May 19, 1936. W. M. HEPBURN 2,041,341

HEAT TREATING FURNACE

Original Filed Jan. 25, 1935 3 Sheets-Sheet 1

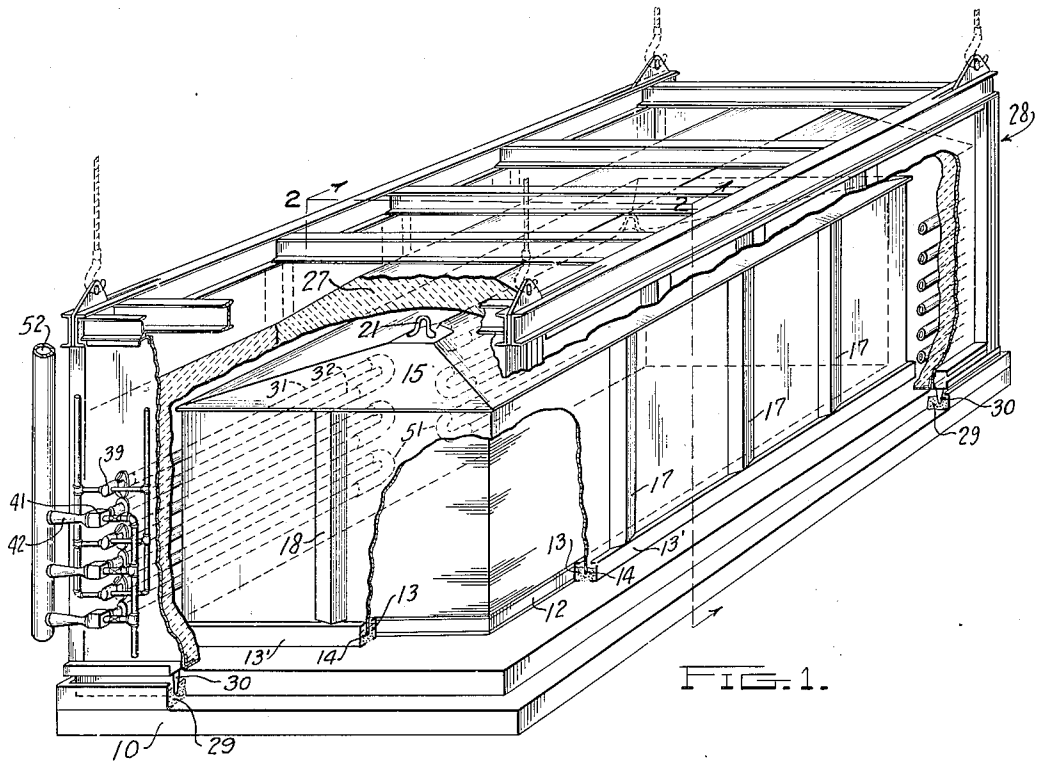


FIG. 1.

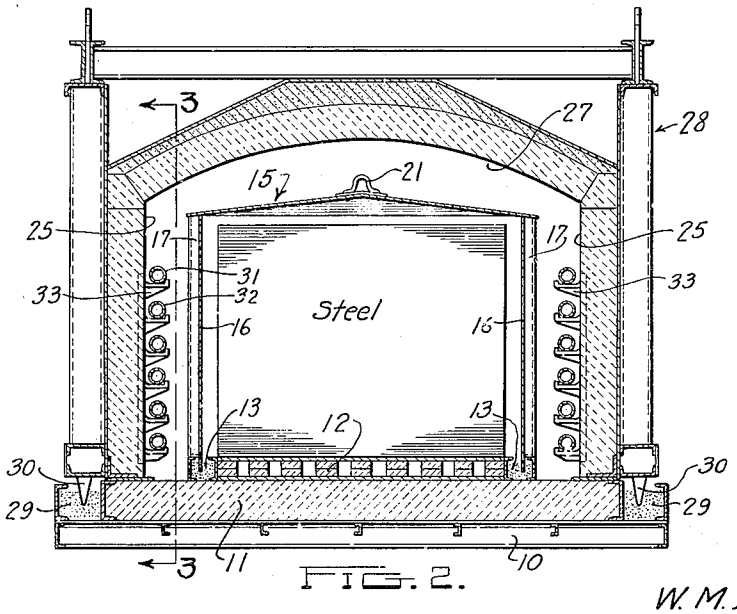


FIG. 2.

INVENTOR
W. M. Hepburn

BY
Charles A. Lind
ATTORNEY

May 19, 1936. W. M. HEPBURN 2,041,341

HEAT TREATING FURNACE

Original Filed Jan. 25, 1935 3 Sheets-Sheet 2

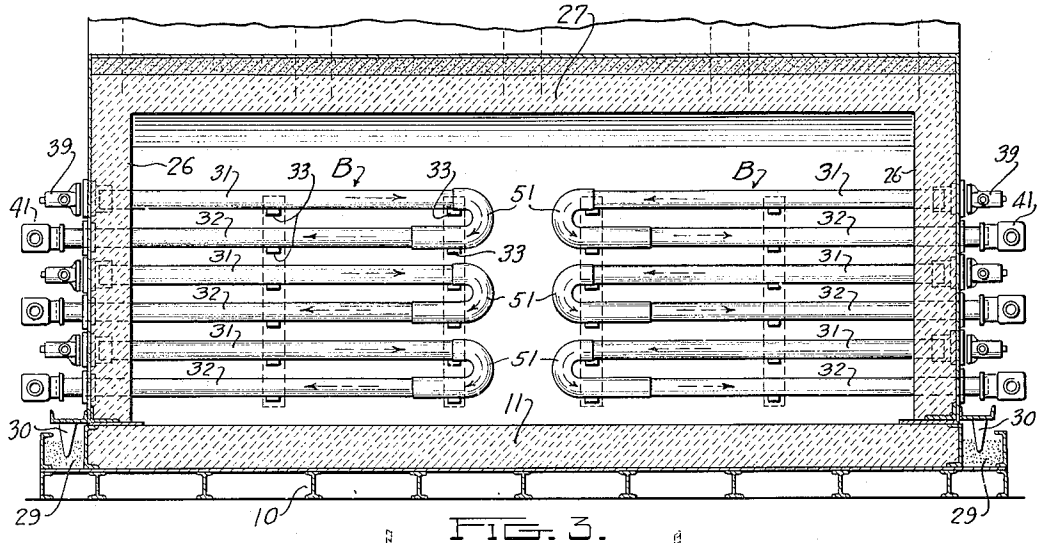


FIG. 3.

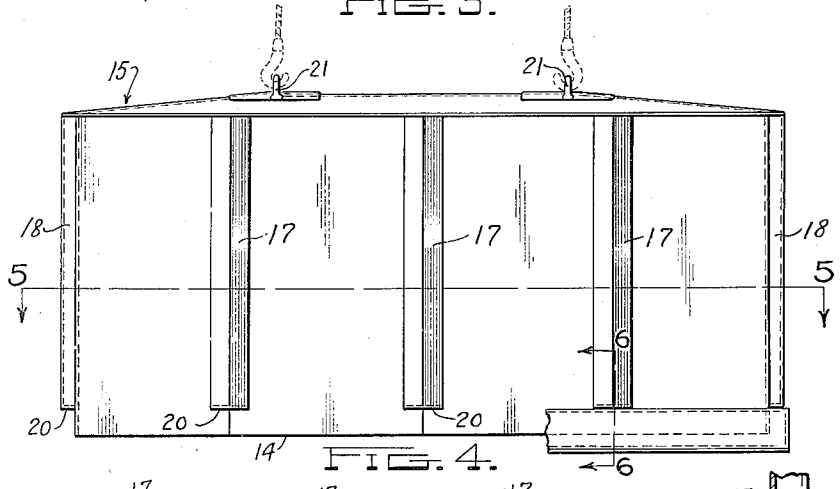


FIG. 4.

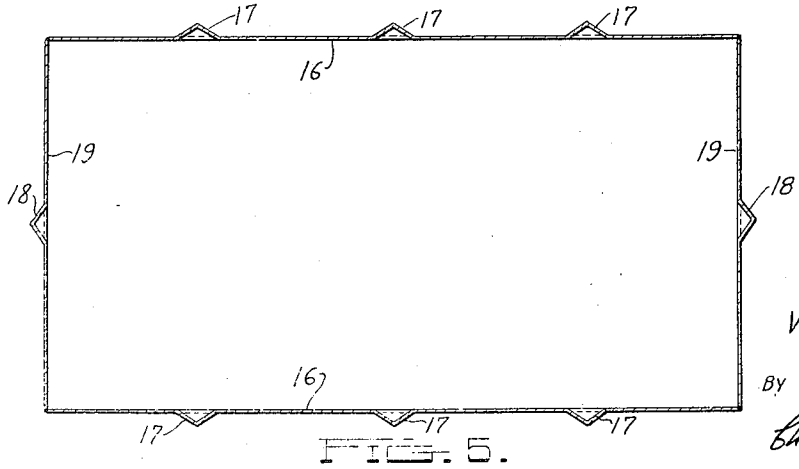


FIG. 5.

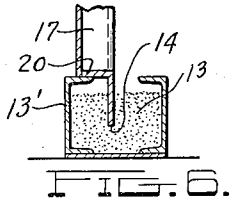


FIG. 6.

INVENTOR
W. M. Hepburn

BY
Charles A. Lind
ATTORNEY

May 19, 1936. W. M. HEPBURN 2,041,341

HEAT TREATING FURNACE

Original Filed Jan. 25, 1935 3 Sheets-Sheet 3

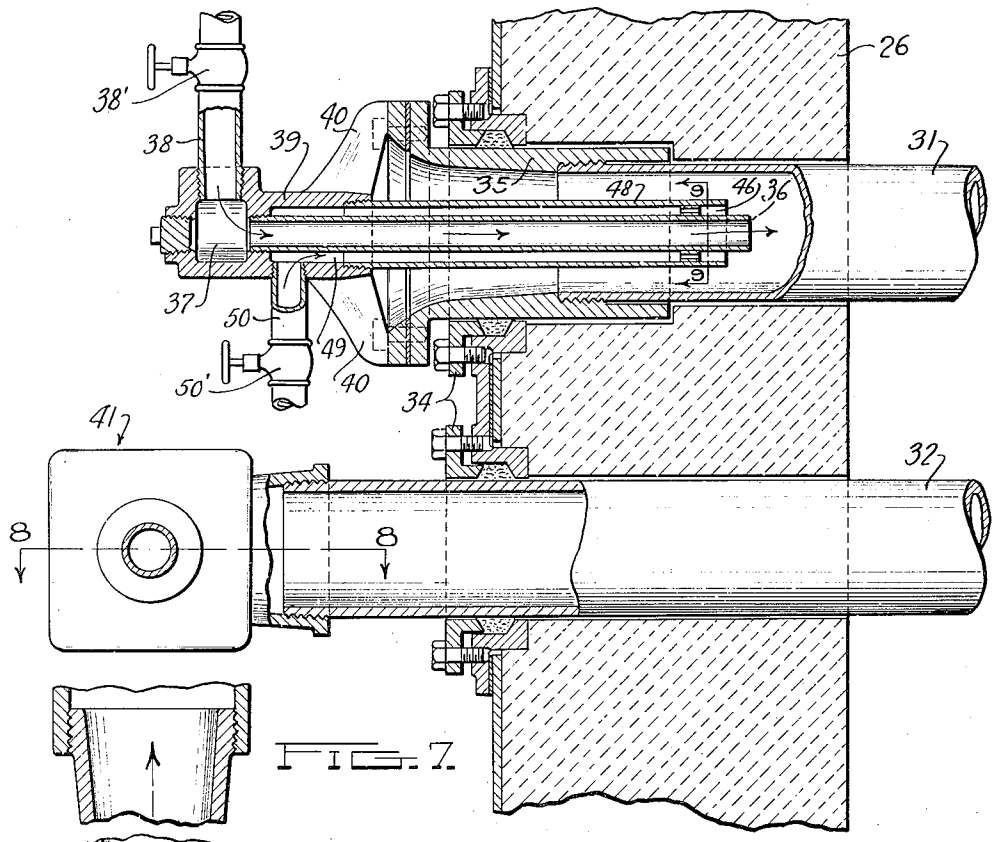


FIG. 7.

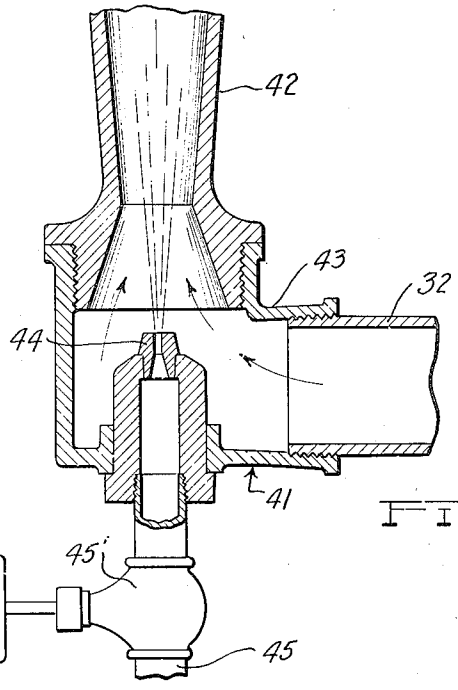


FIG. 8.

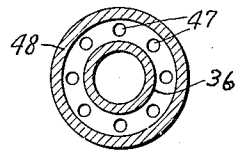


FIG. 9.

INVENTOR
W. M Hepburn

BY
Charles A. Lind
ATTORNEY

Patented May 19, 1936 2,041,341

UNITED STATES PATENT OFFICE

2,041,341

HEAT TREATING FURNACE

William M. Hepburn, Ottawa Hills, Ohio, assignor to Surface Combustion Corporation, Toledo, Ohio, a corporation of New York

Application January 25, 1935, Serial No. 3,378
Renewed January 20, 1936

8 Claims. (Cl. 266—5)

This invention relates to improvements in annealing furnaces such as are used for annealing packs of sheet metal supported on a base during the annealing operation. In furnaces of this type the material is heated by a heating hood adapted to be lowered over the material. It is also customary to lower a protective bell over the material whereby after the heating operation has been completed the heating hood may be removed and the charge allowed to cool in the open air with the protective bell in place to protect the metal against oxidation.

The object of the invention is to provide a furnace of the type indicated having a heating chamber which is rectangular in plan with an improved arrangement of combustion radiator tubes for effecting heating of a charge or pack of rectangular material. Another object is to provide an improved protective bell for use with a furnace of the type indicated.

For a more complete understanding of the invention reference is made to the detailed description taken in connection with the accompanying drawings wherein the preferred form of the invention is shown.

Referring to the drawings,—

Fig. 1 is a perspective view of the improved furnace with parts broken away to show certain features of construction;

Fig. 2 is a vertical cross section on line 2—2 of Fig. 1;

Fig. 3 is a vertical longitudinal section on line 3—3 of Fig. 2;

Fig. 4 is a side elevation of the improved bell which covers the steel during the annealing operation;

Fig. 5 is a horizontal section on line 5—5 of Fig. 4;

Fig. 6 is a fragmentary section on line 6—6 of Fig. 4;

Fig. 7 is an enlarged sectional view of parts shown in Fig. 3;

Fig. 8 is a sectional view on line 8—8 of Fig. 7, and

Fig. 9 is a sectional view on line 9—9 of Fig. 7.

The base of the furnace is oblong in plan and comprises a steel frame 10 on which is mounted a floor 11 of heat-insulating material. The floor has a raised platform 12 on which the pack of steel to be annealed is supported. The platform is surrounded by a sand trough 13 for receiving the lower edge 14 of an air tight bell 15 which is lowered over the pack and remains in place during the entire annealing operation.

In accordance with the present invention, the bell 15 is made of metal; and each of its opposite sides 16 is provided with a plurality of vertically-continuous lateral projections 17 which are V-shape in cross section. There is also one such projection 18 at each of the ends 19 of the bell arranged at the vertical center of each end wall 19. Each side wall 16 preferably has three projections, one of which is at the vertical center of the wall, the others being at either side thereof inwardly of the vertical corners of the bell. The lower ends 20 of the various projections are at a common level above the lower edge of the bell and rest on the outer wall 13' of the sand trough 13 whereby to support the bell with the lower edge 14 thereof above the bottom of the trough as clearly indicated in Fig. 6. It will be readily appreciated that the lateral projections serve to impart rigidity to the walls of the bell. The projections may be formed by welding wall sections together at the apex of the V, each section being bent out of its normal plane to form one side of the V. Or the projection may be formed by angle irons arranged between and welded to the adjacent edges of separate wall sections. The roof of the bell is bowed upwardly and is provided with eyes 21 to permit the bell to be lifted as by a crane.

The projections 17 and 18, in addition to adding stiffness to the vertical walls of the bell, provide additional heat-dissipating area to the walls of the bell during cooling of the pack of steel after the heating hood has been removed. It will be observed that the various projections are remote from the vertical corners of the bell and are arranged centrally between such corners. The reason for this arrangement is that the middle of the pack tends to cool less quickly than the corners thereof and it is, therefore, desirable to provide the bell with additional cooling area opposite such middle portions.

The heating hood comprises heat-insulated side walls 25, end walls 26, and a roof 27, all inside of a steel frame 28 of such construction as will permit the hood as a whole to be lifted by a crane for raising and lowering with respect to the base on which the hood is normally supported while heating the pack of steel. The furnace base is surrounded by the usual sand or liquid sealing trough 29 for receiving a sealing rim 30 which depends from the heating hood.

Arranged inside of the heating hood, in horizontally spaced relation, along each of the two opposite side walls are two similar banks B of combustion radiator tubes, each bank comprising a group of hairpin tubes, the legs 31 and 32

of each tube extending horizontally, the one above the other, and the ends of each tube being outside of the hood. Each tube is slidably supported inside of the hood on ledges 33 which project from the adjacent side wall and each leg of the tube passes through a stuffing box 34 at the outside face of the end wall of the hood.

The outer end of each leg 31 comprises a tubular extension 35 having a flaring mouth which is open to the atmosphere and through which air flows into the heating tube for supporting combustion of fuel gas flowed thereinto from a fuel tube 36 which has its outlet within the intake end of the said extension at a point a substantial distance inwardly from the said mouth. The intake end of the fuel tube leads from a chamber 37 to which fuel is supplied by a supply pipe 38 having a regulating valve 38'. Said chamber 37 is formed in a body 39 having radial arms 40 which at their outer ends are appropriately secured to the rim of the extension 35 whereby to support the body in fixed position with respect to said extension.

At the outer end of each leg 32 is an exhauster generally indicated at 41, the same comprising a Venturi-tube 42 which, with a fitting 43, forms an extension of said leg. A jet orifice nozzle 44 within said fitting discharges into the inlet end of the tube 42. Air under pressure is delivered to the nozzle by a supply pipe 45 having a regulating valve 45'. It will be readily appreciated that an exhauster of this type permits the degree of suction at the discharge end of the heating tube to be closely controlled and that due to such suction, air will be induced to enter the intake end of the heating tube.

The fuel flowing from the fuel tube 36 is ignited by flames produced by burning a preformed mixture of air and fuel gas in an annular chamber 46 around the outlet end of said tube. The combustible mixture is supplied to said chamber 46 through a series of jet orifices 47 (see Fig. 9) at the outlet end of a mixture supply tube 48 wherethrough the fuel tube 36 extends. The inlet end of the tube 48 leads from a chamber 49 in the body 39, the mixture being supplied to said chamber under pressure by a supply pipe 50 having a regulating valve 50'.

The air for supporting combustion of the fuel flowing from the fuel tube 36 is the air which is drawn into the heating tube through the tubular extension 35 by the suction produced by the exhauster 41 at the discharge end of the heating tube. By thus drawing the air into the tube complete combustion is materially delayed as compared, for example, with combustion of a preformed mixture of air and gas; and the hottest part of the heating tube is considerably remote from the point where the fuel discharged from the fuel tube 36 first begins to burn. In passing around the bend of the heating tube combustion is accelerated due to comparatively rapid intermixing of the air and fuel at that point. It is also worthy of note that due to the use of an exhauster at the discharge end of each heating tube, the gases in the tube will not tend to leak out into the heating chamber of the furnace in case cracks should develop in the tube.

Since the heat radiating tubes are of hairpin type and are fired in the manner described and arranged in two banks along a side wall of the heating hood at opposite sides of the vertical center of such wall, it will be readily appreciated that the zone of high heat intensity will be inwardly of the end walls of the hood and consequently that there is no danger of overheating the corners of the pack of steel to be annealed while at the same time high intensity heat is applied to the sides of the pack facing the banks, the high temperature portion of each bank being at or near the bends of the heat radiating tubes thereof.

Since both of the legs of each heating tube are arranged in parallelism and project out of the hood through the same wall, it will be readily appreciated that trouble due to thermal expansion of the legs is reduced to a minimum. Moreover, since the tubes are arranged horizontally, there is practically no draft through the tubes due to convection. This is an important consideration in controlling combustion in the tube since the amount of air which flows into the tube is entirely dependent on the setting of the exhauster associated with such tube.

All of the exhausters for each bank of radiating tubes may discharge into a common flue 52 having its outlet at some convenient point above the hood.

What I claim as new and desire to secure by Letters Patent is:

1. A furnace comprising, in combination, a base for supporting a rectangular pile of material, a bell which is rectangular in plan and which is removably seated on said base and which forms with the base a closed chamber for said material, said bell comprising upright walls of sheet metal, each of said walls having a vertically continuous lateral projection midway between the adjacent vertical corners of the bell, said projections terminating short of the lower edge of the said walls whereby to form shoulders which interengage with the base to support the bell, and a sealing trough whereinto the bottom edge of the bell extends.

2. Heat-treating apparatus comprising, in combination, a base for supporting material to be treated, a metal bell cooperating with the base to form a closed chamber for said material, a sealing trough whereinto the bottom edge of the bell extends, and upright ribs forming part of the walls of the bell and at their lower ends cooperating with said base to support the bell with the bottom edge of the bell free and clear of the bottom of said trough.

3. A furnace comprising, in combination, a base for supporting the material to be treated, a heating hood open at the bottom and adapted to cooperate with the base to form a closed chamber, means for internally heating said hood comprising a hairpin tube having its bend inside of the hood remote from one wall thereof and having its intake and discharge ends extending out of the hood through said wall, means for supplying heat-producing gases to the tube at the intake end thereof, and means at the discharge end of the tube for drawing said gases through the tube.

4. The combination with a hood adapted to cooperate with a base to form a furnace chamber, of means for producing heat in said chamber comprising two groups of horizontally-disposed return-bend tubes, both of said groups being arranged in a common vertical plane, the legs of the tubes of one group extending out of the chamber in one direction and those of the other group extending out in the opposite direction, and means for flowing heating gases through the several tubes.

5. The combination with a hood adapted to cooperate with a base to form a furnace chamber, of means for producing heat in said chamber

comprising two groups of horizontally-disposed return-bend tubes, both of said groups being arranged in a common plane, the legs of the tubes of one group extending out of the chamber in one direction and those of the other group extending out in the opposite direction, the return-bend ends of said groups being opposite each other, and means for flowing heating gases through the several tubes.

6. The combination with a hood adapted to cooperate with a base to form a furnace chamber, of means for producing heat in said chamber comprising two groups of horizontally-disposed return-bend tubes arranged along one and the same side wall of the chamber, the legs of the tubes of one group extending out of the chamber in one direction and those of the other group extending out in the opposite direction, the return-bend ends of said groups being approximately midway the ends of said wall, and means for flowing heating gases through the several tubes.

7. The combination with a structure forming a furnace chamber, of means for producing heat in said chamber comprising two horizontally spaced groups of horizontally-disposed return-bend tubes, both of said groups in a common plane and the legs of one group of tubes extending out of the chamber in one direction and those of the other group extending out in the opposite direction, and means for flowing heating gases through the several tubes.

8. The combination with a structure forming a furnace chamber, of means for producing heat in said chamber comprising two groups of horizontally-disposed return-bend tubes, both of said groups being in a common plane and the legs of one group of tubes extending out of the chamber in one direction and those of the other group extending out in the opposite direction, both of said groups being disposed along one and the same side wall of said chamber, and means for flowing heating gases through the several tubes.

WILLIAM M. HEPBURN.