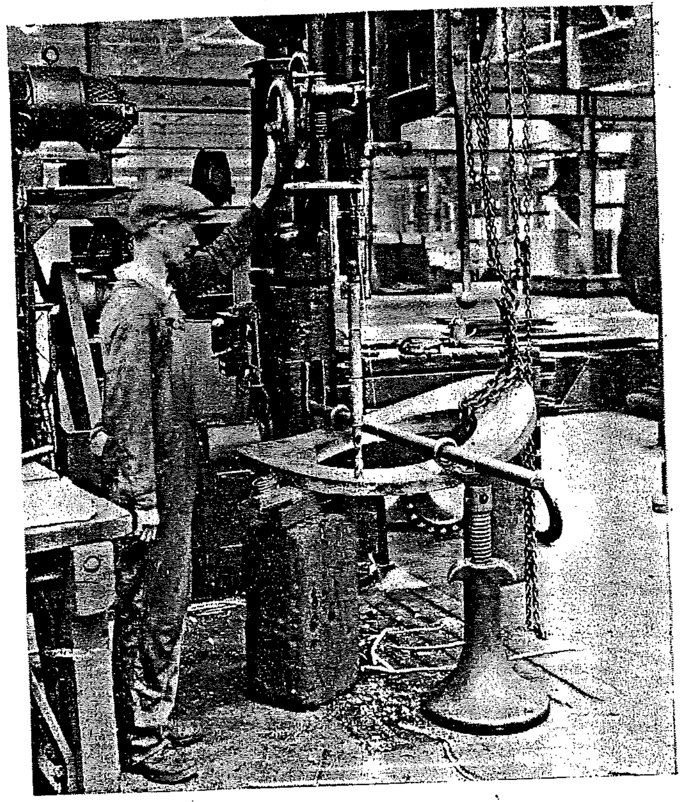
The steam pipe ring that has been machined in a lathe, is drilled in regard to rivet holes only. This ring



Flue holes being cut with a twist drill and radial drilling machine



Steam pipe ring set up in a lathe for machining



Drilling dome flange rivet holes—note holding jig

is riveted to the tube sheet already in this department.

The tap holes for the connection of the dry-steam pipe flange are laid out accurately on the tube sheet and drilled therein before the ring has been riveted to the tube sheet. The tap holes are then accurately drilled and tapped in the ring after the ring is in position.

Tee bars for the attachment of roof stays to the tube sheet are laid out and drilled in this department, fitted on and then sent to the upper bay where they are reamed and riveted to the tube sheet.

The inner surface of the dome flange being machined in a radius planer

The greatest economy of production is obtained at The Baldwin Locomotive Works by the observance of all the laws of material flow. Lost motion is eliminated by following the shortest route of procedure and through this economy a high standard of boiler construction is obtained.

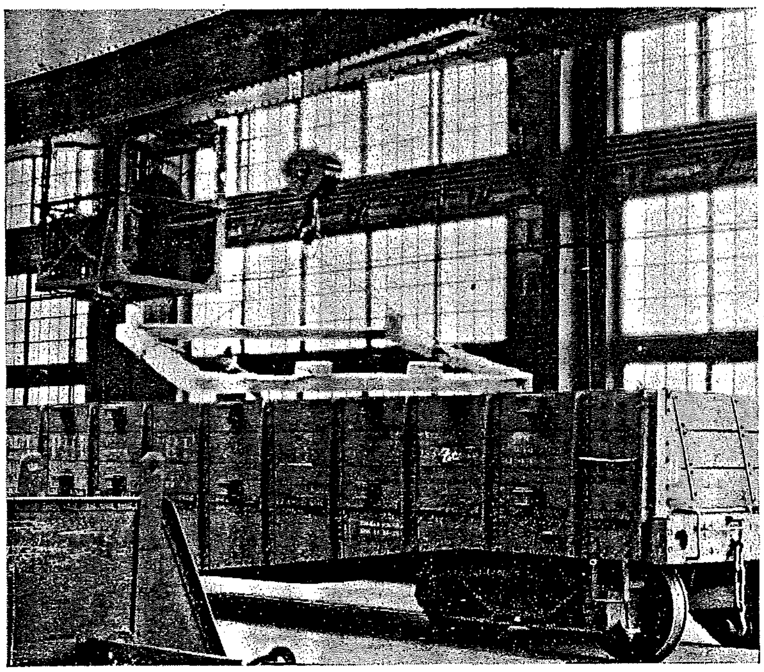
New Welding Electrode

EXTENSIVE research and experimentation by the Lincoln research laboratories has made possible the offering to the trade of the "New Kathode" welding electrode by The Lincoln Electric Company, Cleveland, Ohio. The electrode is manufactured for the arc welding of mild steel and for cast-iron repair work.

It is claimed that the composition of the electrode, as well as the special treatment given in its manufacture, imparts qualities heretofore lacking in the usual electrode. Flowing easily with freedom from sputtering, the new electrode produces clean welds with minimum slag and oxidation. The high heat permissible for use with this fast-running electrode makes possible increased welding speed. The quality of the weld is not sacrified for speed of welding, as the electrode fuses easily with deep penetration. The resulting weld on steel is soft and readily machineable.

The "New Kathode" electrode is manufactured in stock lengths of 14 inches and 24 inches. To provide best possible protection, during shipment, the rod is packed in metal containers holding 50 pounds each.

WELDING EQUIPMENT.—A new catalogue, No. 29, just issued by the Torchweld Equipment Company, Chicago, Ill., covers the complete Torchweld line with cross sectional views of gas welding and cutting, lead welding, soldering, brazing and de-carbonizing equipment.



Unloading mudrings in bay No. 10

Boile a Baldwin Loc

The fabrication (and waist sheets (

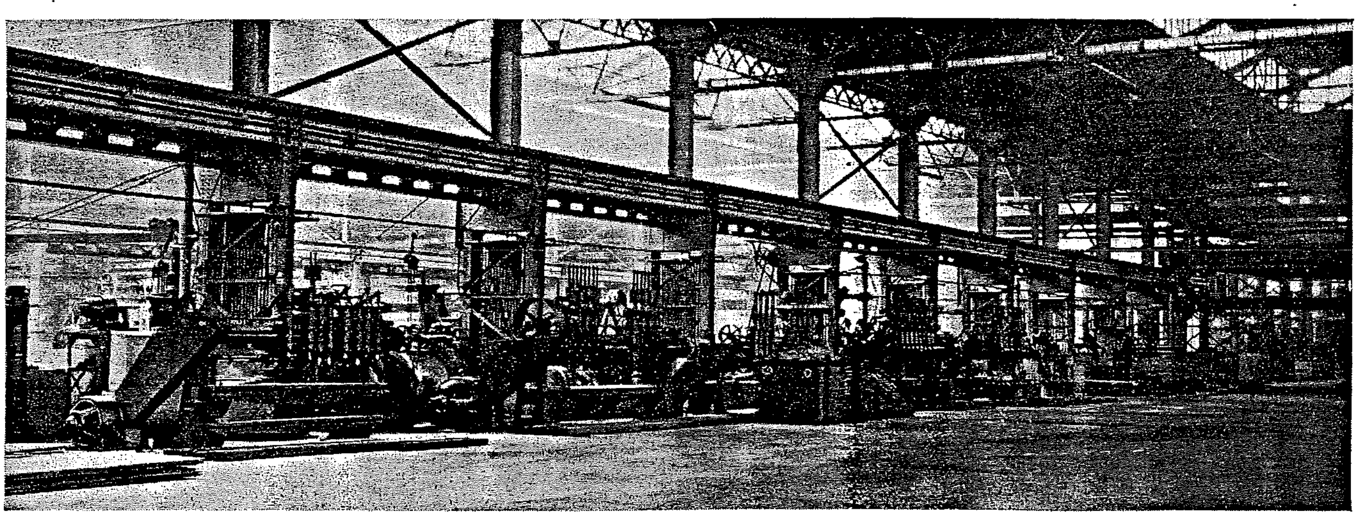
ONE of the country's outstanding water space frame departments from the standpoint of extensiveness and equipment is located in the boiler shop of The Baldwin Locomotive Works, Eddystone, Pa. It is in this department that water space frames or mud rings, waist sheets and special castings are fabricated complete for assembly. All this is accomplished in a section of the main boiler shop extending between panels 19 and 31 in bays Nos. 9 and 10, a floor space of approximately 48,000 square feet.

This department is served by two 10-ton Shepard, overhead, electric traveling cranes, one located in each bay. The machines are served by two 6-ton hand jib cranes, two 3-ton hand jib cranes and four 1¼-ton hand jib cranes. A hand transfer track located in panel 23 extends between the two bays. This track, which is 120 feet in length, is equipped with a small flat car which serves to transport material from one bay to the other in the same department.

The equipment for the fabrication of water space frames is most complete, 32 machines being employed in all. These include seven open side planers, seven 60-inch vertical milling machines, five 8-spindle multiple drills, two tapping machines, one horizontal drill press, one plate planer, two shapers, one slotter and six emery wheels or grindstones. These are described in more detail in the accompanying table on page 206.

The greater part of the water space frames constructed by The Baldwin Locomotive Works is made of steel, the castings for which are generally supplied by an outside foundry. A few frames, however, are of forged steel construction, fabricated in the company blacksmith shop. In either case, the castings or forgings are transported to the boiler shop in gondola cars which are spotted in the extreme end of bay No. 10 by means of the ladder track. An overhead crane unloads the castings which are stored at the end of the bay adjacent to the tracks.

Before the process of fabrication is started the blank casting is placed on the layout surface block in panel



Bay No. 9 showing five 8-spindle drilling machines

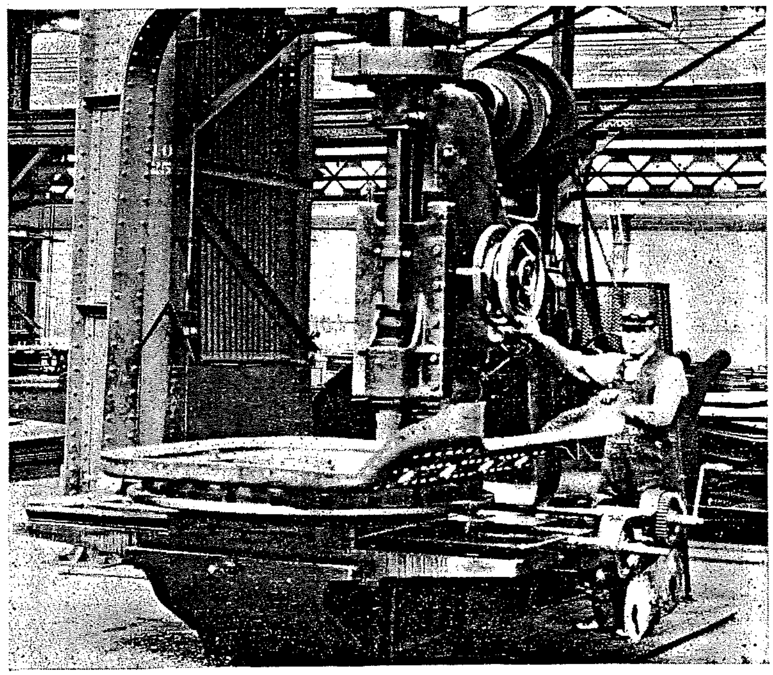
Work

the

motive Shops

water space frames

the Eddystone Plant



Machining tube sheet flanges on a vertical miller

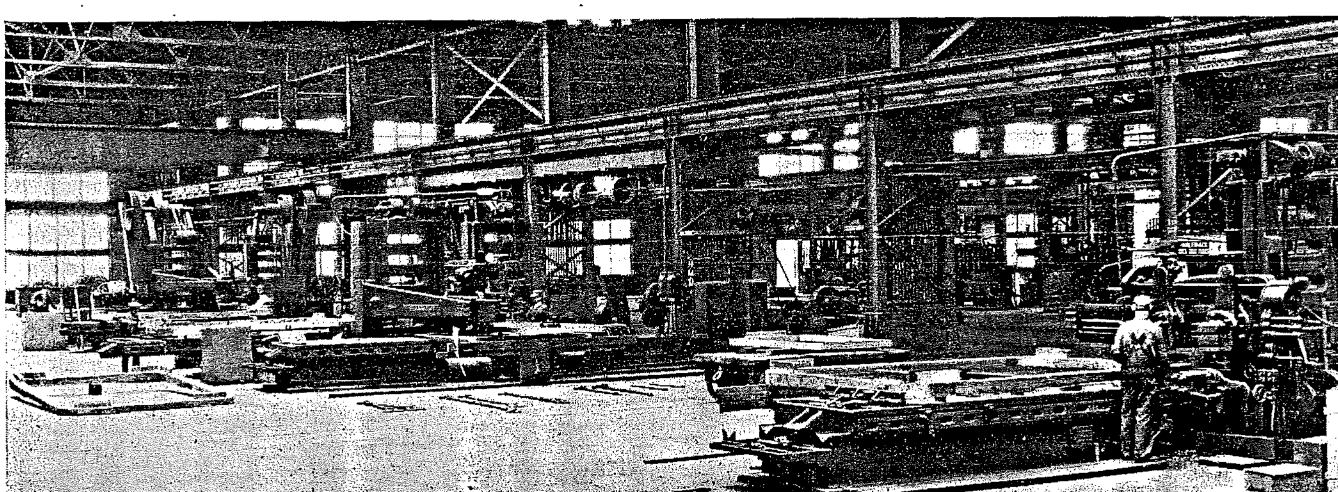
27 of bay No. 9 where it is lined up by means of surface gages to determine whether the material is square and whether sufficient material has been allowed for planing.

The limits are set for the planing operations on the outside edges and the mud ring is transported to one of five large planers located in bay No. 9. These machines are of Bethlehem Steel Company make, built at the Detrick Harvey Plant, Baltimore, Md. Each machine has four motors. A motor at the top of the machine raises and lowers the cross rail or beam carrying the two cutting arms. One located on the cross arm operates the tool, moving it to any position. A 35-horsepower motor operates the table and feed while the fourth motor operates an oil pump. All electrical equipment for these machines is of Westinghouse make. At one side of the table is a track on which runs a removable frame used as a rest for the mud ring when in the machine.

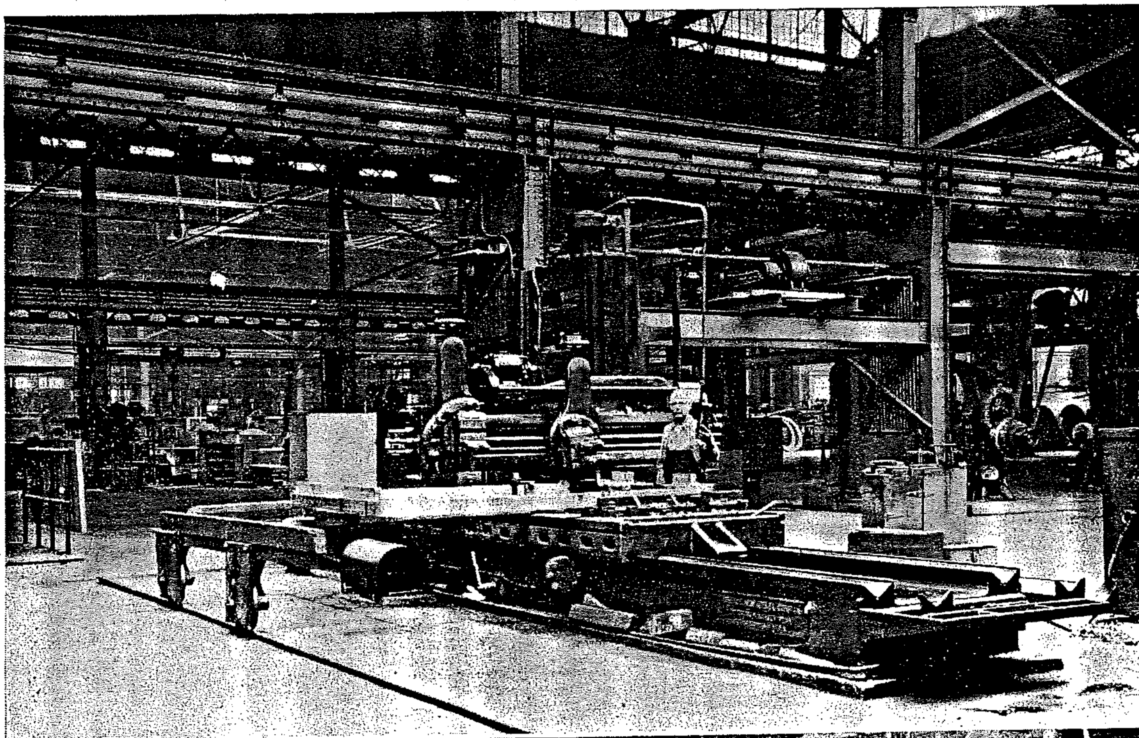
In this machine the mud ring is planed on the outside edges, right and left, front and back, the limits being previously determined.

When the outsides are planed, the ring is again set up on the surface block where it is completely laid out from templates supplied by the layout department. This process consists of laying out the corner radii for both the outer and inner edges of the four corners. The rivet holes, stud holes, lug sides and general dimensions of the card are placed upon the water space frame.

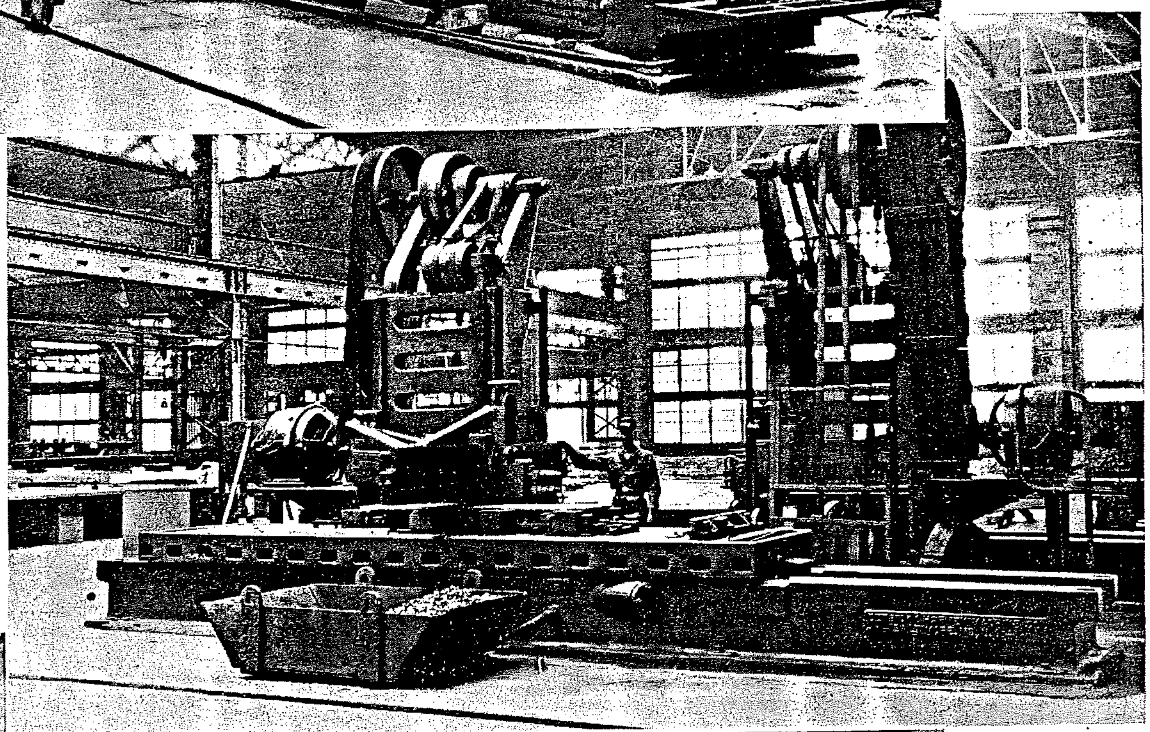
The frame is then set up on one of the seven vertical milling machines where the outer and inner corner radii are machined. After this has been completed, the frame is again set up on the planing machine where the inner sides are planed to the limits set by the milled corners and the marked dimensions. Lug sides can generally be machined in the planer, but it is often found necessary to finish this work in the shapers supplied for that purpose. The bottom of the mud ring is machined in the planer, where necessary, to permit the fitting of the ash pan. The shaper finishes the bottom where



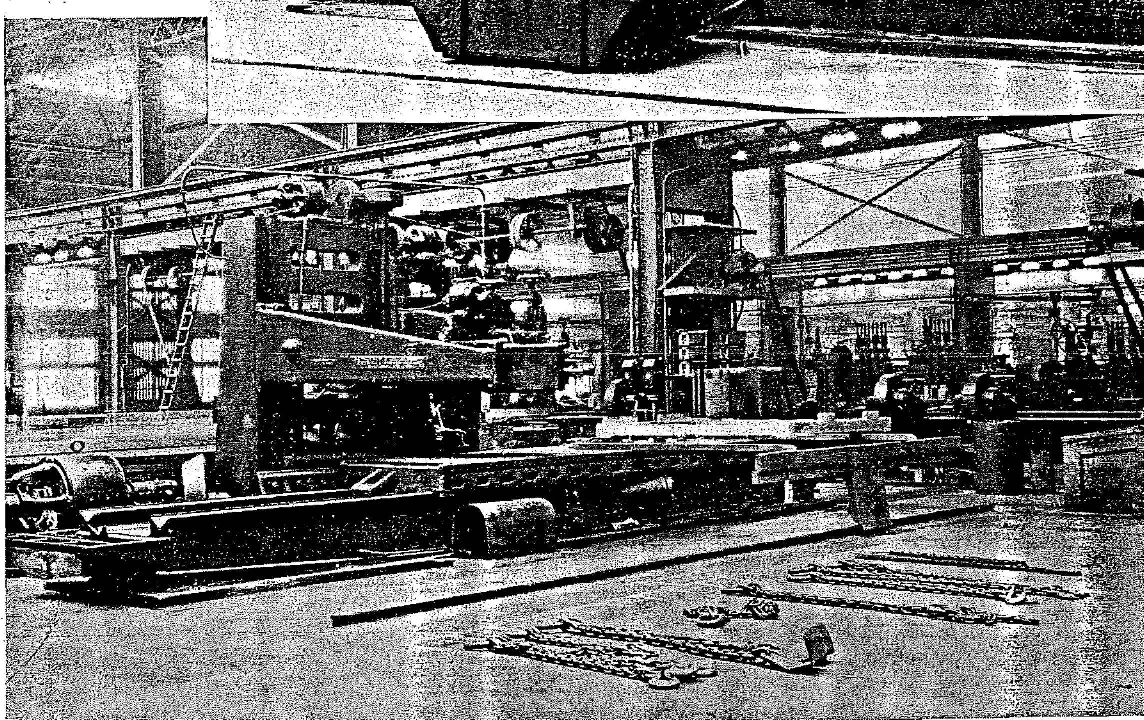
General view of bay No. 10 showing planing machines



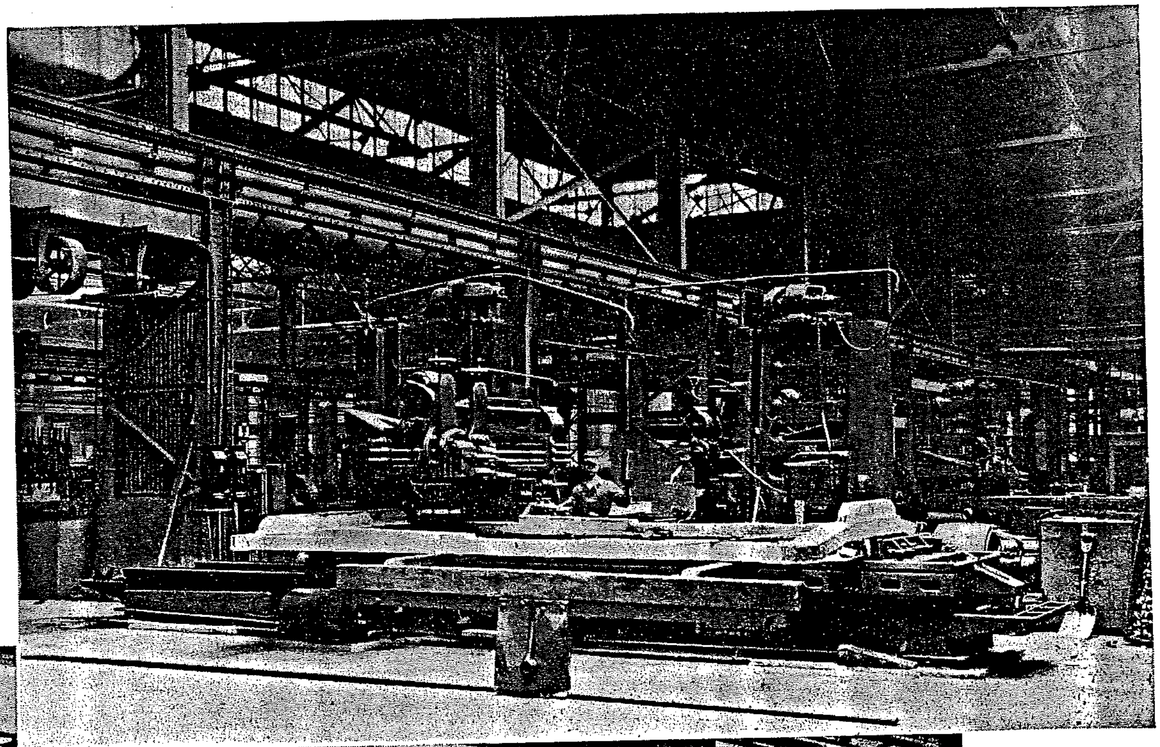
(Left)—A mud-ring set up in a planing machine for inside planing



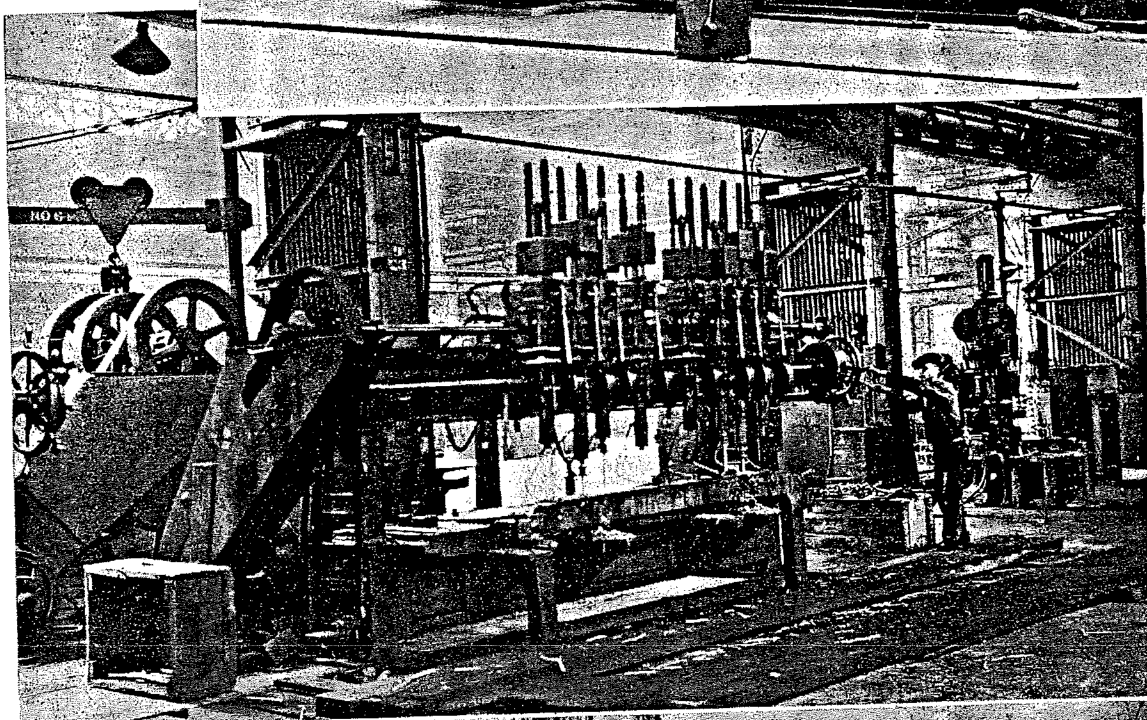
(Right) — Dietrick & Harvey 16-inch by 19-inch by 60-inch open side planer



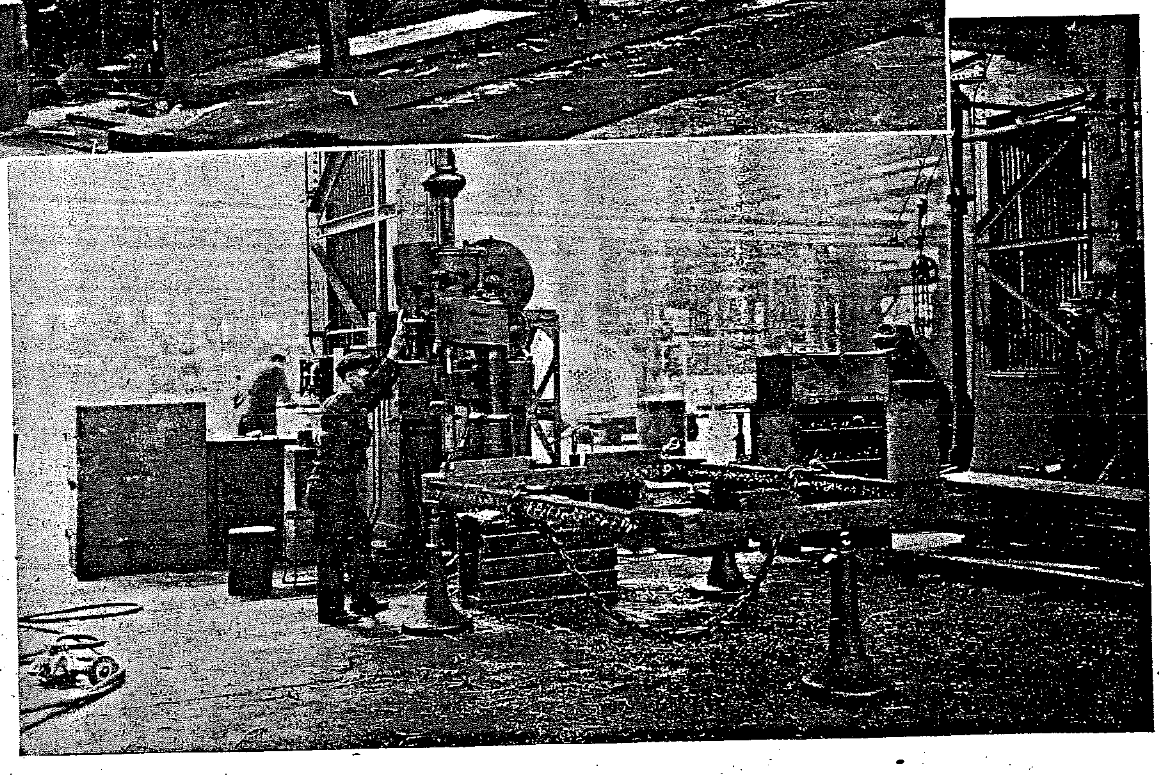
(Left) — Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer



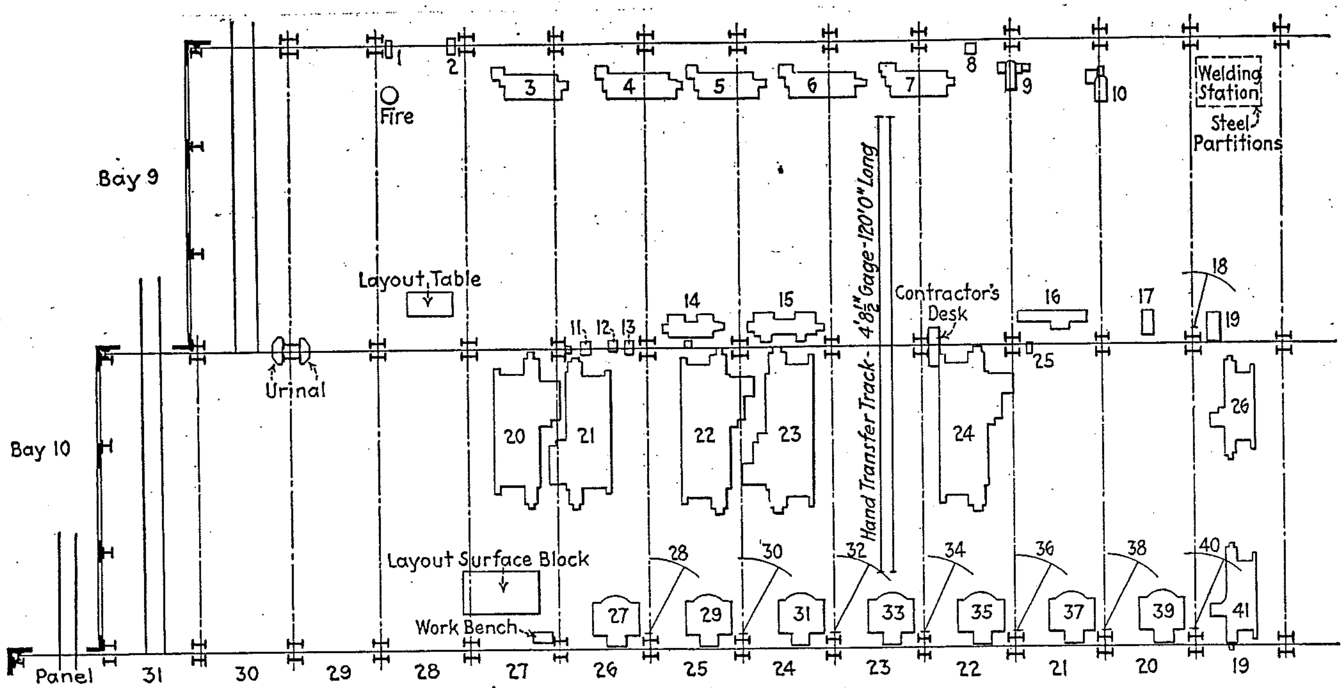
(Right)—A mud-ring set up in a planing machine for outside planing



(Left)—Mud-ring set up in an eight-spindle multiple drilling machine

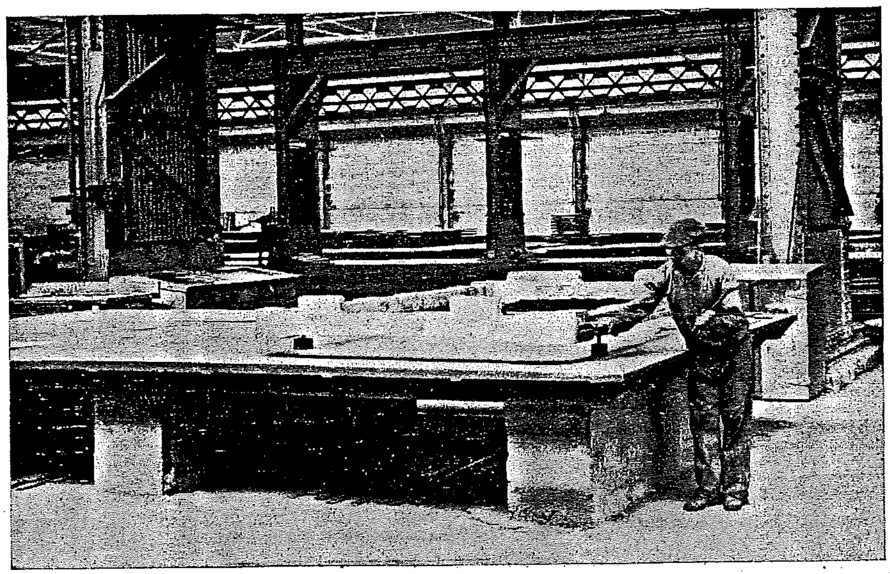


(Right)—Tapping the mudring for the attachment of the ash pan

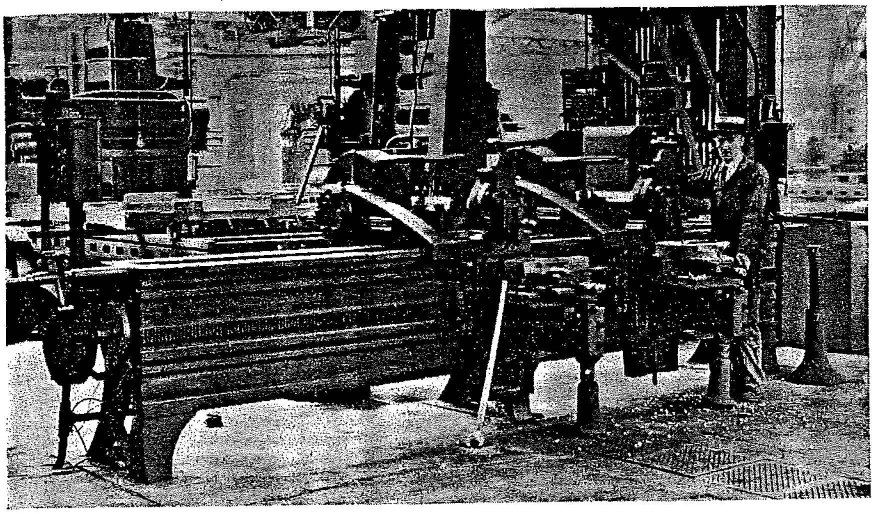


Arrangement of the water space frame department

1 No. 5 Sturtevant blower for fire.
2 Baldwin 42-inch grindstone, motor on building column bracket, belt drive.
3 Bement-Miles 8-spindle multiple drill, motor on floor.
4 Harrington 8-spindle multiple drill, motor on floor.
5 Harrington 8-spindle multiple drill, motor on floor.
6 Harrington No. 18, 8-spindle multiple drill, motor on floor.
7 Harrington No. 10A, 8-spindle multiple drill, motor on floor.
8 Hisey-Wolf 6 WFA emery wheel, motor on machine, direct drive.
9 Harrington 48-inch tapping machine, motor on machine, direct drive.
10 Fosdick & Halloway 6-inch tapping machine, motor on separate stand, belt drive.
11 Baldwin 24-inch emery wheel, machine driven by belt to line shaft.
12 Baldwin 9-inch emery wheel cutter sharpener, driven by belt to the line shaft.
13 Baldwin 42-inch grindstone with 12-inch face, driven to line shaft.
14 Bement-Miles 18-inch shaper, motor on floor, belt drive.
15 Bement-Miles 25-inch by 14-foot double shaper, motor on building column bracket, belt drive.
16 Bement plate planer, motor on steel work overhead.
17 Sellers 60-inch slotter, motor on building column, belt drive.
18 Baldwin 3-ton hand jib crane having 15½-foot reach.
19 Baldwin 1¼-inch hole horizontal drill press, motor on separate stand, belt drive.
20 Dietrick & Harvey 16-inch by 49-inch by 60-inch open side planer, motor on machine, direct drive.
21 Dietrick & Harvey 16-inch by 49-inch by 60-inch open side planer, motor on machine, direct drive.
22 Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer, motor on machine, direct drive.
23 Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer, motor on machine, direct drive.
24 Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer, motor on machine, direct drive.
25 Hisey-Wolf 14-inch single emery wheel with 2-inch face, 3-horsepower power motor mounted on machine, direct drive.
26 Dietrick & Harvey 3-foot by 3-foot by 12-foot open side planer, motor on separate stand, belt drive.
27 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, belt driven.
28 Richmond & Kemp 3-ton hand jib crane having a 20 foot reach.
29 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
30 Six-ton hand jib crane having a 20-foot reach.
31 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
32 R. D. Wood 1¼-ton hand jib crane having a 20-foot reach.
33 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
34 Sellers 1¼-ton hand jib crane having a 20-foot reach.
35 Bement-Miles No. 10 60-inch milling machine, motor on steel work overhead, direct drive.
36 Baldwin 1¼-ton hand jib crane having a 20-foot reach.
37 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
38 Sellers 1¼-ton hand jib crane having a 20-foot reach.
39 Niles-Bement-Pond No. 10, 60-inch vertical milling machine, motor mounted on machine, direct drive.
40 Six-ton hand jib crane having a 20-foot reach.
41 Dietrick & Harvey 3-foot by 12 foot open side planer, motor on separate stand, belt drive.



Laying out the water-space frame on the surface block



Planing a firedoor ring on the 25-inch double-head shaper

the work cannot be done on the planer. The top or water space side is not finished.

On completion of the machinery process, the frame is ready for drilling. It is transported to bay No. 9 by means of the hand transfer track in panel 23. The overhead crane transports the frame to the desired machine where it is lowered into a pit with side of the frame to be drilled, resting on the machine brackets.

The pits before each of the multiple drilling machines are 18 feet deep and 4 feet wide. They extend the entire length of the machine. Water which is used for cooling the cutting tool when drilling collects in the bottom of the pit and is drained by means of a syphon system. This system consists of two pipes leading into the pit, through one of which water flows into the pit to maintain the syphon action. The other pipe draws the water from the pit to the main drainage system. A floating valve controls the water flow from the inlet pipe by stopping the pipe when the water in the pit becomes too high. To remove the collection of a large quantity of chips and turnings that fall into the pit, a large electric magnet is employed. This is lowered into the pit and effectually cleans the pit of such turnings on its removal.

After the sides of the water space frames are drilled for the riveting of the firebox and sides sheets, the frame is then taken to the tapping machine where the bottom of the frame is tapped. These tapped holes are required for the attachment of ashpan studs. After drilling and tapping, the lugs are drilled on a horizontal drill press.

Burrs on the water space frame are removed by a pneumatic hand-operated grinding machine after which process, the frame is completed and is ready for assembling in the firebox fitting floor.

The complete fabrication of waist sheets is done in this department. This type of work includes valve motion sheets, guide bearing sheets, back of furnace sheets and front of furnace sheets for connecting the boiler to the locomotive frame. Here they are laid out, burned out, milled, planed and delivered to the erecting shop.

In general, the waist sheet is made of one-half inch plate or a casting and this material is laid out on the layout table in panel 28 of bay No. 9. After being laid out, the edges of the sheet are rough-burned and machined to card size. The straight edges of the plate are planed and the concave or shaped edges of the plate are finished on the milling machine. The holes are cut out on the milling machines and the rivet holes are drilled in both the sheet and the liner, where a liner is used as is the case of large waist sheets. The rivet holes are drilled and countersunk, the rivets driven and the heads ground in this department.

In some cases holes are of such size or shape that they may not be machined on the milling machine, therefore the slotter is used for that purpose.

All edges of the waist sheet, with the exception of the center leg which attaches to the locomotive frame, are finished. This center leg is left rough in the shop and is not finished until the boiler is set in the locomotive frame in the erection shop, at which time the sheet is accurately fitted.

If a waist sheet is to be slightly bent, as is the case of many front and back furnace waist sheets, it is sent to the flange shop where it is given the required bend. This is done before the liners are fitted.

Angles or tee bars that attach to the barrel of the boiler for fitting waist sheets are brought to the water space frame department for milling only. The final drilling operation is done in the erecting shop.

Special work requiring milling or shaping is done in this department. Furnace tube sheets where specifications call for a taper on the inside of the flange are machined here. The tube sheet is generally set up on one of the 60-inch vertical milling machines and the inside flange is machined with a tapered milling cutter.

Fire door rings for certain types of locomotives usually for foreign railroads, are fabricated and machined in this department in a similar manner to water space frames.

Further descriptions of the equipment and methods employed in the boiler shop of The Baldwin Locomotive Works will appear in later issues of THE BOILER MAKER, the August number containing an outline of the dome machine shop and the tube sheet shop.

A section of the shop for laying out and cutting waist sheets

Checking the throat sheet layout prior to drilling

Assemblin
and Applyin

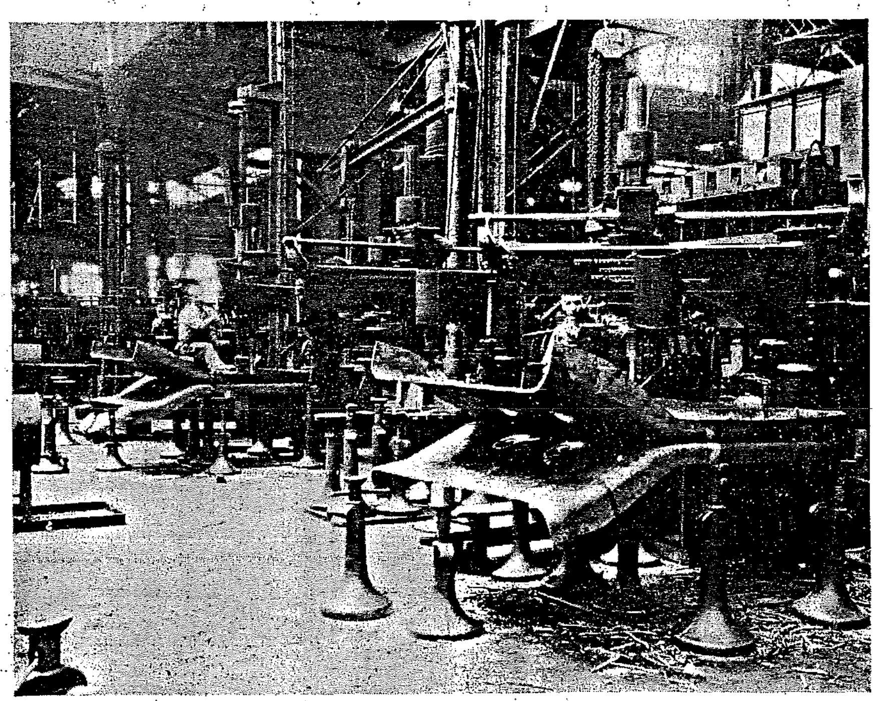
Fabrication metho employed in buildi

LOCOMOTIVE boilers, as constructed by the Baldwin Locomotive Works, Eddystone, Pa., are built with due regard to the most modern production methods, the organization of the boiler shop being divided into a number of departments, each specializing in a particular phase of boiler manufacture. Among the numerous groups of specialists is the firebox fitting department whose sphere of activity lies generally in the upper section of bay No. 6.

Bay No. 6 is divided into two sections; the lower of which is occupied by the rivet storeroom, and the upper section of which comprises the firebox fitting floor. This floor, extending between panels 2 and 17, occupies an area of 30,720 square feet and is equipped with 29 modern machine tools, a tabulation of which is given together with the floor layout on page 282.

This section of the bay is served by a 20-ton Pawling & Harnischfeger crane and a 50-ton Sellers crane, while two 25-ton Niles-Sellers cranes, each spanning half the width of the bay, serve two bull riveters located in panels 2 and 3.

It is in this bay that back tube sheets, firebox throat sheets, door sheets and crown and side sheets are received and assembled into the firebox unit preparatory to the fitting of the firebox to the boiler proper. All flanged sheets connected with the firebox are laid out by the layout department in bay No. 12, prior to the receipt by the firebox fitting department. The crown sheets, however, are laid out and rolled to shape before they are sent to bay No. 6.



Door sheets set up in vertical radial drills for drilling

The firebox tube sheets are drilled and reamed in a similar manner to the front tube sheet, the tube holes being drilled and reamed, using lead holes as is the general practice in such cases. The method for drilling the front tube sheet was described in the August, 1929, issue of THE BOILER MAKER. After drilling the tube holes, the flange of the tube sheet is laid out for depth and the flange rivet line is laid out. The rivet holes are then drilled on the horizontal drill press located in panel 12.

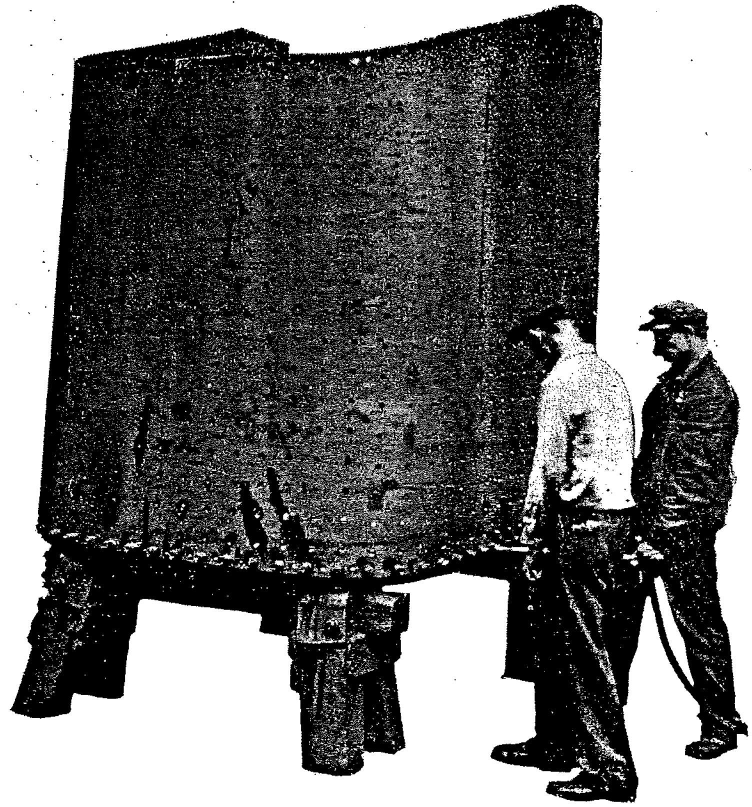
Instead of machining the tube sheet flange in a boring mill, as was the case with front tube sheets, the flange is trimmed by means of an oxy-acetylene torch and then chipped by means of hand-operated pneumatic chipping hammers, thus finishing the flange edge.

The tube sheets of some types of locomotive boilers are required to be scarfed and in such cases they are taken to milling machines and milled in bay No. 10. The tube sheets are then ready for application with the other sheets comprising the firebox assembly.

The crown and sides sheets may be manufactured in one piece or in several, but in either case they are laid out, drilled, planed, and rolled to

Fireboxes Syphon Units

and welding practices Baldwin locomotives



Reaming the crown and tube sheet rivet holes

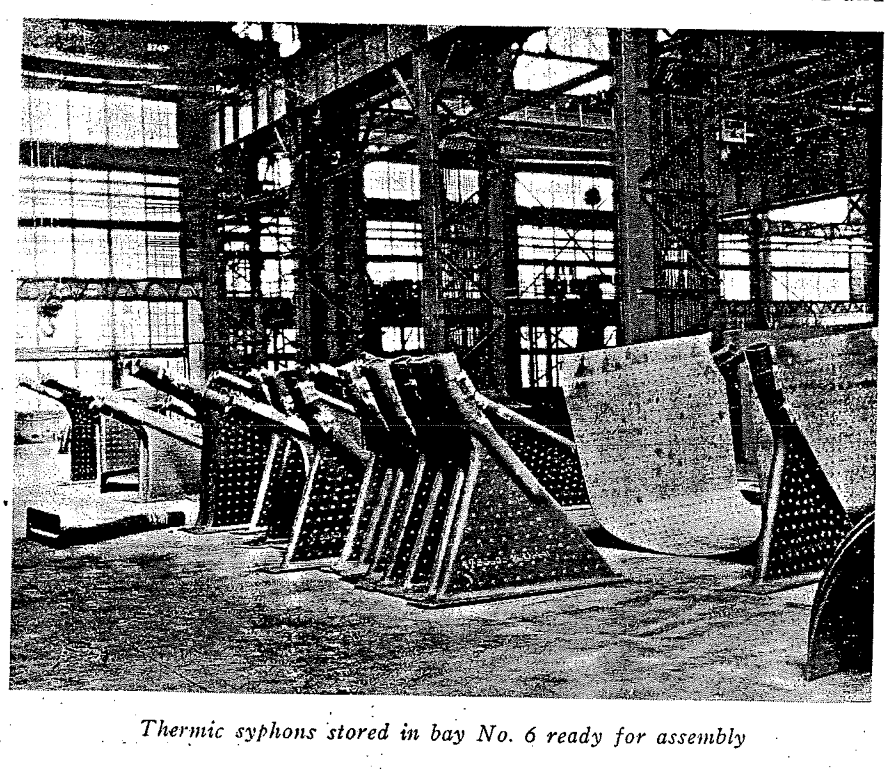
shape before being received by the firebox fitting gang. Where the crown and sides sheets are made in several pieces, these sheets are joined by this department, the sides sheets being bolted to the crown sheet and usually electrically welded in place. For the purpose of keeping the plates in alinement during the welding operation, a continuous plate, extending the full length of the seam, is bolted to the crown and sides sheets through the staybolt holes. This is placed back of the weld or on the water side of the sheets, the seam being planed to a full V in shape on the fire side of the sheet. After the V-seam is welded, the continuous plate is removed and the under or water side of the weld is gouged out to a depth of about 1/8 inch. A re-enforcing bead is then welded to the water side of the weld, the gouge serving to clean the surfaces to be welded and assure a satisfactory fusion of weld in bottom of the V.

In the case of fireboxes with combustion chambers, it is usually necessary to apply the bottom of the combustion chamber when the crown and sides sheets are being welded. The chamber bottom is welded in place using a full V weld with the re-enforcing bead as in the case of other crown and sides sheet welds. Extreme care must be taken in assembling the combustion chamber bottom to the crown sheet to insure the proper alinement of and spacing of staybolt holes. This is thoroughly checked before the sheet is welded or riveted together as the case may be.

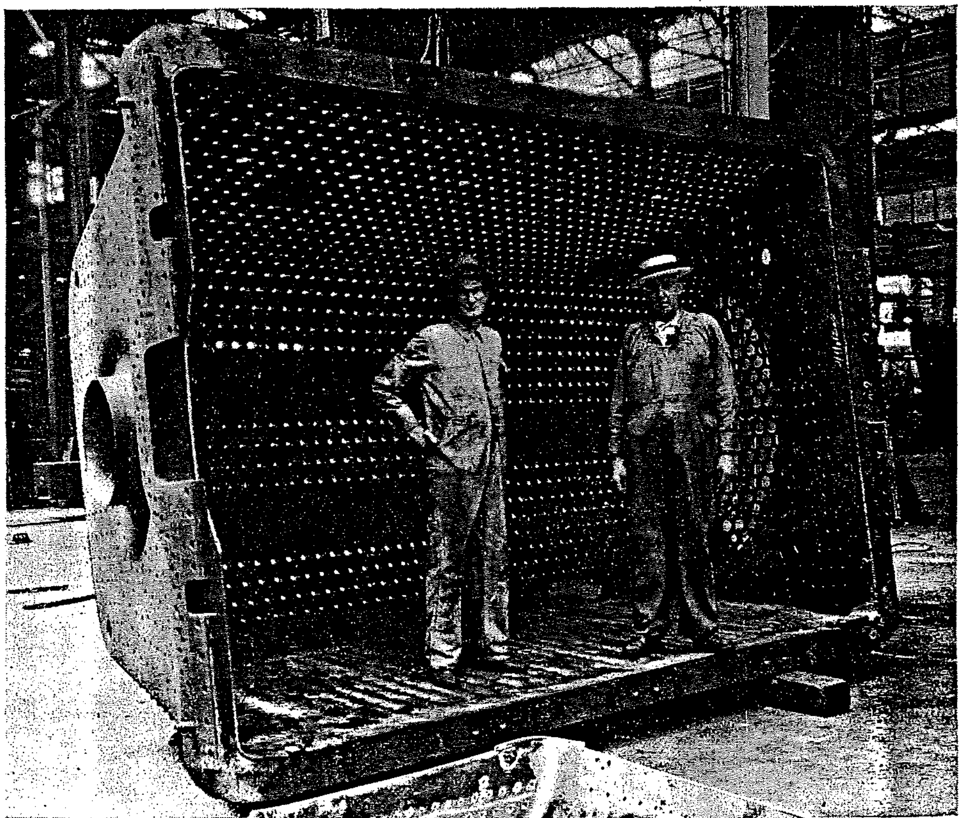
Throat sheets, having been laid out, flanged and scarfed, in other departments are trimmed, drilled and assembled to the firebox by the firebox fitting department. The staybolt holes located in the apron of the throat sheet are drilled on one of nine vertical drill presses located at the side of bay No. 6. The belt and side wings are drilled on one of two horizontal drill presses located in this department. These machines are located in panels 11 and 15.

In the case of a combustion chamber firebox, the throat sheets must be trimmed and fitted in place carefully so as to maintain the accurate spacing of staybolt rows forward and rear.

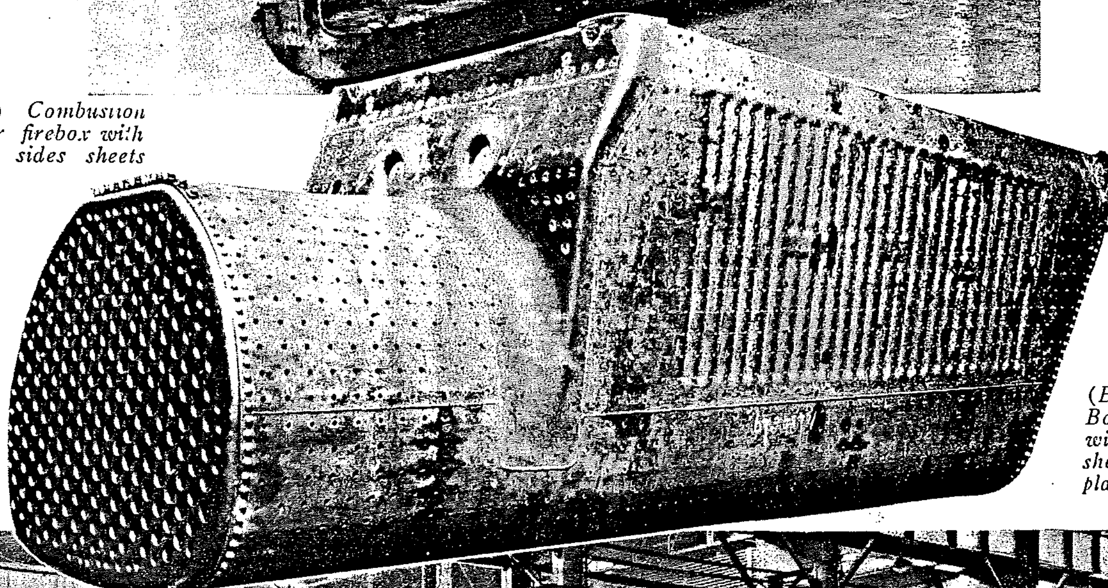
The firebox throat sheet is usually applied to the assembly after the crown and sides sheet is bolted to the waterspace frame, in order to accurately line up the throat sheet in the assembly, the waterspace frame serving as a guide. Rivet holes along the bottom of the sides sheets adjacent to the mud ring



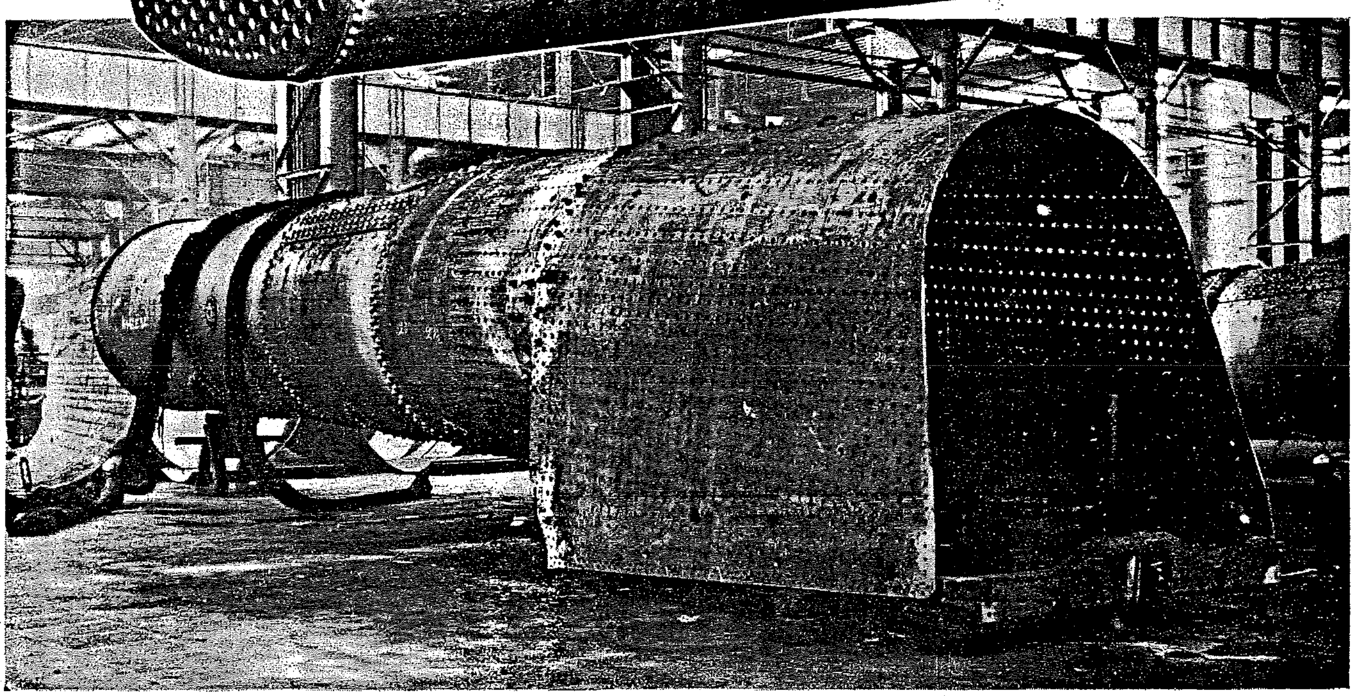
Thermic syphons stored in bay No. 6 ready for assembly



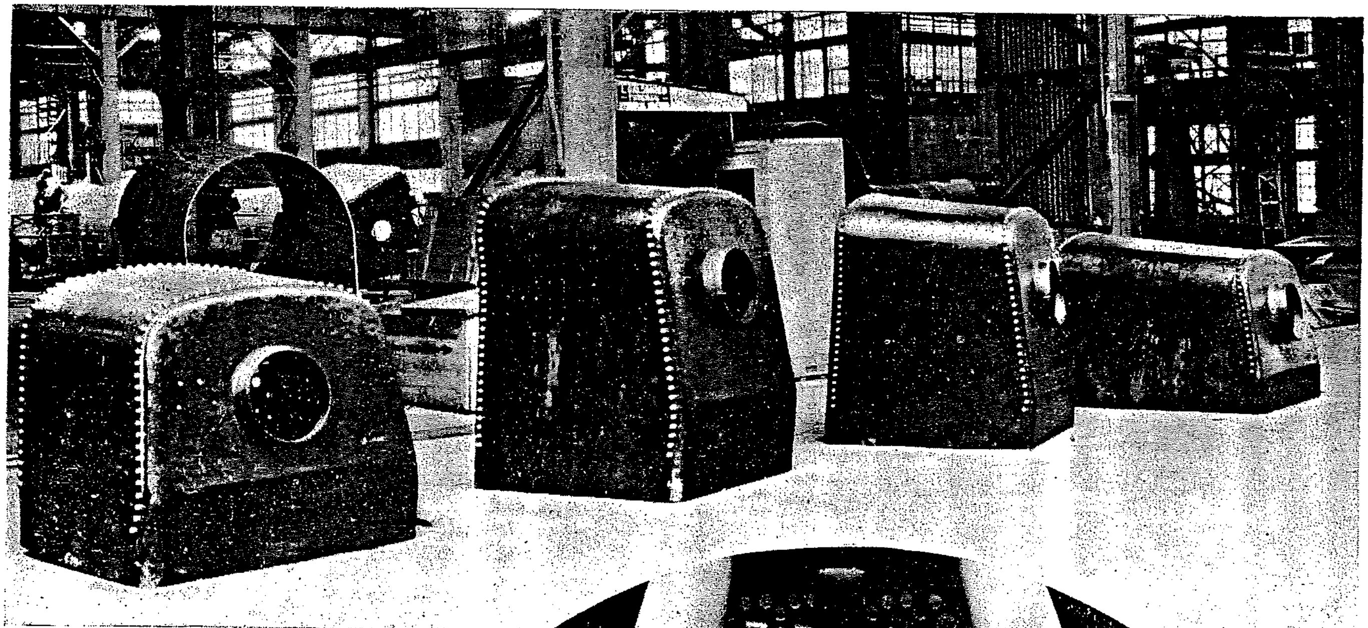
Assembled firebox ready for application of syphons



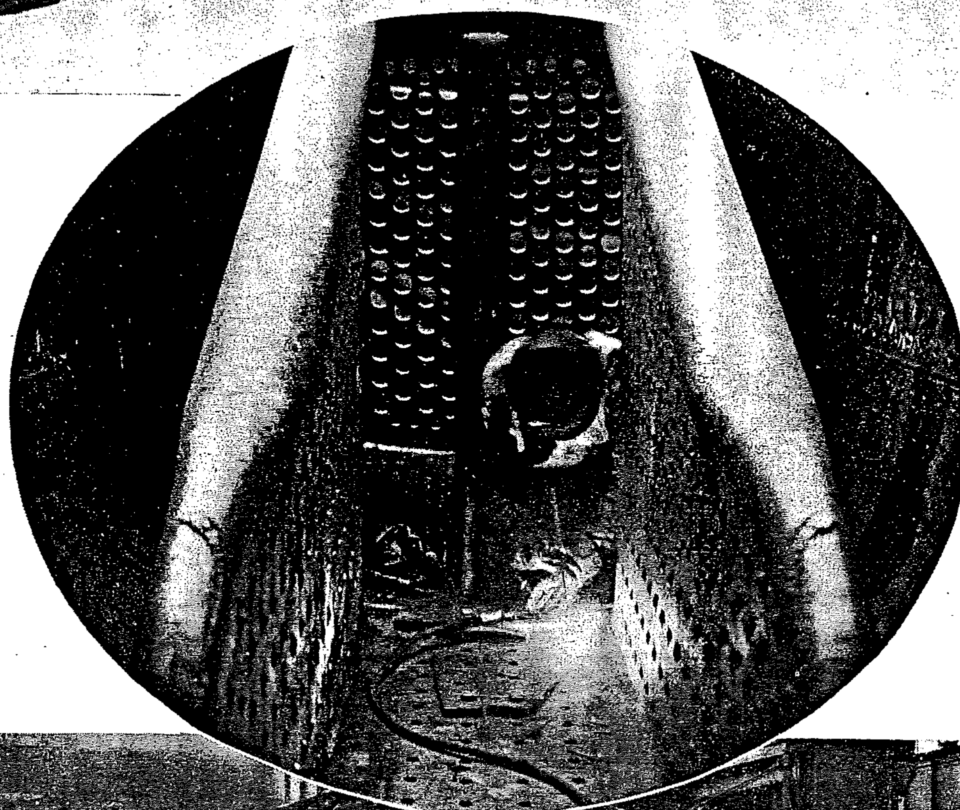
(Right) Combustion chamber firebox with corrugated sides sheets



(Below) Boiler barrel with wrapper sheet in place

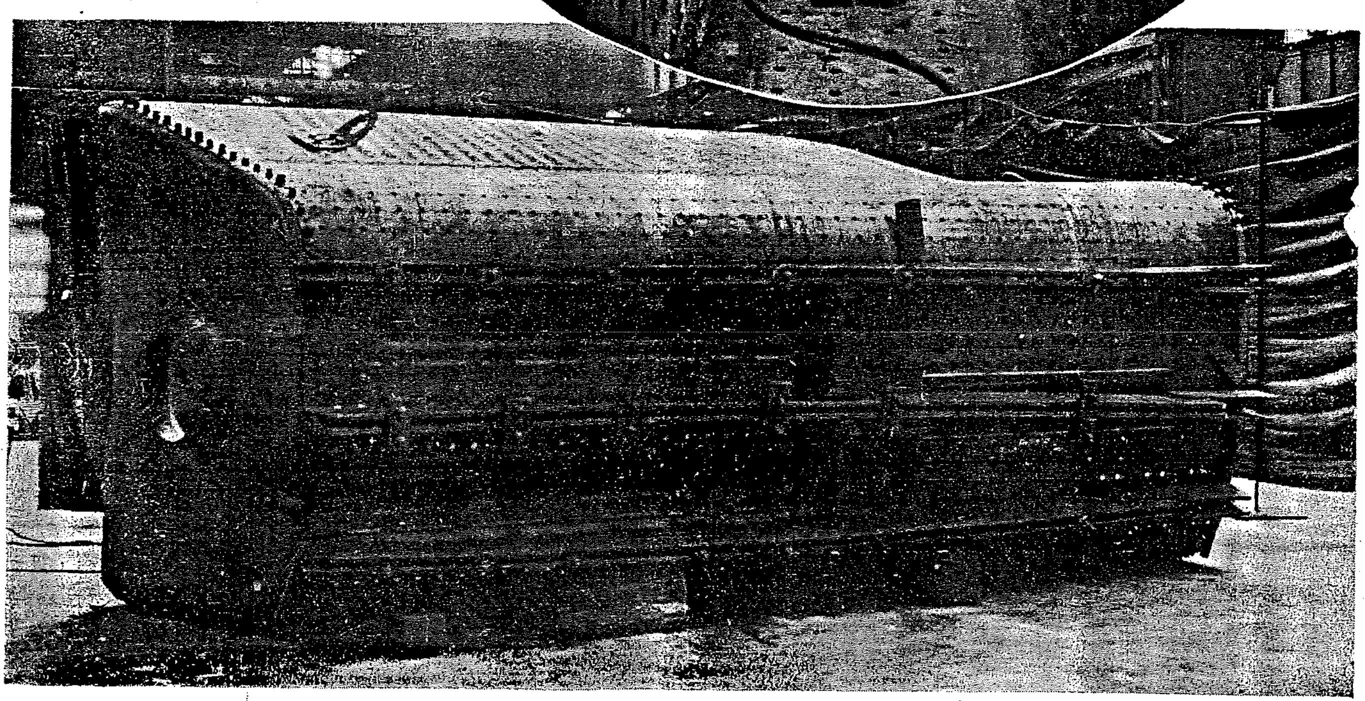


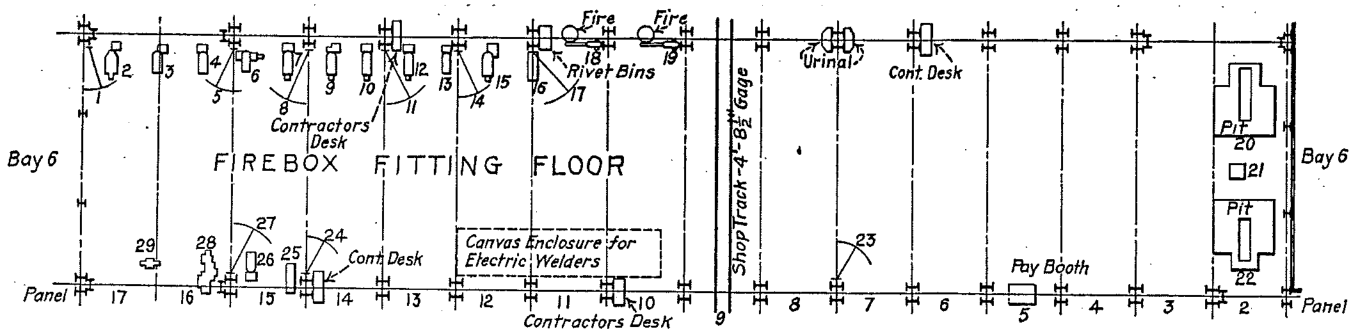
(Above) Completely fabricated small fireboxes



(Right) Welding the fireside of the crown sheet syphon seams

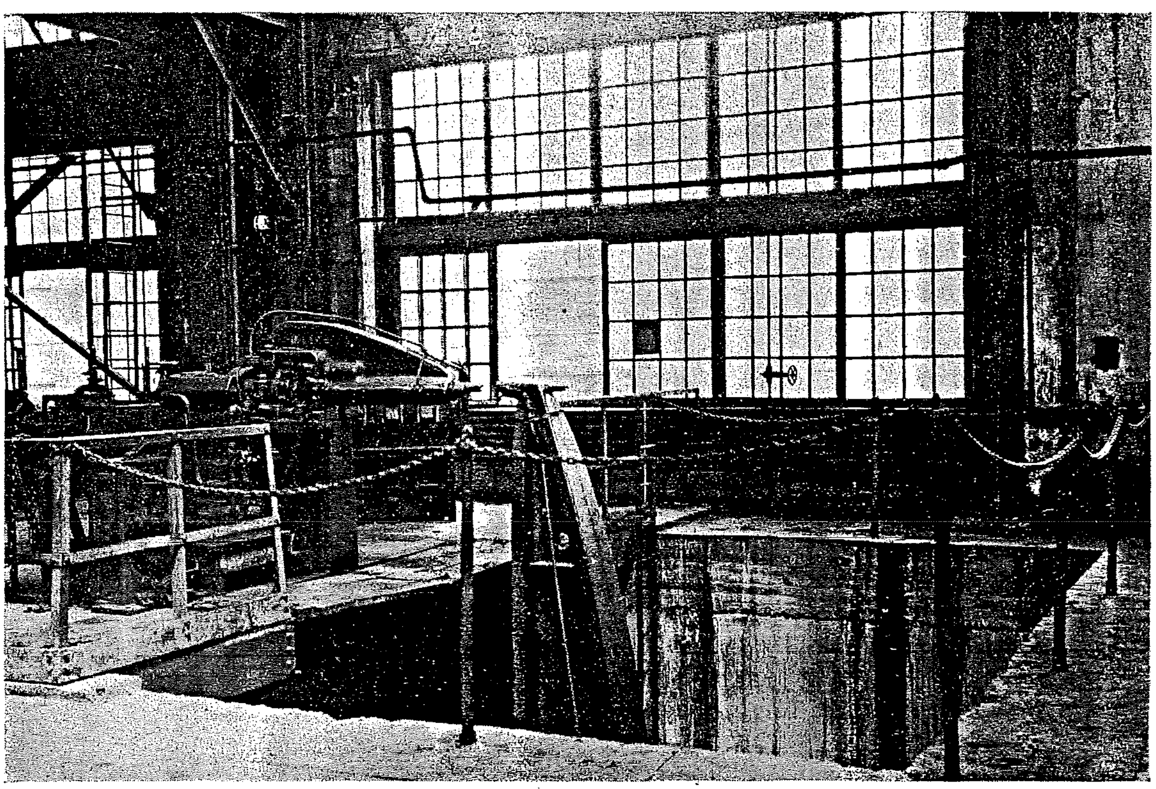
(Below) Arrangement of strongbacks to prevent crown sheet sag during welding





Machinery located on the firebox-fitting floor in the upper section of bay No. 6

1.—Baldwin 1½-ton hand jib crane, having a 14-foot 6-inch reach.
2.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
3.—Harrington 48-inch radial drill, motor on separate stand, belt drive.
4.—Harrington 48-inch radial drill, motor on machine, direct drive.
5.—Baldwin 3-ton hand jib crane, having a 13-foot 9-inch reach.
6.—Harrington 48-inch radial drill, motor on machine, direct drive.
7.—Harrington 60-inch radial drill, motor on machine, direct drive.
8.—Baldwin 3-ton hand jib crane, having a 17-foot 9-inch reach.
9.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
10.—Harrington 60-inch radial drill, motor on machine, direct drive.
11.—Baldwin 3-ton hand jib crane, having a 17-foot 9-inch reach.
12.—Harrington 60-inch radial drill, motor on machine, direct drive.
13.—R. H. Barr 52-inch reaming machine, motor on separate stand, belt drive.
14.—Baldwin 1½-ton hand jib crane, having a 15-foot 6-inch reach.
15.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
16.—Baldwin 1¼-inch horizontal drill press, motor on separate stand, belt drive.
17.—Baldwin 3-ton hand jib crane, having a 17-foot reach.
18.—Sturtevant No. 6 blower, motor on bracket, on building column, belt drive.
19.—Sturtevant No. 5 blower, motor on bracket, on building column, belt drive.
20.—Sellers 74 to 23-ton hydraulic bull riveter, having a 16-foot 8-inch stake.
21.—Baldwin 18-inch die dresser, motor on bracket, on building column, belt drive.
22.—Bement 162 to 54-ton hydraulic bull riveter, having a 17-foot 1-inch stake.
23.—Baldwin 3-ton hand jib crane, having a 12-foot reach.
24.—Baldwin 1-ton hand jib crane, having a 14-foot 6-inch reach.
25.—Baldwin 1¼-inch horizontal drill press, motor on separate stand, belt drive.
26.—Harrington 48-inch radial drill, motor on machine, direct drive.
27.—Baldwin 1½-ton hand jib crane, having a 15-foot 8-inch reach.
28.—Baldwin ⅞-inch hole, ¾-inch plate, horizontal punch, motor on machine, direct drive.
29.—Baldwin fire door hole facer, motor on separate stand, belt drive.



Sellers bull riveter with 16-foot pit for use in firebox fabrication are not drilled until the firebox is finally assembled on the finishing floor. The same is true in the case of the throat sheet rivet holes adjacent to the mud ring. Several tack holes, however, are drilled at convenient locations, these being placed in exact alinement with the staybolt holes. These tack holes are laid out at the time of the sheet layout and enable the firebox fitting gang to bolt the various sheets to the mudring in correct position.

After the throat sheet is bolted up, it is either welded or reamed and riveted to the crown sheet, depending upon the requirement set forth in the boiler plans.

The back tube sheet which has previously been fabricated, is bolted in place with the crown and sides sheet. As is the practice at The Baldwin Locomotive Works, every other rivet hole is bolted in order to eliminate any slack that might be present when the assembly goes to the bull riveters. After the seam between the tube sheet and crown and sides sheet is tried with a thin feeler gage to assure a close fit, the rivet holes are reamed out by hand-pneumatic reamers. After reaming out alternate holes, the bolts are changed to these holes and the other holes reamed. After reaming, the tube sheet is bull riveted in either of the two bull riveters located in panel 2 of bay No. 6. Where the tube sheets are scarfed, however, hand riveting is employed.

The staybolt holes in the door sheet are drilled on one of the vertical drill presses while the flange rivet holes are drilled on a horizontal drill press, these locations having been laid out before receipt of the sheet by the firebox fitting department.

The door sheet is usually the last sheet to be applied, this being bolted in place to the mudring and crown and sides sheet. When this is done, the backhead of the boiler is temporarily pinned to the mudring in order to line up and mark off the door hole in both the door sheet and backhead. In case the door hole is found out of alinement, the flange is heated with an oxy-acetylene torch and shaped to the correct alinement by means of flatter tools. The door sheet is usually hand riveted to the crown sheet.

The firebox is then transferred to the finishing floor in bays No. 1, 2, 3, & 4, where the last rivets are put in by hand. When this has been done, the seams and rivets are caulked and the firebox is ready for fitting to the boiler proper.

Thermic syphons when called for in boiler construction, are applied in bay No. 6, but are not applied until the firebox is assembled and partially tied up with rivets to keep the crown sheet from creeping.

The syphons when received by the Baldwin Locomotive Company are completely fabricated ready for assembly as they arrive from the syphon manufacturing company. These are examined by the shop inspectors prior to their use in the boilers.

In ordinary fireboxes, syphons may be fitted with a lap weld or a butt weld. Riveting, however, is never used. The methods employed in applying syphons to ordinary fireboxes will be understood from the description given below for the application of syphons to combustion chamber boilers. The following steps are taken in such application.

The combustion chamber syphon is first lined up and chipped to card size after which the crown sheet is lined up, cut and chipped for the combustion chamber syphon only. The syphon is then applied in the chamber and tack welded.

Every effort is made to preserve the straightness of the crown sheet and to this end, special strongbacks are applied. It is found that best results are obtained by using strongbacks which stretch the entire length of the crown and rest on spacers lying directly on the flange of the tube and door sheets. The strongbacks each consist of two pieces of one-inch plate, 16 feet long, straight on the bottom and curved on the top with a height of 12 inches at the top and seven inches at the ends. The two plates are joined with a number of staybolts holding the plates at sufficient distance to allow the passage of the holding-on bolts between the plates.

Two of these strongbacks are applied on the outside to hold the crown and then the inside combustion chamber syphon seam is welded completely.

The rear syphons are then tried out in the firebox and trimmed to size after which the crown sheet is cut and chipped for the rear syphons. The rear syphons are applied to the firebox, held with clamps and then tack welded.

With three strongbacks again in place running the full length of the firebox, the crown sheet is drawn up from ¼-inch to ⅜-inch above normal to prevent sagging of the sheet. Experience has shown that this is necessary to give the straightest crown sheet after the job is finished.

After the strongbacks have been applied, one layer of metal is welded between the bolts or clamps. The clamps are then moved and the weld is made continuous, finishing the inside welding.

Similarly to the welding of the crown and sides sheets, all welds are gouged out on the waterside or back of the crown sheet. These welds are then re-enforced by welding beads on the waterside of the sheet.

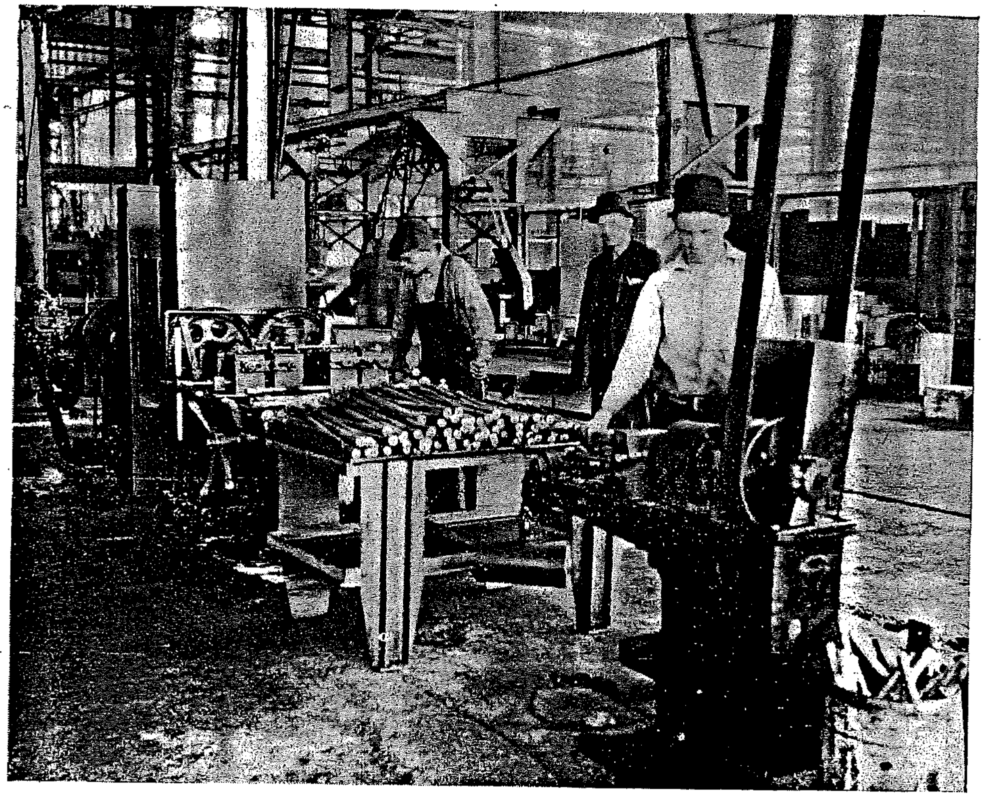
The syphon necks are set up to the combustion chamber and throat sheet and are welded. The strongbacks are then removed and the staybolt holes in the syphon flanges are drilled, after which the syphon necks are chipped to the correct clearance, thereby completing the syphon installation.

All electric welding in the boiler shop at the Baldwin Works, while done in different sections, comes under the direct supervision of the firebox department. Individual Lincoln motor-generator sets on portable trucks are employed and appropriate outlets, into which the welding set may be plugged, are distributed at strategic points throughout the shop. Small areas are curtained off with canvas to protect the eyesight of the workmen in the shop. Coated wire electrodes are generally used.

Future issues of THE BOILER MAKER will contain additional articles dealing with the layout, equipment and methods employed at the Baldwin Locomotive Works. These articles will cover the fitting of shells, manufacture of staybolts, and the completion of the locomotive boiler prior to its shipment to the erecting shop.

RIVETERS AND PRESSES.—This is the title of a catalogue recently published by the Hanna Engineering Works, 1765 Elston avenue, Chicago, Ill. Complete specifications, workings, drawings and numerous illustrations of 18 types of riveters and pneumatic presses are described. Among these riveters are the Standard rapid-speed riveter, the deep gap riveter, the turret riveter, the yolk riveter, and the push type riveter. High-speed pneumatic presses, portable presses, and special size gap riveters are also included in this description.

The Central Iron & Steel Company, Harrisburg, Pa. announces a change in the address of their Boston office which, effective immediately, will be Statler Office building, Park Square, Boston, Mass.



Rounding the points and cutting the heads of crown staybolts

Fabricating Staybolts

Methods and equipment employed in the staybolt machine shop of The Baldwin Locomotive Works

THE boiler shop layout of the Baldwin locomotive Works, Eddystone, Pa., provides for a definite and uninterrupted flow of materials through the entire building. The passage of raw material, fabricated parts, and assemblies in one direction, permits the employment of production methods with the greatest economy and the least transportation of material. While the flow of material moves from right to left from bay No. 13 towards bay No. 1, the minor flow in each bay moves toward panel 9, where the shop track carries the ~~major~~ flow through the bays. Located in the lower sections of bays Nos. 3 and 4 where the resulting products may be fed to the finished floor in the upper section of those bays, is the staybolt shop. From this location, the material enters the active boiler assembly at the point where it is required, thereby eliminating lost motion and unnecessary transportation of material.

This department is divided into two sections covering both fabrication and storage. The machine shop is located in bay No. 4 and extends between panels 18 and 25, covering an area of 15,360 square feet, and the storeroom in bay No. 3 occupies 13,440 square feet between panels 18 and 24. A spur track enters the end of bay No. 4 in panel 25.

The equipment in the machine shop includes 53 power-driven machine tools specially adapted to the process of staybolt manufacture. Tote pans and an Elwell-Parker lift truck with 6 low and 4 high skids serve for transporting material in the department.

All types of staybolts are machined at the Baldwin works, their fabrication being completed on machines set up for each special process. Iron is generally employed for staybolt manufacture but foreign practice frequently specifies copper or bronze.

In the case of ordinary waterspace staybolts, the bar stock is received in panel 25 and placed in racks located in panel 24. In the latter panel is located a Hilles & Jones 1¼-inch bar shear in which the bar stock is cut to size with a ⅛-inch allowance for rounding.

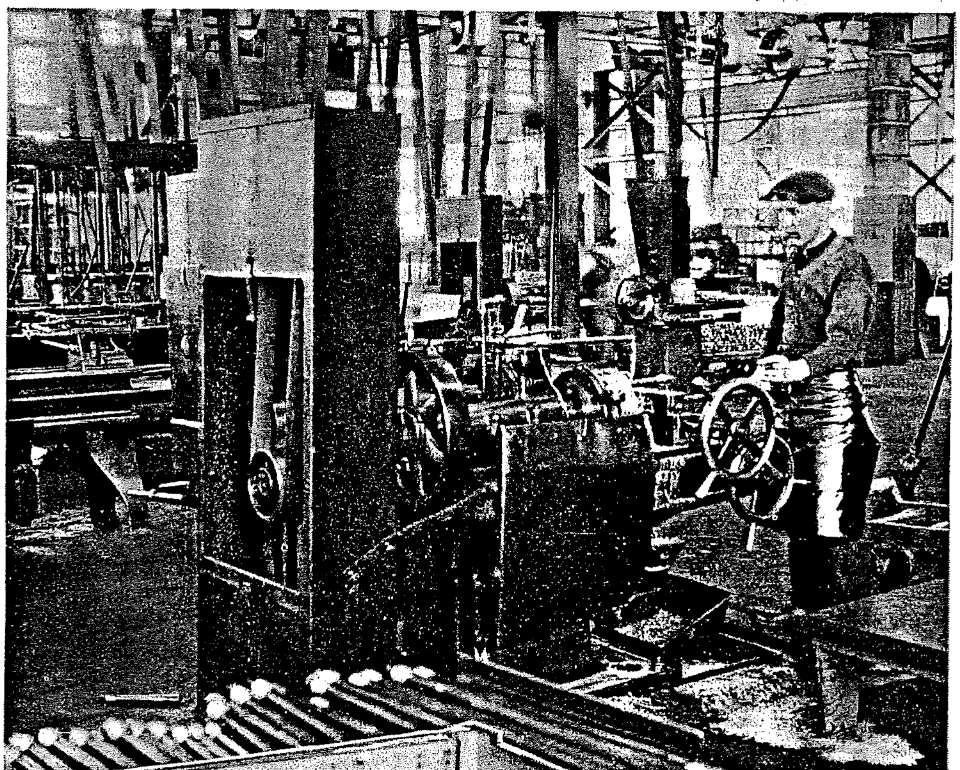
From this machine the cut bars are sent to one of two centering machines in panel 23 where the center is spotted on one or both ends, if specified.

Continuing in the line of progress, the stock next goes to one of the two 4-spindle drill presses in panel No. 23 where the telltale hole is drilled. This hole is 7/32 inch in diameter and is drilled to a depth of about 1¾ inches. The bars are held in the machine by means of a chuck, which holds work vertical and the telltale hole is drilled, the depth being estimated by the position of the drill in the work. After drilling, the finished work is dropped from the machine when the screw in the chuck is loosened. The bolts or bars are then collected in tote pans and moved along the line to one of two squaring machines in panel 22.

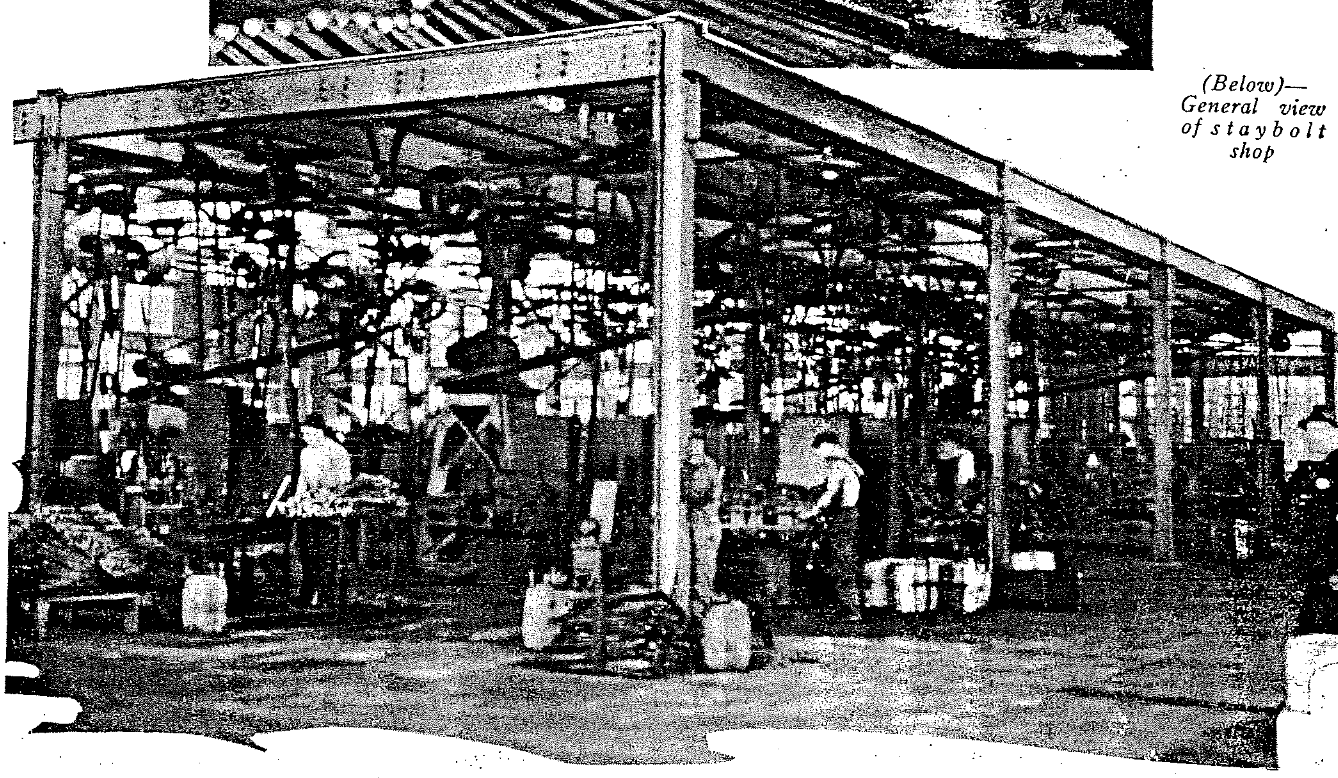
The two squaring presses were manufactured by the Ferracute Machine Company, Bridgeton, N. J., and the larger machine has a speed of 36 strokes per minute. The jaws of the press are fitted with 90-degree V-shaped dies which shape the bar stock to the required dimensions for the assembling wrench. The length of square on the staybolts is limited to ¾ or ⅞ inch and this is maintained by the insertion of a small piece of bar stock in the jaws of the press at the proper distance from the face of the jaws.

After the staybolt has been squared, the opposite end of the stock is rounded in a Pratt & Whitney double rounder located in panel 22. This machine has two horizontal spindles, the cutter being mounted in the rotating head. A carriage shaped to take the square end of the bolt may be moved forward and back by means of a foot pedal. This forces the stay into the rotating head and the end of the bolt is given a curvature of 1-inch radius.

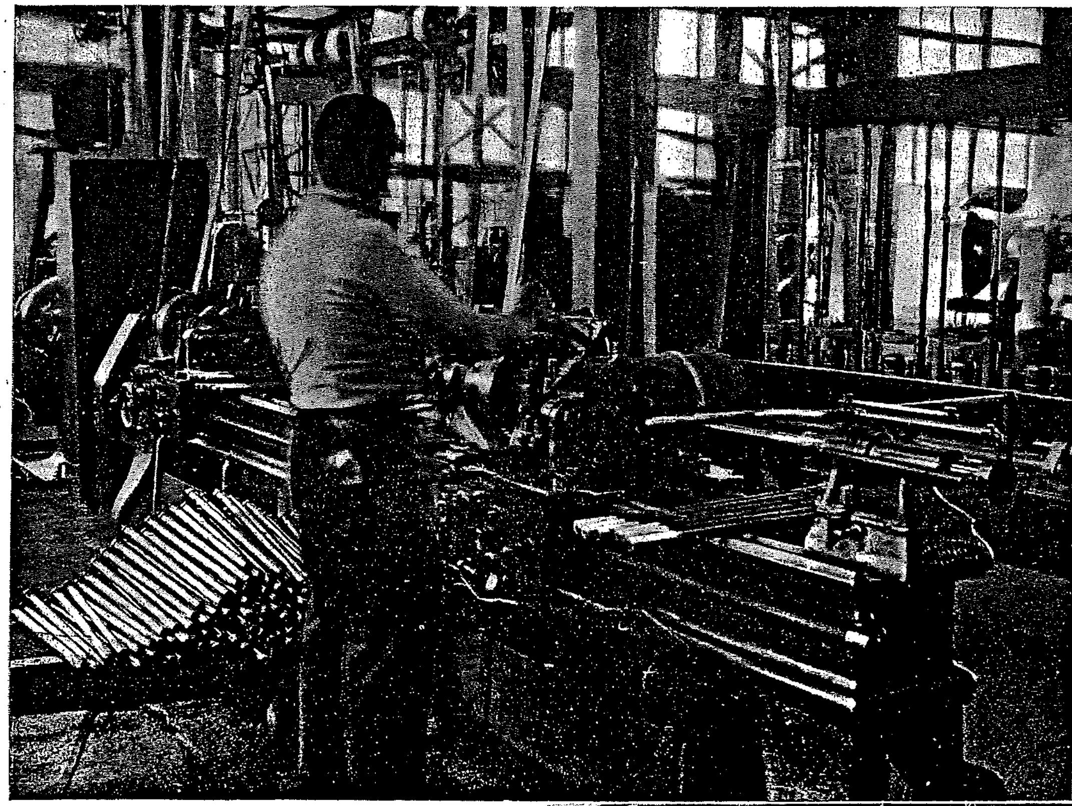
Two new Landis machines thread the staybolts after the bolt is rounded. These machines, manufactured by the Landis Machine Company, Waynesboro, Pa., are



Threading the points of crown staybolts

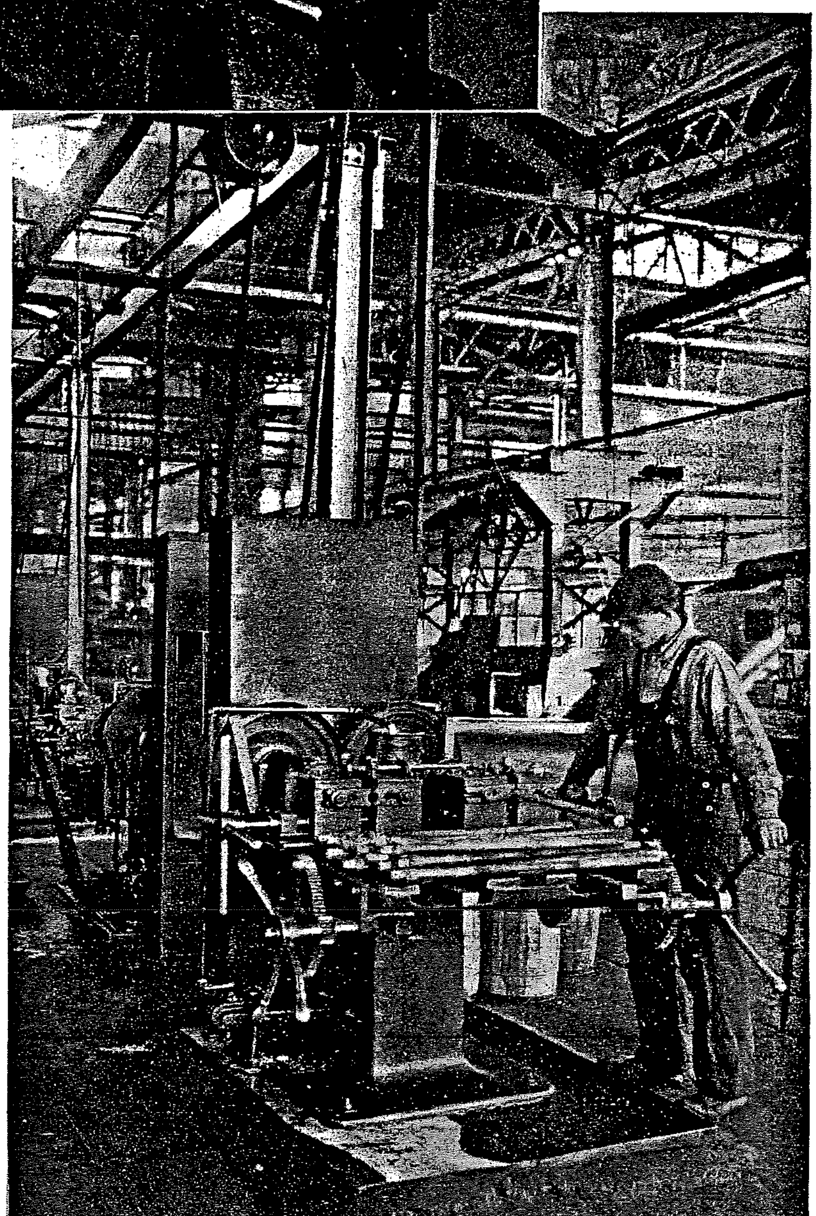


(Below)—General view of staybolt shop



Threading the taper and cutting head grooves in crown staybolts

(Below) — Roughing out the crown staybolt taper head

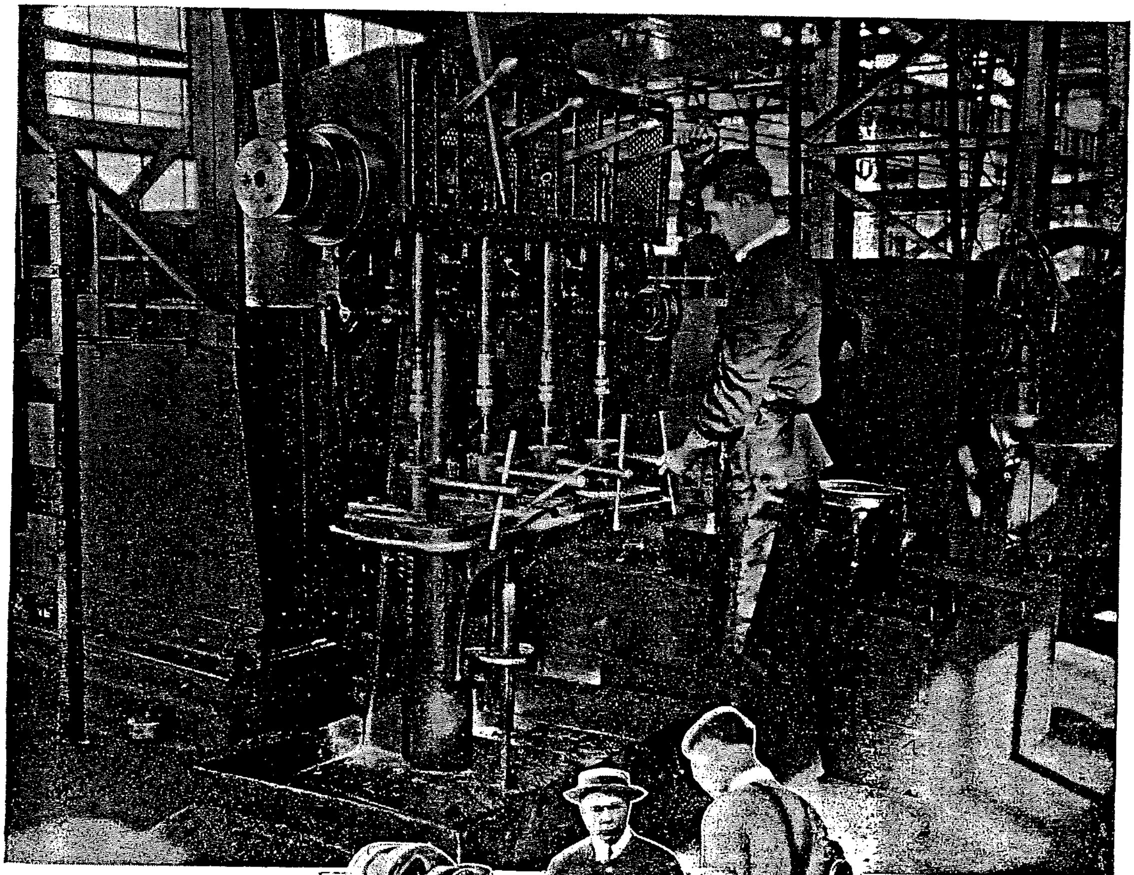


motor-driven, self-contained with lead screw and automatic cut-off. Each machine has two spindles and the two machines are run by one operator. These machines run at a maximum speed of 137 revolutions per minute and now handle the work formerly done on the six-spindle special machine. In these machines, the staybolts are threaded the entire length, four at a time.

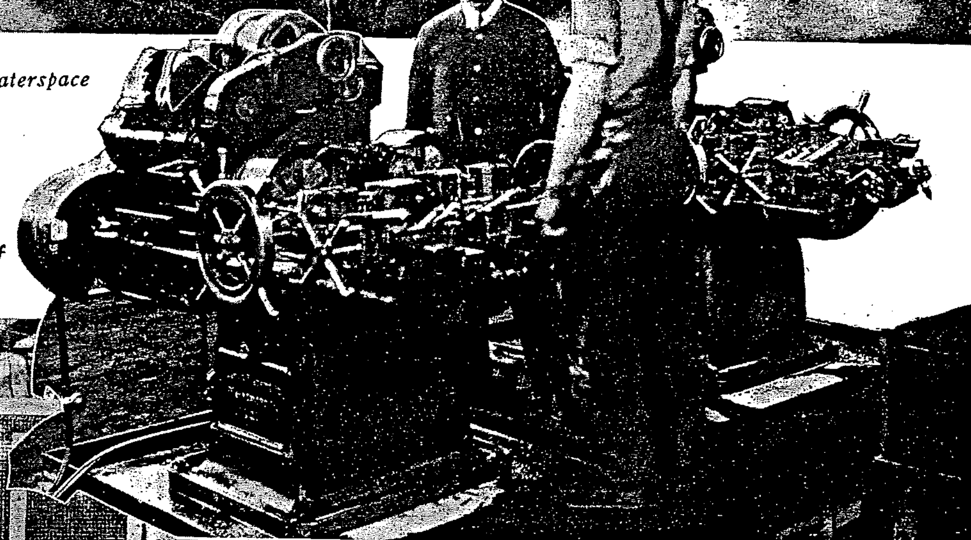
The final operation on waterspace staybolts before shipping them to the storeroom, is the turning down of the middle portion of the bolt. This work is done in one of four staybolt-cutting machines located in panel 19. In the revolving head of the machine is a set of jaws to take the square head of the staybolt. Into this the staybolt is fitted and given a rotary motion. The carriage is moved toward the head until a stop limits the travel thus gaging the depth of threaded length at the bolt head. A lever on the carriage allows a threaded portion on the carriage to engage with the bolt thread. This gives the carriage an outward movement. A ⅝-inch width cutter fitted in the carriage cuts the middle portion of the bolt to the proper depth and its travel is caused by that of the carriage. The length of thread at the end of the bolt is judged by marks on the carriage.

The waterspace staybolts are then taken to the storeroom where they are stored in bins according to size.

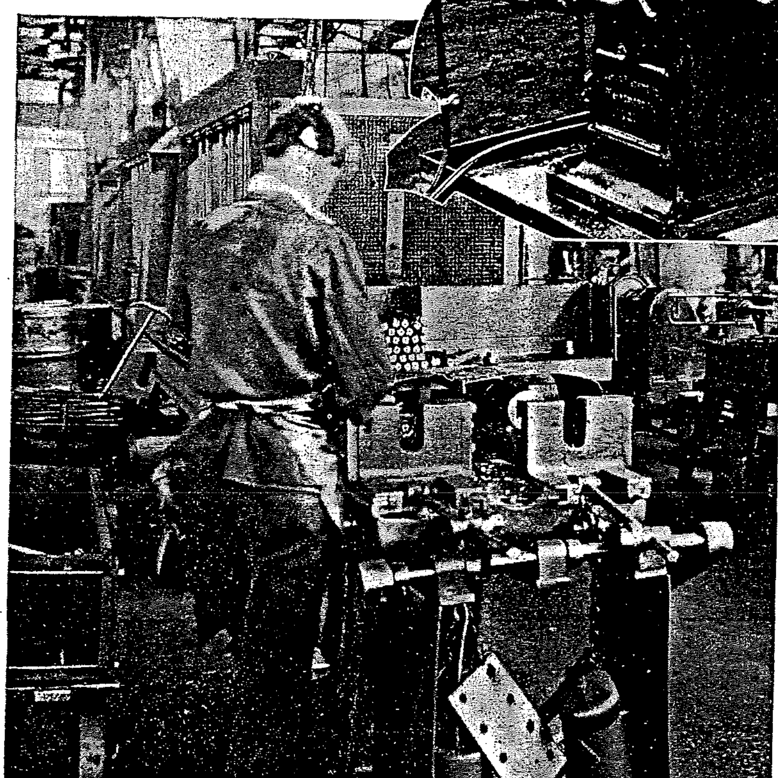
Hollow staybolts are fabricated similar to waterspace staybolts except that the bar stock is received with a 7/32-inch hole drilled the entire length and the first



Drilling the telltale hole in waterspace staybolts



(Right)—Threading the waterspace staybolts



(Below)—Rounding the ends of waterspace staybolts

centering and telltale hole-drilling operations are omitted. These stays, as the ordinary and waterspace stays, may be supplied with or without the reduced center area, whichever may be specified.

Radial staybolts of the buttonhead type or staybolts with oil-burning type heads are fabricated in a similar manner. The buttonhead type is generally made with a taper of ¾ inch in 12 inches in the threaded portion under the head. The oil-burning head has a taper of 1½ inches in 12 inches in the screw head. In some cases, however, a straight-threaded radial staybolt is used without a taper at the head.

The bar stock for radial staybolts is received in panel 24 of this department as a forging, this having been made in the black-