May 19, 1953 H. N. IPSEN 2,639,047

CONVEYER APPARATUS FOR HEAT-TREATING METAL PARTS

Filed Feb. 3, 1950 3 Sheets-Sheet 1

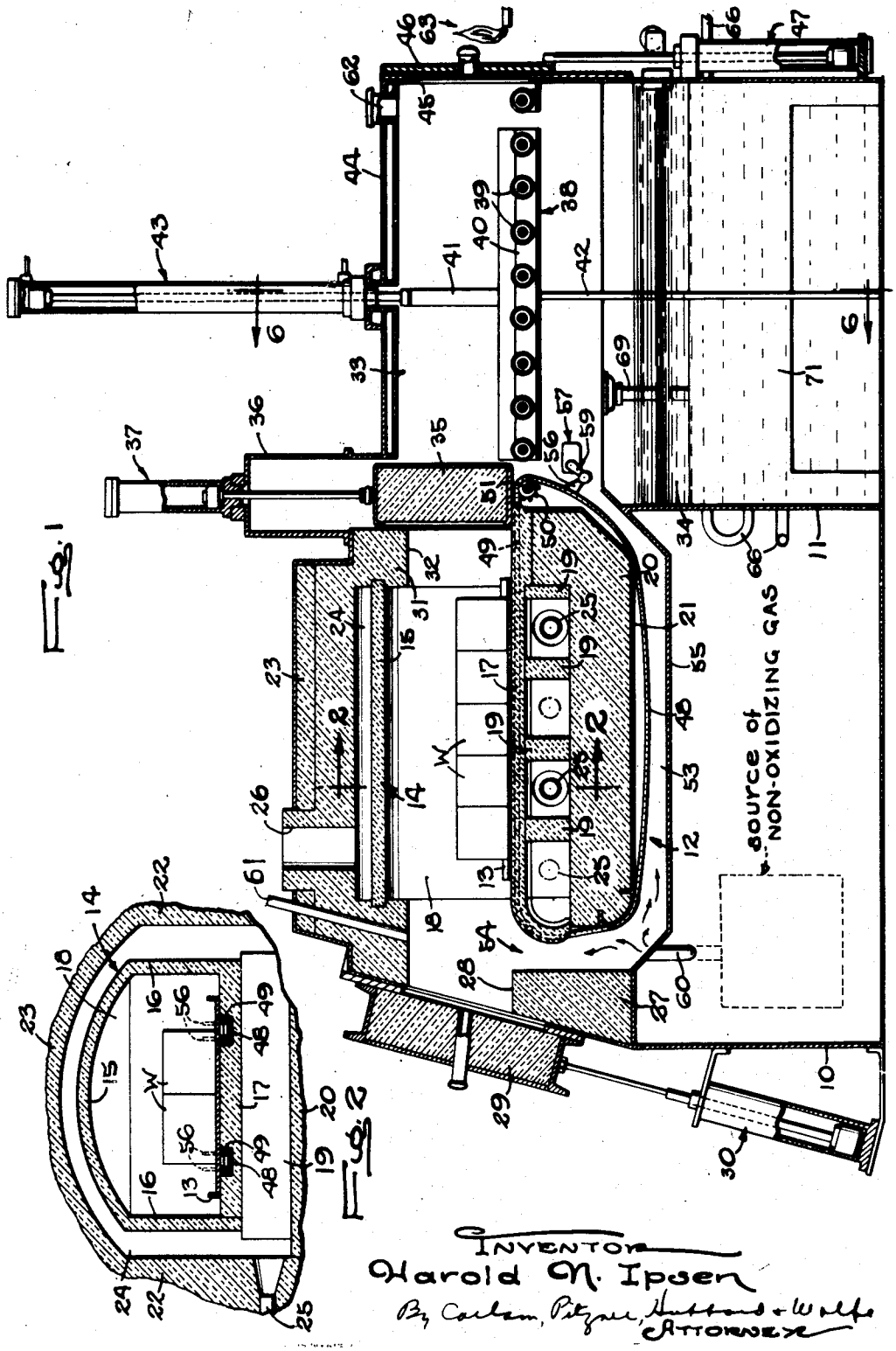


Fig. 1

Fig. 2

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Fig. 3

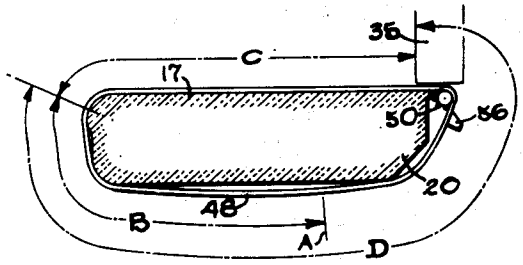
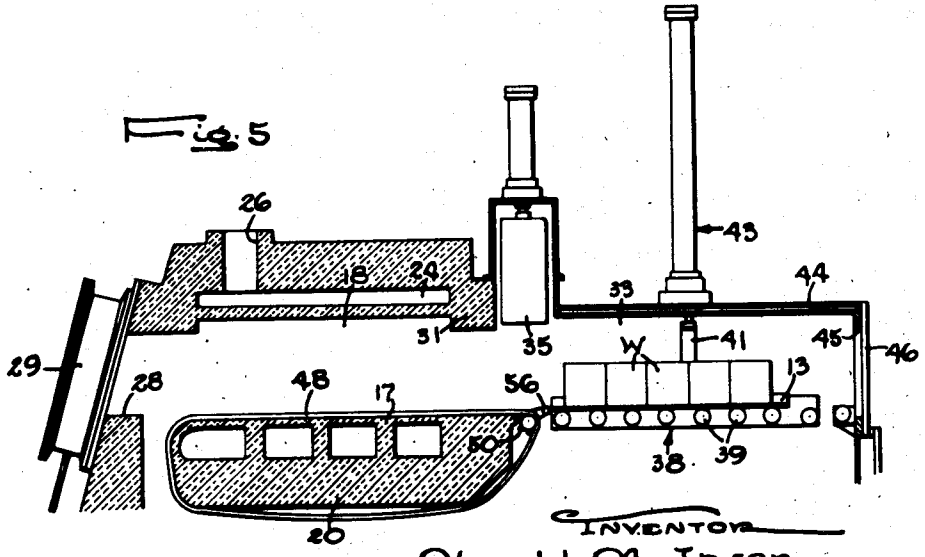


Fig. 4

Fig. 5



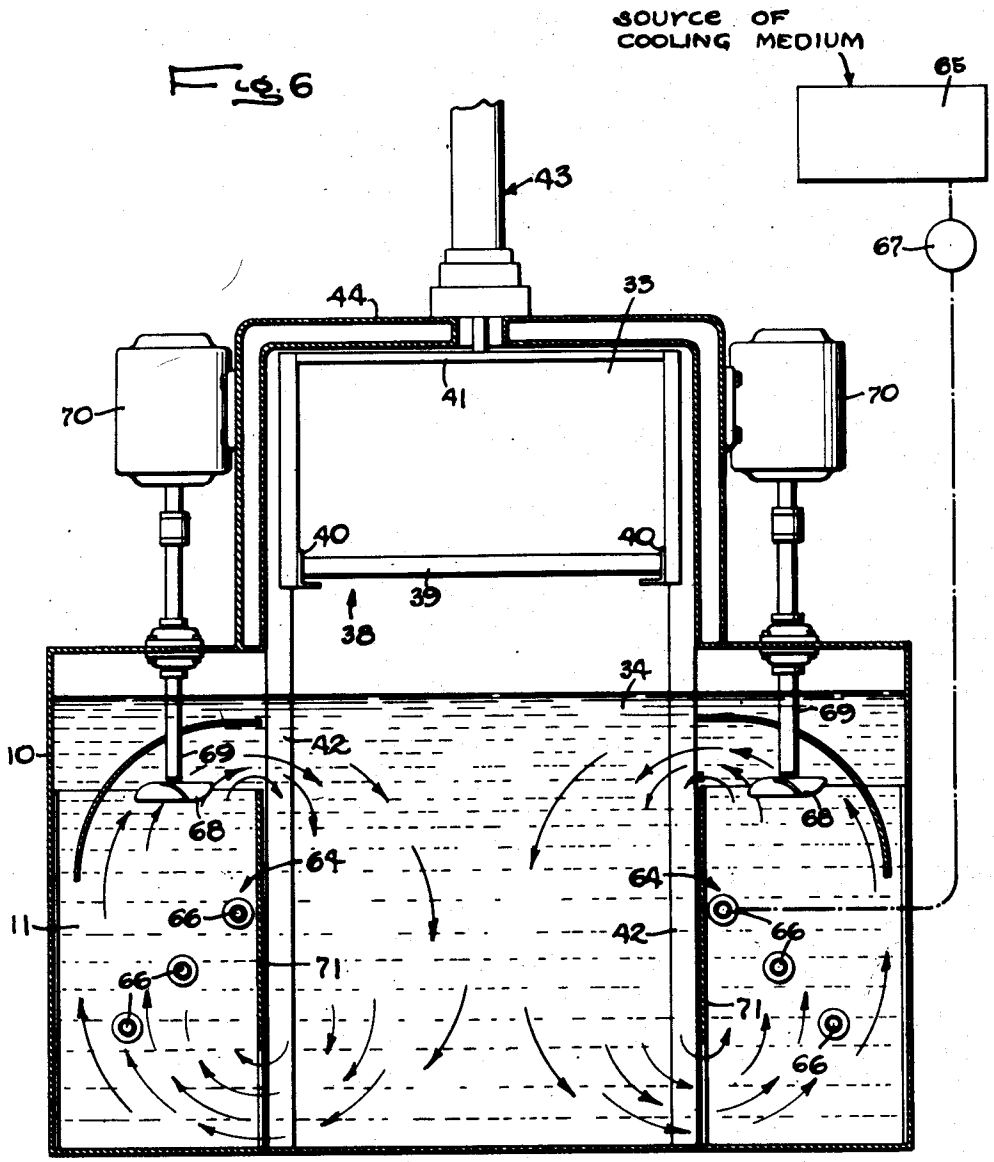
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Fig. 6



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CONVEYER APPARATUS FOR HEAT-TREATING METAL PARTS

Harold N. Ipsen, Rockford, Ill.

Application February 3, 1950, Serial No. 142,326

1 Claim. (Cl. 214—21)

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This invention relates to furnaces for heat treating metal parts in which the parts are first heated in a heating chamber and then transferred to a quenching position.

One object of the invention is to transfer heated workpieces out of the heating chamber of the furnace by a novel mechanism which permits the use of an endless conveyor and which prevents any heated portion of the conveyor from being unduly stressed.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a vertical sectional view taken centrally and longitudinally through heat treating apparatus embodying the present invention.

Fig. 2 is a fragmentary sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic view showing the parts in positions shown in Fig. 1.

Figs. 4 and 5 are fragmentary sectional views similar to Fig. 1 showing diagrammatically different positions of the parts of the apparatus.

Fig. 6 is a fragmentary sectional view taken along the line 6—6 of Fig. 1.

The heat treating apparatus shown in the drawings to illustrate the present invention includes a box-like frame 10 having an enclosed quenching tank or vessel 11 rigid with the frame at one end thereof and adapted at its other end to support a furnace 12 in which work W is heated. The work W may be a single piece or several pieces as shown usually supported in a tray 13, the unit being referred to hereafter and in the claim either as the work or workpiece.

The furnace 12 comprises a muffle 14 having top, side, and bottom walls 15 to 17 defining a heated chamber 18 and supported by crossbars 19 on a brick support 20 which is carried by a plate 21 extending across the frame 10. Spaced from the muffle are brick side and top walls 22 and 23 which define a chamber 24 surrounding the muffle and heated in any suitable way as by fuel burners 25 from which heated gases rise through the chamber 24 and escape through a top opening 26. At the front end, the furnace is closed by a brick wall 27 having an aperture 28 formed therein for the passage of the work W into the furnace and normally closed by a sliding inlet door 29 having a power actuator 30. A brick wall 31 at the rear of the furnace is formed with an aperture 32 therein communicating with a chamber 33 above the body 34 of quenching liquid within the tank 11, which aperture is normally closed by an intermediate door 35. The latter is slidable vertically in an extension 36 of the top wall 15 and across the aperture 32 by a power actuator 37 and, when in a closed position, engages an extension of the floor 17 of the muffle.

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The workpieces W after being transferred horizontally from the muffle 14 and out through the end opening 32 after raising of the door 35 are received in the chamber 33 on the front end of a horizontal platform 38 which comprises a series of closely spaced rollers 39 journaled on bars 40 connected by a yoke 41. The platform is normally disposed substantially at the level of the muffle floor 17 but is slidable along vertical guide rails 42 within the tank into and out of the quenching fluid 34 which fills the tank up to a level below the muffle floor. To raise and lower the platform, the yoke 41 is suspended from the rod of a fluid actuator 43 mounted on the top wall 44 of the tank. At the rear end of the platform 38, the quenching tank is formed with an outlet aperture 45 through which the work is removed from the chamber above the quenching liquid and which is closed by a sliding outlet door 46 having an actuator 47.

Discharge of the work from the heating chamber 18 onto the platform 38 in the chamber 33 above the quenching liquid is effected by one or more endless chains or flexible conveyors 48 which are slidable longitudinally of the heating chamber in recesses 49 extending along the floor 17 of the latter. Herein, there are two spaced parallel chains meshing positively with axially spaced sprockets 50 disposed outside of the chamber 18 and secured to a shaft 51. The latter is journaled in suitable bearings supported on the furnace frame and is connected to and driven by a motor 52 indicated diagrammatically in Fig. 4. The chains are pulled by the sprockets along recesses 49 in the heating chamber floor and toward and through the end aperture 32. From the latter, each chain follows a path extending first into the chamber 33 above the quenching liquid 34, then, downwardly and along a horizontal passage 53 below the plate 21, and finally, along a vertical passage 54 between the front furnace wall 27 and the muffle floor and back into its recess in the latter. The passage 53 is defined by the plate 21 and another plate 55 spaced below the latter and supported on the frame.

One or more lugs or abutments 56 are secured to the chains 48 to engage the work W and advance the same toward and through the end aperture 32 in the rear brick wall 31. The lugs pro-

ject outwardly from the chains and, as the chains are advanced along the muffle floor, project above the latter and engage the part of the work adjacent the floor and facing toward the inlet end of the heating chamber 18. In the continued movement of the chains and the lugs, the work is slid along the chamber floor, the portions of the chains between the lugs and the sprockets 50 being subjected to the tension of pulling the work.

To prevent stretching or breaking of the chains 48 and thereby prolong their service life, the invention contemplates arranging the lugs 56 on the chains and positioning the sprockets 50 in a novel manner with respect to the heating chamber 18 to insure that the work may be transferred out of the latter without unduly stressing those portions of the chains disposed within the chamber during heating of the work therein. For this purpose, each chain has only one lug 56 thereon which is effective to engage the work and transfer the same out of the heating chamber. Also, the sprockets are spaced from the inlet end of the chamber floor 17 along the chains and in a direction reverse to the direction of movement thereof (counterclockwise as viewed in Fig. 1) a distance at least as long as the heating chamber. With this arrangement, the chains may be stopped in such a position during heating of the work that the portions of the chains disposed within the heating chamber during the heating will always be on the slack side of the sprockets during transfer of the work.

Preferably, to minimize the length of each chain subjected to tension, the sprockets are located within the chamber 33 adjacent the outlet aperture 32 of the heating chamber 18 between the muffle floor and the platform 38 and below the level of the muffle floor. Thus, the work may be transferred directly from the muffle floor onto the platform as shown in Fig. 5.

During loading of the work or heating thereof as shown in Fig. 3, the chains 48 are stopped to position the lugs 56 between the outlet end of the heating chamber 18 and a point, indicated at A, which is spaced from the inlet end of the chamber along the chains and in the direction reverse to the movement thereof a distance, indicated at B, at least as long as the spacing of the sprockets from the chamber inlet end taken in the reverse direction along the chains. Herein, this spacing B of the point A from the inlet end of the chamber is approximately equal to the length of the chamber since the sprockets 50 are located adjacent the outlet end thereof. The heated portion of each chain, that is, that portion disposed within the heating chamber with the lugs positioned between the point A and the outlet end of the chamber, is indicated at C and the remaining or cooler portion is indicated at D.

Means shown diagrammatically in Fig. 4 is provided for positioning the lugs 56 between the outlet end of the heating chamber 18 and the point A during the time that the chains are idle. Herein, this means comprises a normally closed switch 57 connected in parallel with a normally open manual starting button 58 (see Fig. 4) in one of two lead lines L_1 and L_2 connecting the motor 52 to a source (not shown) of electrical energy. The normally closed switch is shown in closed position in Fig. 4. An actuating arm 59 for the switch is positioned in the path of one of the lugs 56 for engagement by the latter to move the arm in a direction to open the switch as shown in Fig. 1.

Let it be assumed that the chains are in their idle position with one of the lugs engaging the actuating arm 59 and the switch 57 opened. When it is desired to transfer the work from the heating chamber 18 onto the platform 38, the starting button 58 is pressed manually to complete the circuit to the motor 52 for driving the chains clockwise as viewed in the drawings and moving the switch actuating lug 56 away from the actuating arm to permit the switch 57 to close and to energize the motor upon release of the starting button. The lugs move with the chains into engagement with the work. At the time that the lugs initially engage the work (see Fig. 4), the heated portions C of the chains have advanced beyond the sprockets 50 and only the cooler portions D are disposed along the chamber floor between the sprockets and the lugs. Thus, only the cooler portions are subjected to tension in the continued movement of the chains in which the lugs engage the work to advance the same out of the chamber. At the time that the work is pushed by the lugs across the gap between the muffle floor 17 and the platform and onto the latter (see Fig. 5), substantially all of the cooler portions have passed beyond the sprockets and the heated portions have advanced back into the heating chamber. The motor continues to run until the chains are brought back to their idle position (Figs. 1 and 3) in which the switch actuating lug again engages the arm 59 to open the switch and deenergize the motor.

To minimize oxidization of the surfaces of the workpieces W during heating and quenching thereof, air and moisture are eliminated from the quenching liquid 34 as well as from the spaces within the heating chamber 18 and the chamber 33 above the quenching liquid. For this purpose, a non-oxidizing gas such as a hydrocarbon gas is introduced into the chambers 18 and 33 in this instance through a supply pipe 60 which extends from a source of gas (see Fig. 1) disposed outside of the furnace and which communicates with the passages 53 and 54 at the junction of the latter. Exhaust outlets 61 and 62 are located respectively in the upper part of the heating chamber near the inlet opening 28 and in the upper part of the chamber 33 adjacent the outlet opening 45 thereof. By maintaining a continuous flow of gas in through the supply pipe, the two chambers will be maintained under a slight pressure so as to preclude the flow of air in through the inlet opening 28 and the outlet opening 45. To further exclude air from entering the chamber 33 above the quenching liquid 34 through the outlet opening 45, a flaming gas curtain, indicated at 63 (Fig. 1) of a well known character may be provided across the opening. If desired, a similar curtain (not shown) may be provided across the inlet opening of the heating chamber.

For the purpose of cooling the quenching liquid without exposing the same to air, the tank 11 containing the liquid is formed with a heat-exchanging wall 64 of the proper surface area exposed on one side to the quenching liquid 34 and on opposite side to a cooling medium 65 circulated across the wall in sufficient volume to maintain the liquid at a desired quenching temperature. In this instance, the heat-exchange between the quenching liquid and the cooling medium is effected by a plurality of closed tubes or conduits 66 the walls of which form the heat-exchanging wall 64 and are joined to the tank walls so as to constitute a continuation of the

latter and, in effect, form a part of the tank enclosing the liquid. While the tubes may be disposed outside of the quenching tank, in the present instance, they extend into the latter from a source of cooling medium disposed outside of the tank, the cooling medium flowing through the tubes and the quenching liquid flowing past the tubes on the outer side thereof.

The cooling medium **65**, which may be water, is circulated through the tubes **66** by a pump indicated diagrammatically at **67** (Fig. 6) and disposed between the tubes and the source of the medium. The quenching liquid **34** is circulated past the tubes by agitators **68** in the form of fan blades fast on shafts **69** which are driven by motors **70** mounted on the outside of the side walls of the tank. Preferably, baffles **71** are positioned in the tank to cause the liquid to flow in a definite path, indicated by the arrows in Fig. 6, and circulate efficiently past the tubes. The initial removal of oxygen from the quenching liquid is effected automatically by immersing a few heated metal parts therein prior to immersing the workpieces which are to be maintained bright.

In the operation of the apparatus above described, the doors **29**, **35**, and **46** are normally closed with the non-oxidizing gas flowing continuously into the heating and quenching chambers **18** and **33** through the passages **53** and **54**. Assuming that the chambers and the quenching liquid have been purged of air and moisture and that the chains **48** have been stopped with the lugs **56** positioned between the chamber outlet end and the point A, the work W is loaded in the heating chamber by opening the inlet door **29** for a short time and pushing the work manually onto the chamber floor **17**. After heating the work for the proper time at the desired temperature, the intermediate door **35** is opened for a short time to permit the chains to advance in the manner described above completely around their paths and push the work onto the platform **38** across the gap between the latter and the muffle floor **17**. During such advance, the lugs follow behind the trailing ends of the heated portions C of the chains a distance which is at least as long as the spacing of the sprockets from the chamber inlet end along the chain and in the direction of movement thereof.

After the work W is positioned on the platform **38**, the intermediate door **35** is closed and the platform is lowered to submerge the work in the quenching fluid **34** for the desired time. Following the quenching, the platform is raised and the outlet door **46** is opened to permit the work to be slid off from the platform and removed from the quenching tank through the outlet opening **45** and the curtain **63** of flame covering the same. Because the heating and quenching chambers **18** and **33** are maintained under a non-oxidizing atmosphere, the workpieces are as bright when unloaded from the chamber **33** through the outlet opening **45** as they were upon entering the heating chamber.

This application is a continuation-in-part of my copending application Serial No. 83,735 filed March 26, 1949, now abandoned.

I claim as my invention:

In a batch type heat treating furnace, the combination of, an elongated heating chamber having an outlet opening at one end through which heated work may be removed, an endless flexible chain supported for endwise movement longitudinally through said chamber and said opening and adapted to pass freely beneath the work disposed in the chamber, said chain having a heated section disposed within the chamber and a cooler section disposed outside of the latter during heating of the work therein while the chain is dwelling in a normal rest position, a sprocket meshing with said chain outside of said chamber and operable during turning of the sprocket in one direction to move said heated section past the work and said cooler chain section away from its normal rest position and toward and through said chamber and said opening, and a single abutment projecting outwardly from said cooler chain section and operable after advance of said cooler chain section through said heating chamber and into mesh with said sprocket to engage the work in said chamber and advance the same out of the chamber through said opening, said abutment being positioned on said cooler section to follow behind the trailing end of said heated chain section before engagement with the work in said chamber a distance at least as long as said heating chamber whereby only said cooler chain section is disposed between said lug and said sprocket during actual movement of the work out of said heating chamber.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
737,079	Chase	Aug. 25, 1903
786,365	Kenworthy	Apr. 4, 1905
876,183	Herrick	Jan. 8, 1908
890,251	Thompson	June 9, 1908
1,168,313	Kenworthy	Jan. 18, 1916
1,920,652	McKee	Aug. 1, 1933
2,063,784	Bechtel et al.	Dec. 8, 1936
2,116,070	Hoffman et al.	May 3, 1938
2,223,603	Darrah	Dec. 3, 1940
2,246,675	Gronemeyer	June 24, 1941
2,247,770	Cox	July 1, 1941
2,394,002	Ness	Feb. 5, 1946

FOREIGN PATENTS

Number	Country	Date
31,938	France	Mar. 15, 1927
	(Addition to 553,561)	
158,111	Germany	Jan. 28, 1905
617,567	Germany	Aug. 21, 1935