March 28, 1939. J. FLETCHER ET AL 2,152,138

HEAT TREATING EQUIPMENT

Filed April 20, 1937 5 Sheets-Sheet 1

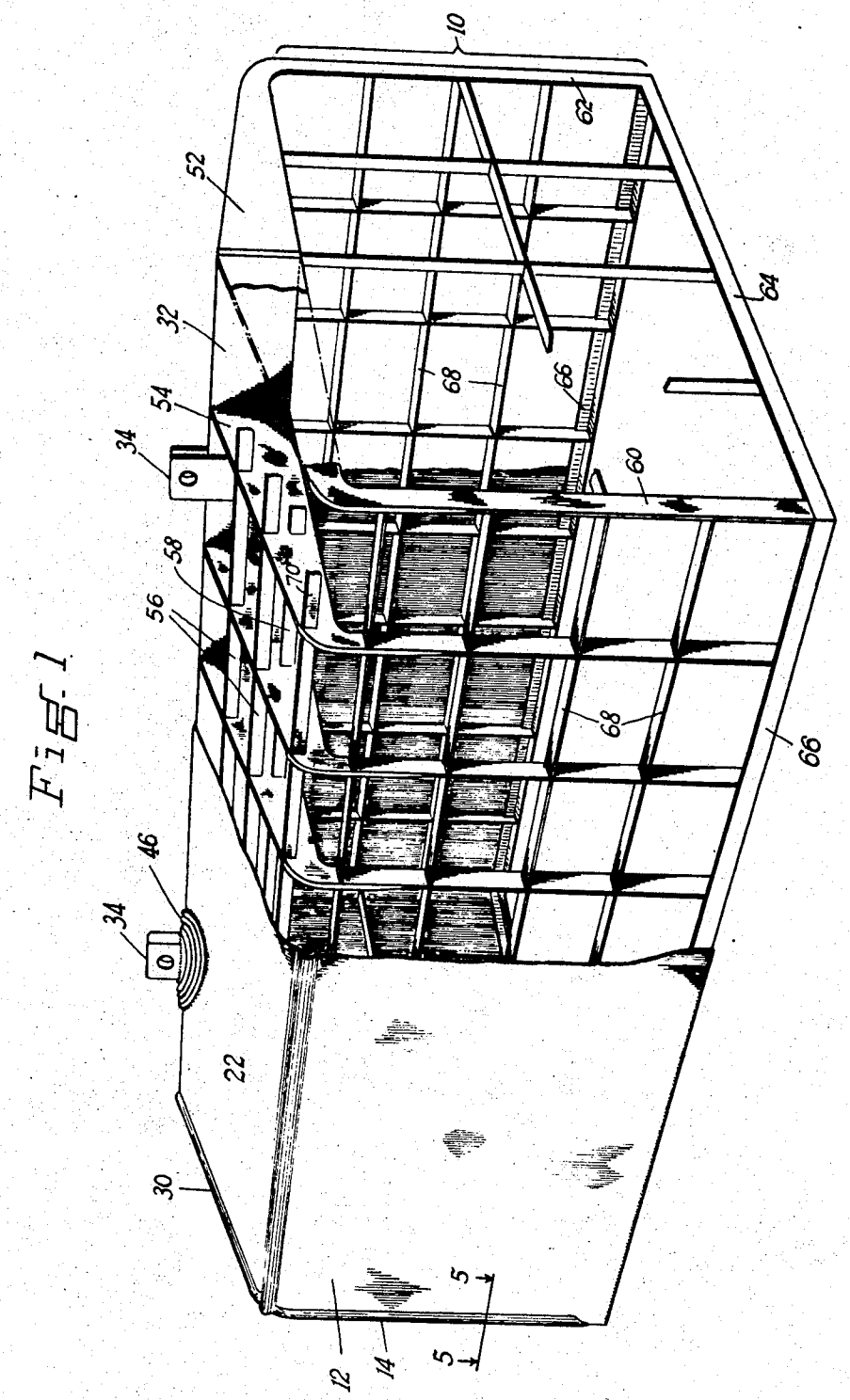



Fig. 1

INVENTORS
James Fletcher &
Earl E. Schoessow

BY Dewey R. Faucett
ATTORNEY.

March 28, 1939. J. FLETCHER ET AL 2,152,138

HEAT TREATING EQUIPMENT

Filed April 20, 1937 5 Sheets-Sheet 2

Fig. 4

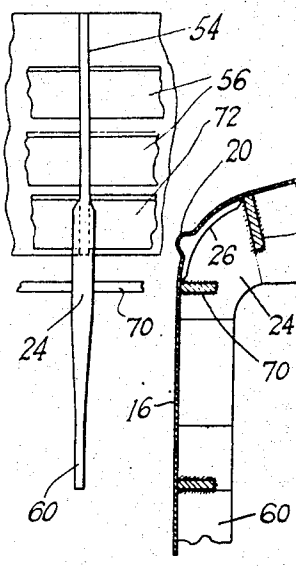



Fig. 3

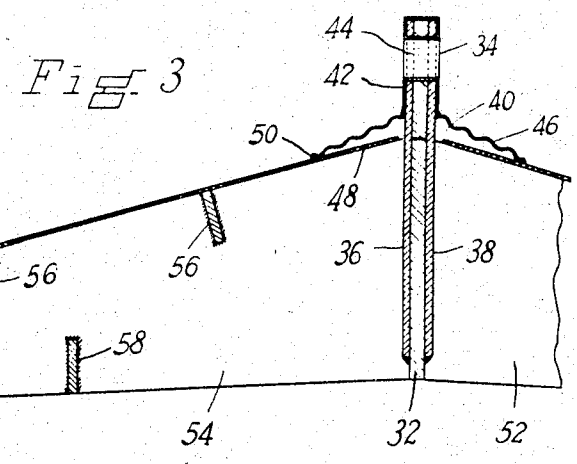



Fig. 7

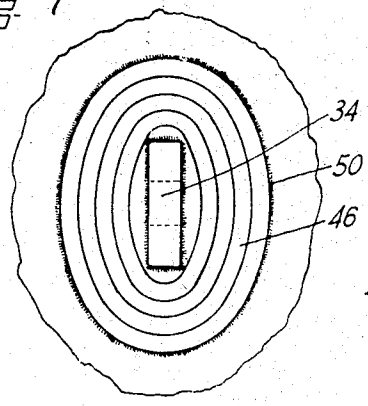



Fig. 5

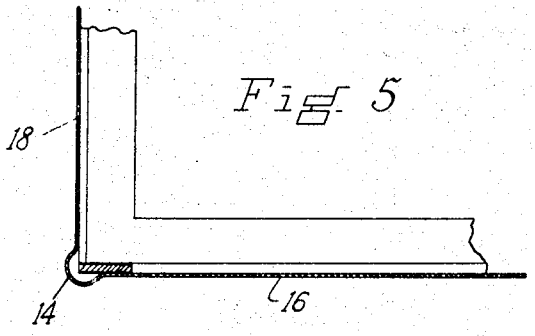



Fig. 6

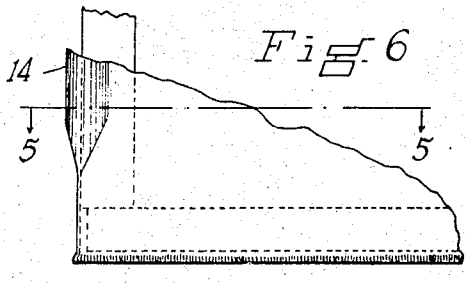
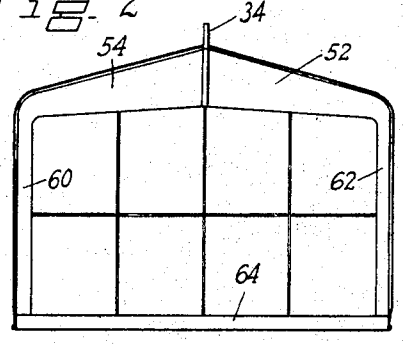



Fig. 2




INVENTORS
James Fletcher &
Earl E. Schoessow

BY

ATTORNEY.

March 28, 1939. J. FLETCHER ET AL 2,152,138

HEAT TREATING EQUIPMENT

Filed April 20, 1937 5 Sheets-Sheet 3

Fig. 10

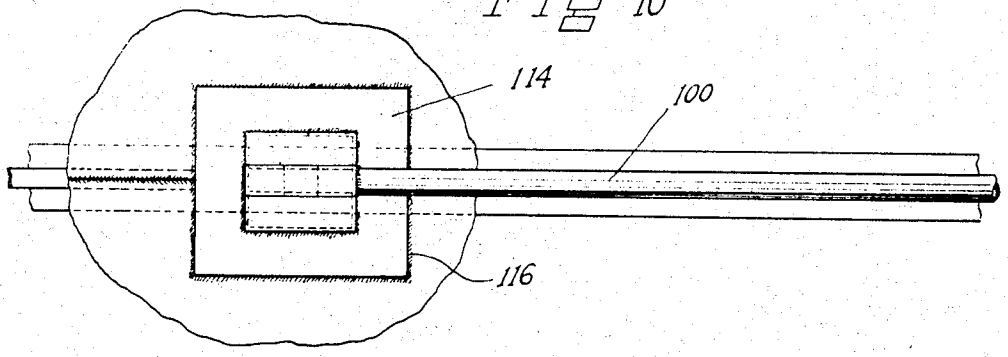



Fig. 11

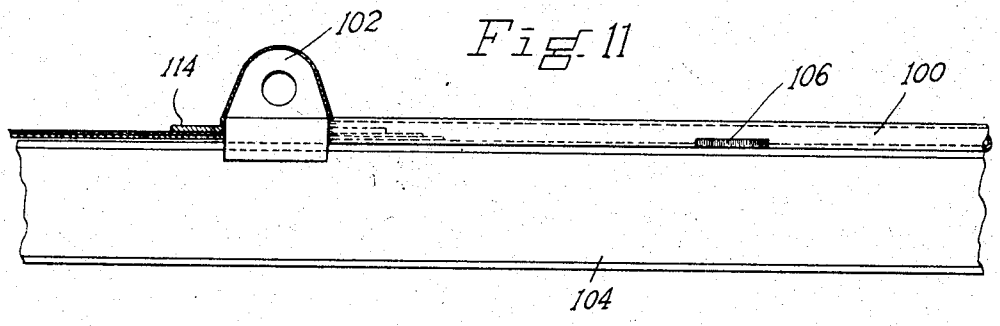



Fig. 8

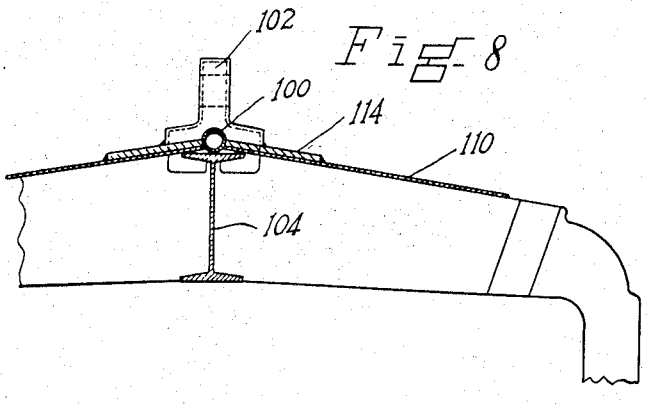
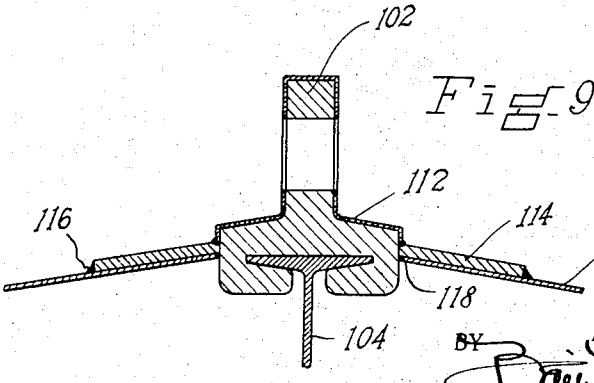



Fig. 9




INVENTORS
James Fletcher
Earl E. Schoessow

BY Percy R. Hancock
ATTORNEY.

March 28, 1939. J. FLETCHER ET AL 2,152,138

HEAT TREATING EQUIPMENT

Filed April 20, 1937 5 Sheets-Sheet 4

Fig. 15

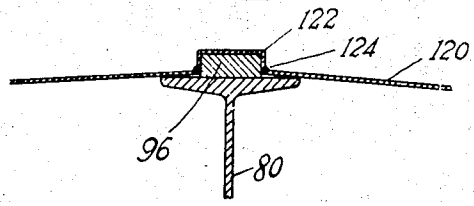



Fig. 13

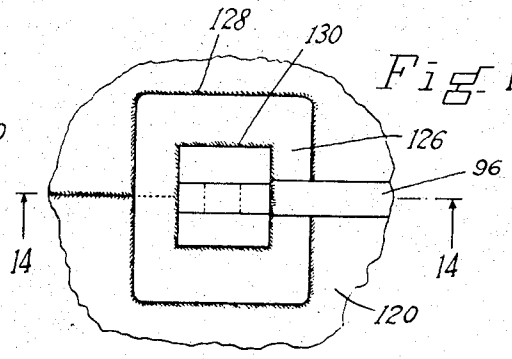



Fig. 14

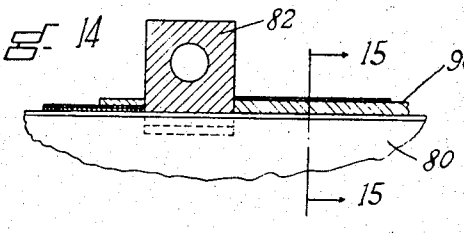
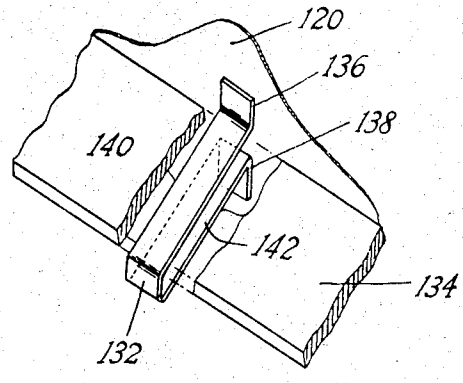



Fig. 12




Fig. 16




INVENTORS
James Fletcher
Earl E. Schoessow

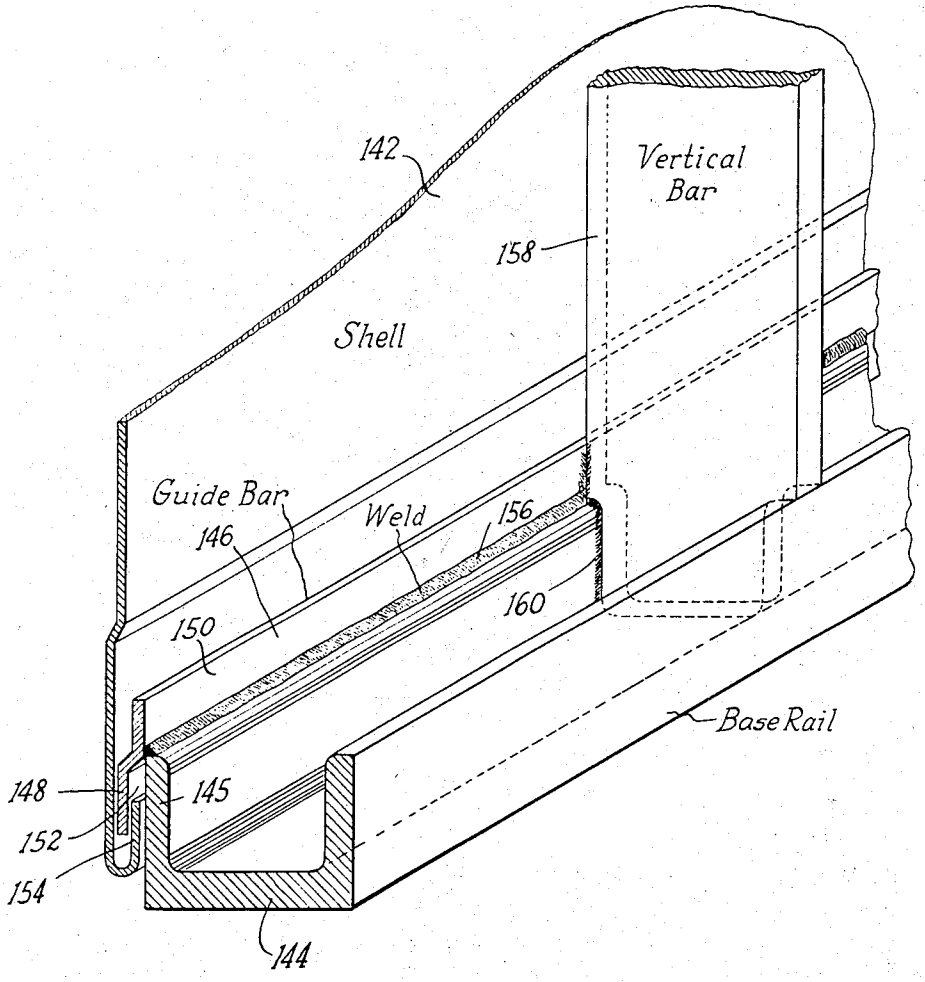
BY Benj. R. Newcomb
ATTORNEY.

March 28, 1939. J. FLETCHER ET AL 2,152,138

HEAT TREATING EQUIPMENT

Filed April 20, 1937 5 Sheets-Sheet 5

Fig. 17




INVENTORS
James Fletcher
Earl E. Schoessow

BY
ATTORNEY.

Patented Mar. 28, 1939 2,152,138

# UNITED STATES PATENT OFFICE

2,152,138

## HEAT TREATING EQUIPMENT

James Fletcher, Akron, and Earl E. Schoessow, Barberton, Ohio, assignors to The Babcock & Wilcox Company, Newark, N. J., a corporation of New Jersey

Application April 20, 1937, Serial No. 137,934

12 Claims. (Cl. 263—49)

This invention relates to improvements in devices used in metal treating. It is more particularly concerned with improved annealing hoods or boxes adapted for advantageous use in the annealing of steel sheets of considerable width and length.

In annealing operations such as are carried on in the steel sheet and plate industry, it is the usual practice to stack the sheets upon a furnace floor and then place a heavy cast metal cover over the stack of sheets. The lower edges of the cover rest upon the flat bottom of the furnace or the bottom of an annealing base. Appropriate sealing material, such as sand, is placed against the meeting parts of the cover or shell, and the furnace floor or the bottom of the box, to prevent oxidation of the sheets or other materials which are to be annealed. It is important, during such annealing operations that the materials treated be prevented from oxidation effects to a maximum degree.

Such cast metal covers as have been used in these operations have been of excessive size and weight, some of them weighing as much as 30,000 pounds. They are expensive to manufacture and difficult to handle. In the annealing operations they become coated with scale which increases in thickness as the cover or shell is continued in use. This increases the resistance of the annealing cover or shell to the transfer of heat and, consequently, lengthens the time for the annealing operation. It is an object of this invention to overcome these difficulties.

One object of the invention is to provide an annealing box which will have an exceedingly low weight because of the provision of a shell of thin sheet metal which has the property of being highly resistant to heat. It is a purpose of this invention to so support such a shell that it will not warp excessively out of shape, but is free to expand and contract within necessary limits.

Other objects of the invention will appear as the accompanying description proceeds.

For the purpose of illustrating the invention, reference will be made in the following description to preferred embodiments which are shown in the accompanying drawings.

In the drawings:

Fig. 1 is a view in the nature of a perspective view showing the illustrative annealing box with a part of the shell broken away to show the shell-supporting framework.

Fig. 2 is a view in the nature of a diagrammatic view, taken on the small scale and showing the transverse arches, as well as the upright and transverse frame members at the end of the framework.

Fig. 3 is a vertical section through a portion of the annealing box near its top, showing the relation of the shell to the framework along the edges of the roof and at the lifting lugs.

Fig. 4 is a view in the nature of a side elevation of a part of the structure shown in Fig. 3.

Fig. 5 is a view in the nature of a horizontal section through a corner of the shell and a corner of the interior framework, taken on the line 5—5 of Fig. 6.

Fig. 6 is a view in the nature of a partial side elevation showing the relationship of the shell to the frame members at a bottom corner of the box.

Fig. 7 is a partial plan showing the relationship of the alloy sealing pads to the lifting lugs.

Fig. 8 is a partial vertical section of a part of another embodiment of the invention.

Fig. 9 is a partial vertical section, on an enlarged scale, of the embodiment indicated in Figs. 8, 10, and 11. This view is taken on line 9—9 of Fig. 10 of the drawings.

Fig. 10 is a plan showing a part of the roof of the shell of the Fig. 8 embodiment broken away.

Fig. 11 is a view in the nature of a vertical section taken on a plane at right angles to the plane of Fig. 8.

Fig. 12 is a view in the nature of an isometric drawing showing the relation of the lifting lugs to the main beam and the connector secured to the lugs and the beam.

Fig. 13 is a partial plan of the embodiment including the structure indicated in Fig. 12.

Fig. 14 is a partial vertical section taken on a plane indicated by the line 14—14 of Fig. 13.

Fig. 15 is a partial vertical section taken on a plane indicated by the section line 15—15 of Fig. 14.

Fig. 16 is a detailed view in the nature of an isometric view showing how the shell may be tied to the uprights and horizontals of the frame at various positions while still permitting the shell to move freely relative to the components of the framework.

Fig. 17 is an isometric view indicating a manner in which a modified form of the annealing equipment may be made.

The illustrative annealing apparatus includes a metal framework 10 of relatively light weight, and a sheet metal shell 12. The latter constitutes a substantially integral cover enclosing the sides, ends, and top of the framework. For the purpose of effecting high rates of heat transfer and for

the purpose of preventing the oxidation of the metal undergoing heat treatment, the shell is preferably gas tight. Furthermore, and in the interest of economy of heat treating operations, the metal of the shell is very thin. The shell is not self-supporting. It requires the support of the framework to maintain it in the desired form during the use of the apparatus.

Preferably, the shell 12 is secured to the framework 10 only around the perimeter of the latter and at its base. Such securement is preferably effected by welding, and such securement is necessary in order that the annealing box may be capable of being transported into and out of its operative position, with facility. In the use of the illustrative equipment, metal sheets to be heat treated are stacked on a furnace floor and an annealing box is lowered over the stack of sheets. Sand or other sealing material is placed around the lower edges of the box, and the furnace enclosing the box is prepared for operation. Its burners are turned on and impinging flames contact the shell of the box. The thin shell begins to expand, and since it is in a large part free to move independently of the framework, little or no strain is set up in the framework by the expansion of the shell. The shell expands in all directions, thus leaving the frame to approach the annealing temperatures of the charge without appreciable restriction. As the framework comes up to annealing temperature, it takes up the differential expansion and remains at annealing temperatures during the heating of the charge.

After the annealing operation has been carried on for sufficient length of time, the box is withdrawn from the furnace. Air at atmospheric temperatures immediately contacts with the shell, and inasmuch as the latter is relatively thin, little warpage results from the rapid cooling of the outer face of the shell while the inner face of the shell remains at temperatures several hundred degrees higher. As the shell cools down it contracts more rapidly than the supporting framework. Hence, provision for the consequent relative movements of the shell and the framework must be made. To avoid high strains in the shell during this stage of the use of the equipment, some portions of the shell are bent or bowed to provide suitable clearances at either end of the box, and preferably, along the junctures of the roof portion of the shell with its sides and ends. Such an upright bowed portion is shown at 14 in Fig. 5 at the juncture of the side wall 16 and the end wall 18. In Fig. 3 there is shown a horizontal bulge or bowed portion 20 at the junction of the roof portion 22 and the side wall 16. The structure of the framework fillets 24, adjacent the bowed portions 20 is also such as to add to the desired clearances. These fillets are recessed away from the bowed portions 20, as clearly indicated at 26. Along the junctures of the roof portion 22 with the end walls 18, the inclined inverted channels 30 are formed in the shell for similar clearance purposes.

The framework for the illustrative equipment includes a main beam 32 extending along the roof of the box. When the box is to be moved from one position to another, it is lifted by the attachment of some lifting means to lifting lugs indicated generally at 34. As shown, these lifting lugs consist of bars or plates 36 and 38 welded to the beam 32 on opposite sides thereof. They extend up through openings 40 in the shell and are preferably joined and enclosed at their upper ends by metal parts made of an alloy of high resisting properties. These parts include the cover 42, sleeve 44, and the corrugated pads 46. The latter are corrugated, and spaced from the roof of the shell parts 48 as shown in Fig. 3 of the drawings in order to afford sufficient clearance for relative movements of the shell and the framework under different temperature conditions. The pads 46 are preferably welded to the roof portions 48 by means of an endless weld 50.

The drawings indicate the cross beams 52 and 54 extending in opposite directions from the main beam 32, and at right angles thereto. These cross beams are maintained in their desired relationship by struts 56 and 58. The latter are preferably welded to the cross beams.

The roof of the box is supported by spaced uprights 60 and 62, and these uprights are maintained in their operative positions by base members 64 and 66 and struts 68, all of these parts being preferably united by welding.

Along the sides of the box the cross beams 52 are preferably joined to the uprights 60 and 62 by the recessed fillets 24. The latter are maintained in their operative positions by the struts 70 and 72.

As indicated in Fig. 4 of the drawings, the framework, and hence the entire box, is rigidified by constructing the fillets 24 of material which is somewhat thicker than the cross beams 54 and the uprights 60. Preferably, the ends of the fillets are tapered down to the thickness of the uprights and the cross beams for promoting effective welding of these parts together.

One important advantage of the illustrative annealing equipment over the heavy cast steel annealing boxes which have heretofore been used is that it takes a much shorter time to bring the illustrative box and its charge up to annealing temperature. The heating cycles of the annealing operation may, by the use of the illustrative equipment, be reduced as much as twenty-four hours. This also involves a material saving in the amount of fuel required in each annealing cycle. Also, because of the low weight of the illustrative equipment much less power is required to handle it, transporting it to and from its operative position.

The lifting lugs of the embodiment indicated in Figs. 12, 13, and 14 are arranged so as to slidably grip the upper flanges of the main beam 80. In this embodiment, the latter is, for lightness of construction, as well as for co-operation with the lifting lugs, in the form of an I-beam. The relation of the lifting lugs 82 and 84 to the beam 80 is particularly well shown in Fig. 12 of the drawings. The upper flange 86 of the beam 80 is received within opposed slots or grooves 88 and 90 of the lifting lugs. The latter may have their lower portions 92 and 94 bent back to form these grooves.

The connector 96 is positioned above the beam 80 and is parallel therewith, as shown. In Fig. 12 the connector is indicated as a bar rigidly connected at its ends to the lifting lugs 82 and 84. Intermediate its ends this bar is rigidly secured to the flange 86 of the bar 80, and this may be accomplished through the intermediacy of the weld 98. This construction prevents excessive stresses during the moving of the annealing equipment to and from its operative position, and prevents disruption of the shell by these moving operations. It also maintains the proper positioning of the lugs 82 and 84, during all thermal conditions.

The embodiment illustrated in Figs. 8, 10, and 11 of the drawings is somewhat similar to that indicated in Figs. 12, 13, and 14, but the former includes a tubular connector rigidly secured to lifting lugs 102 at its ends and welded at its midportion to the main beam 104, as indicated at 106. With this construction the shell 110 may be welded to the tubular connector. The purpose of using the latter is to provide a lightweight construction that will rapidly reach approximately the same temperature as the shell and still be rigid enough to maintain the correct position of the lifting lugs throughout the temperature range of the shell. This connector, of course, also prevents the lifting lugs from moving toward each other during the lifting operation, but this latter function also applies to the connector 96 of the Fig. 12 embodiment.

The lifting lug 102 of the Figs. 8–11, inclusive, embodiments is preferably of the same construction as the lugs 82 and 84 previously described, but it is shown sheathed with the same lightweight alloy sheet metal which forms the shell 110. This sheathing is indicated at 112 in Fig. 9. The lower part of each lug is shown as extending through an opening in the shell 110. The latter is reinforced around these openings by a plate 114, preferably welded to the shell around its perimeter at 116 and welded to the lug and to the sheathing 112 as indicated at 118. This plate may be also welded to the tubular connector 100. The latter is shown as extending between spaced portions of the plate, in Fig. 8. This figure also illustrates the sections of the shell 110 as contacting with the connector 100, to which they are rigidly secured.

Reverting to the embodiment illustrated in Figs. 12, 13, and 14, the bar 96, between the lugs 82 and 84, is preferably sheathed by a lightweight alloy metal of the same material as the shell 120. This sheathing is indicated at 122 in Fig. 15 of the drawings, and is preferably welded to the shell as indicated at 124. The lugs 82 and 84 extend through openings in the shell 120 and the shell is reinforced around each lug by a plate 126 which preferably closely fits against the lug. This plate is welded along its outside perimeter to the shell 120 as indicated at 128, and around its inner perimeter it is welded to the contiguous lug as indicated at 130. Each plate preferably abuts against the opposite sides of the connector bar 96 and is welded thereto.

At various points on the illustrative structure the shell may be tied to the elements of the framework by clips 132. These are well indicated in Fig. 16 of the drawings where they are shown looped around a frame member 134 and having angularly bent bases 136 and 138. The latter are preferably secured to the shell 120 by welding and it is within the scope of the invention that the upper and lower parts 140 and 142 of each clip are spaced apart a distance much greater than the thickness of the associated frame member 134. Thus, the portion of the shell 120 adjacent the frame member 134 may move, within limits, in any direction relative to the framework member without imposing any stresses whatever in the shell. In spite of any such movements the shell may not move too far away from the framework. It cannot collapse or buckle, and it is generally maintained in its operative position, completely enclosing the framework.

Fig. 17 of the drawings indicates a different manner of holding the shell in operative relation to the base rails of the framework. In this embodiment of the invention the shell 142 envelopes a framework similar to that shown in other figures of the drawings, and the shell is of similar construction as to the kind and gauge of the metal employed. The shell, however, is not directly welded to the base rails of the framework. Fig. 17 shows a section of a base rail formed by a channel 144 which has a guide bar 146 welded thereto, as shown. The latter has a lower flange 148 offset from its upper flange 150 to form, with the flange 145 of the channel 144, a guideway 152. The shell 142 has an inwardly and upwardly turned marginal flange 154 received within this guideway. The guide bar 146 is preferably joined with the base rail by the weld 156.

When the shell 142 is subjected to a temperature variation different from that of the supporting framework, the flange 154 of the shell may freely move upwardly or downwardly with respect to the base rail 144, but the construction is such that this flange always remains in the guideway 152. The shell is thus maintained in operative relation to the base rails of the framework at all times.

When the Fig. 17 construction is employed, the uprights of the framework may be readily united with the base rails so as to form a strong and rigid framework. Fig. 17 shows one of the uprights 158 as having its lower end reduced in width, and tightly received within the channel of the base rail 144. This reduced lower end is preferably welded to the base rail on both sides of the upright or vertical bar 158. A part of one of such welds is indicated at 160.

While the invention has been described with reference to the particular embodiments shown in the accompanying drawings, it is to be understood that the invention is not to be considered as limited to all of the details illustrated. It is rather, of a scope, commensurate with the scope of the sub-joined claims.

Having described our invention in the manner prescribed by law, and particularly section 4888 of the revised statutes, we further clearly set forth the invention in the following claims.

We claim:

1. An annealing box comprising; in combination; a shell supporting framework including base rails, a series of inverted U-shaped frame members including cross beams and uprights spaced longitudinally of and connected to the base rails, and a main top beam connecting said cross beams; and an inverted U-shaped thin metal shell having its lower edges welded to the base rails and its top portion secured by welding to the main beam and its portions intermediate the base rails and main beam being unsecured to the framework so as to permit substantially free expansion of the shell relative to the frame.

2. In annealing equipment, base rails, a series of inverted U-shaped structures including cross beams and uprights spaced longitudinally of and connected to the base rails, a central main beam connecting said cross beams and uniting them to form a lightweight metal supporting framework, an inverted U-shaped metallic shell constructed of thin sheet metal and having its lower edges welded to the base rails and its upper portion secured by welding to the main beam and its portions intermediate the base rails and the main beam being unsecured to the framework so as to permit substantially free expansion of the shell relative to the framework, said framework being provided with lifting lugs rigidly secured thereto and extending through openings in the

shell, and flexible means uniting the lugs and the shell so as to permit movement of the shell with reference to the lugs while maintaining a gas-tight encasement.

3. Annealing equipment of the type shown, comprising, in combination, a lightweight metallic framework including a main beam, a thin sheet metal shell enclosing the framework, means for holding the shell in operative position relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, lifting lugs slidably engaging the main beam, a metallic connector parallel with the main beam and rigidly connected at its ends with the lifting lugs, means for rigidly securing the connector to the main beam at a position between the lifting lugs, and means for uniting the shell with the lifting lugs in gas-tight relationship.

4. Annealing equipment of the type shown, comprising, in combination, a lightweight metallic framework including a main beam, a thin sheet metal shell enclosing the framework, means for holding the shell in operative position relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, lifting lugs slidably engaging the main beam, a tubular metallic connector parallel with the main beam and rigidly connected at its ends with the lifting lugs, means for rigidly securing the connector to the main beam at a position between the lifting lugs, and means for uniting the shell with the lifting lugs in gas-tight relation.

5. Annealing apparatus, comprising, in combination, a lightweight metallic framework including a main beam, a thin sheet metal shell enclosing the framework in a telescoping relationship, means for holding the shell in operative position relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, lifting lugs slidably engaging the main beam, a metallic bar parallel with the main beam and rigidly connected at its end with the lifting lugs, means for rigidly securing the bar to the main beam at a position between the lifting lugs, and means for uniting the shell with the lifting lugs in gas-tight relationship.

6. In a metallic structure, a lightweight metallic framework, a lightweight metallic gas-tight shell construeted of thin sheet metal and telescoped over the framework so as to enclose it, lifting means for transmitting lifting forces from positions exterior of the shell directly to the framework without imposing excessive stresses on the shell, means for holding the shell in its enclosing position while permitting it to be subjected to different temperature ranges, and flexible closure means completing a gas-tight seal around the lifting means while permitting the shell to move relative to the lifting means under the influence of temperature changes.

7. Annealing apparatus, comprising, in combination, a lightweight metallic framework including a main beam, a thin sheet metal shell enclosing the framework, clips embracing the framework members for holding the shell in operative condition relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, lifting lugs, and means for uniting the shells with the lifting lugs in gas-tight condition.

8. In annealing apparatus, a lightweight metallic framework including a main beam and channeled base rails, a thin sheet metal shell enclosing the framework in telescoping relationship, and means for holding the shell in operative position relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, said means including guide bars welded to the base rails and having portions spaced therefrom to form a guideway circumscribing the framework and receiving an upturned portion of the lower edge of the shell in such a manner that there may be relative motion of this upturned edge with respect to the base rails and the guide bars.

9. In annealing apparatus, a lightweight metallic framework including a main beam and channeled base rails, a thin sheet metal shell enclosing the framework in telescoping relationship, and means for holding the shell in operative position relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, said means including a guideway circumscribing the framework and receiving a flange in such a manner that there may be relative motion of the shell with respect to the base rails.

10. In annealing apparatus, a lightweight metallic framework including a main beam and channeled base rails, a thin sheet metal shell enclosing the framework in telescoping relationship, and means for holding the shell in operative position relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, said means including a guideway circumscribing the framework and receiving an upturned portion of the lower edge of the shell in such a manner that there may be relative motion of this upturned edge with respect to the base rails and the guide bars.

11. Annealing equipment of the type shown, comprising, in combination, a lightweight metallic framework including a main beam, a thin sheet metal shell enclosing the framework, framework engaging clips for holding the shell in operative condition relative to the framework without imposing any excessive strains due to the different operative thermal ranges of the framework and the shell, lifting lugs slidably engaging the main beam, a metallic connector parallel with the main beam and rigidly connected at its ends with the lifting lugs, means for rigidly securing the connector to the main beam at a position mid-way of the lifting lugs, and means for uniting the shell with the lifting lugs in gas-tight condition.

12. Heat treating equipment comprising a metallic framework including upright side members and connecting roof members, a lightweight rolled metal shell constituting a unitary gas-tight enclosure for the framework, said shell including a channelled portion, and means around the framework and co-operating with the channelled portion to hold the shell in operative relation thereto without imposing excessive strains due to the different operative thermal ranges of the framework and the shell, said means including a peripheral element received in the channelled portion in such a manner that there may be relative sliding motion between said shell and the frame.

JAMES FLETCHER.
EARL E. SCHOESSOW.