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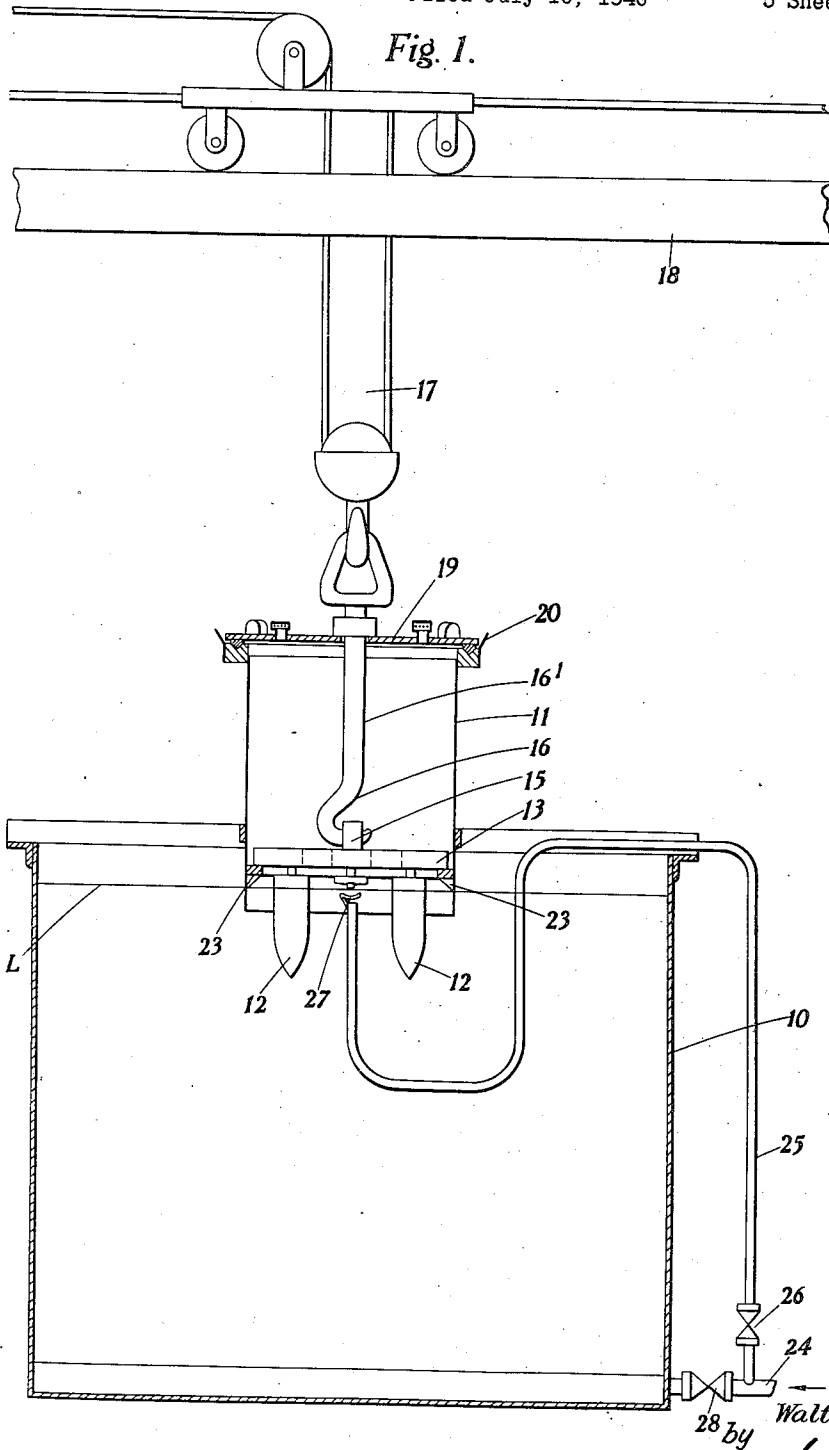
W. BRIDGES
TREATMENT OF METALS

2,280,470

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5 Sheets-Sheet 1

Fig. 1.



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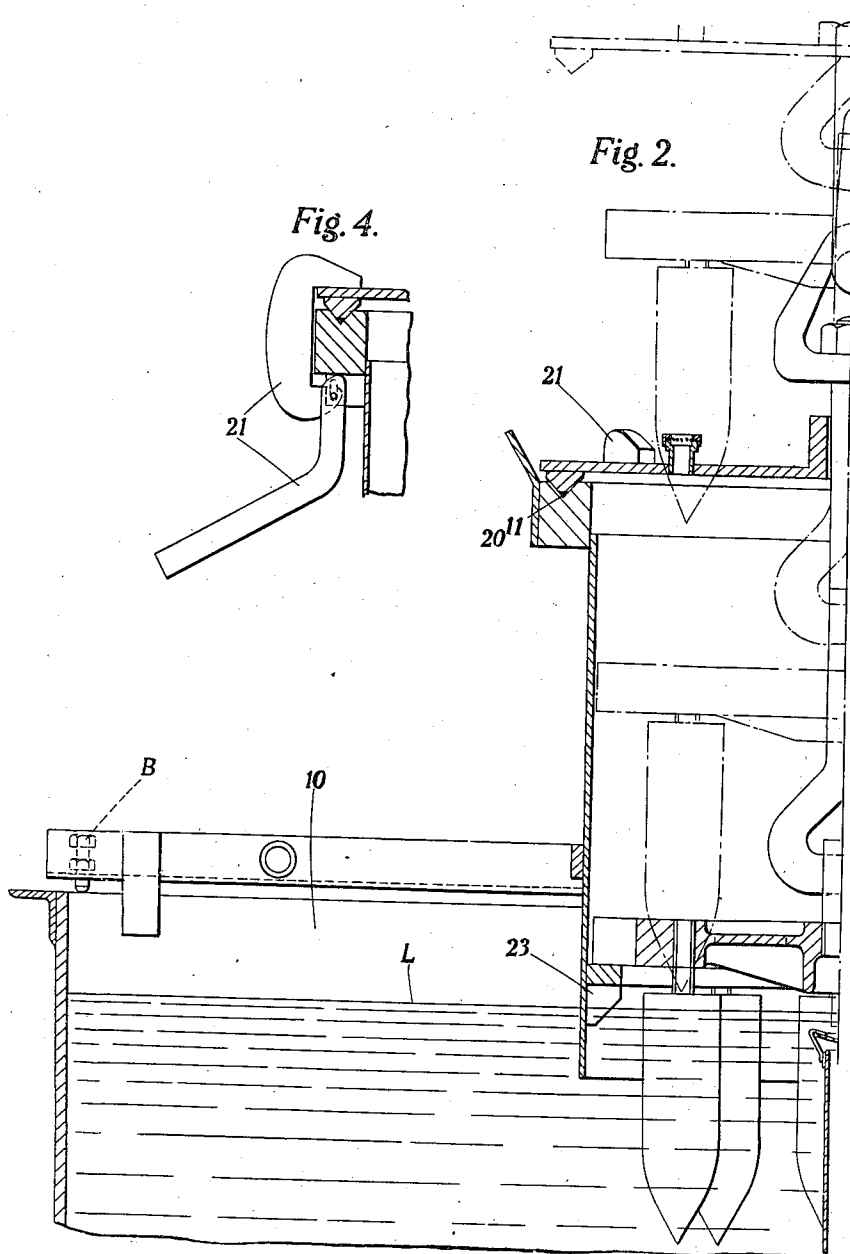
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TREATMENT OF METALS

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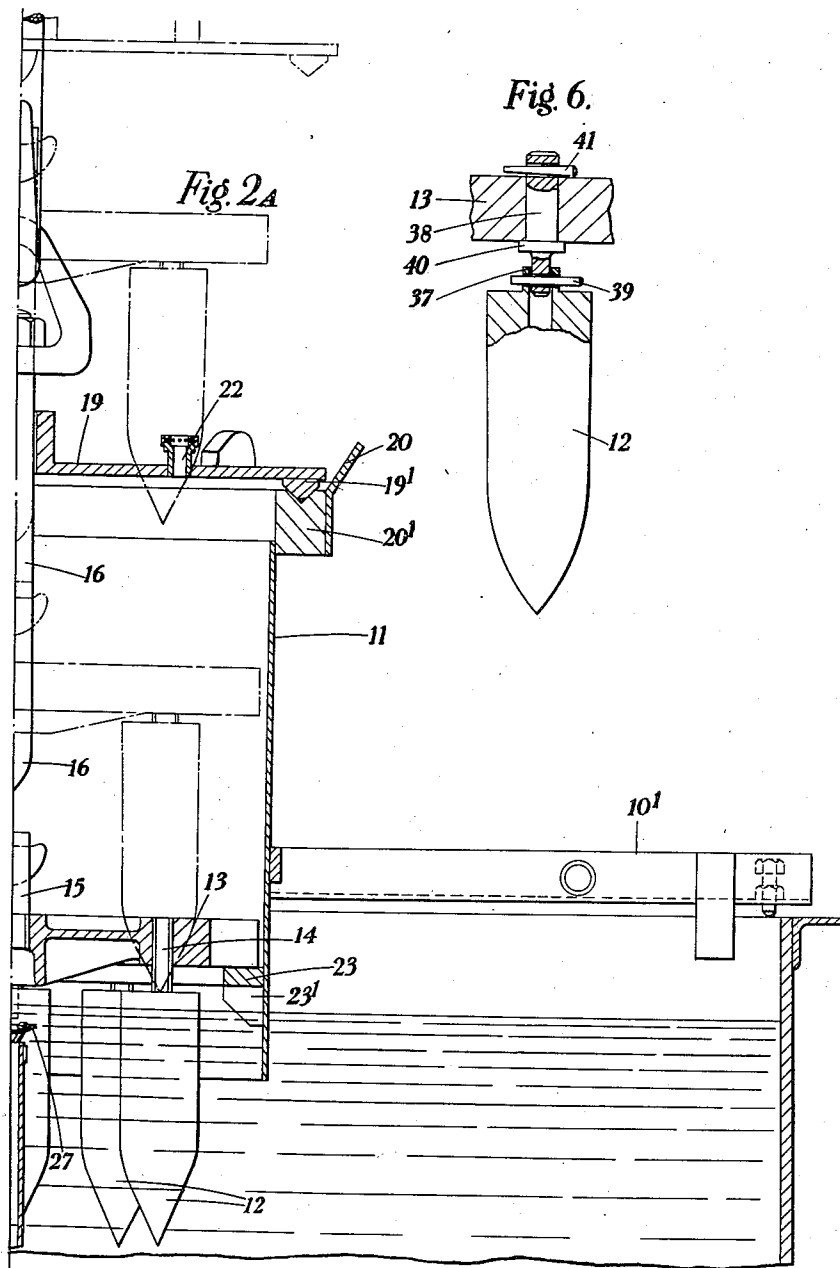
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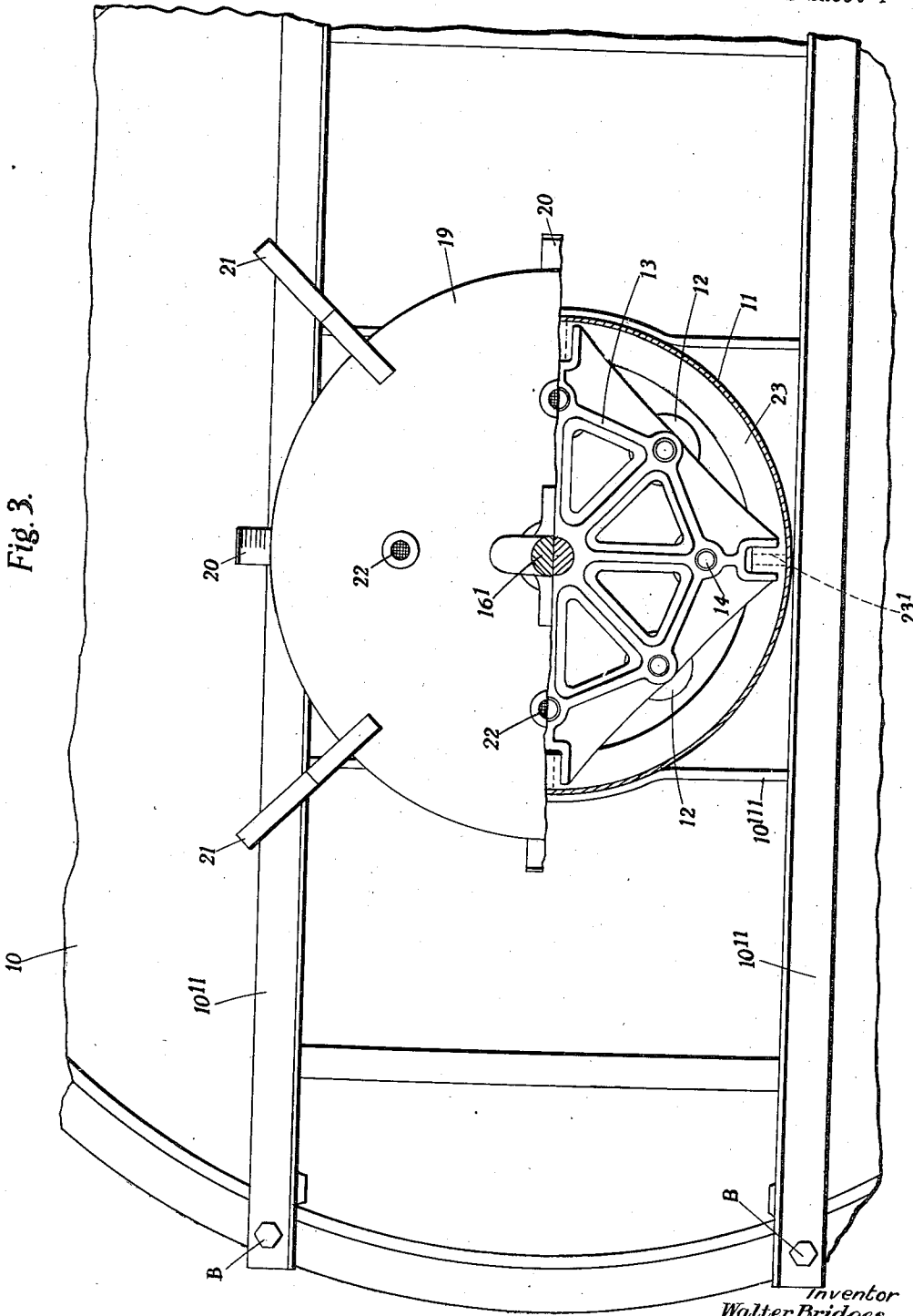
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Fig. 3.



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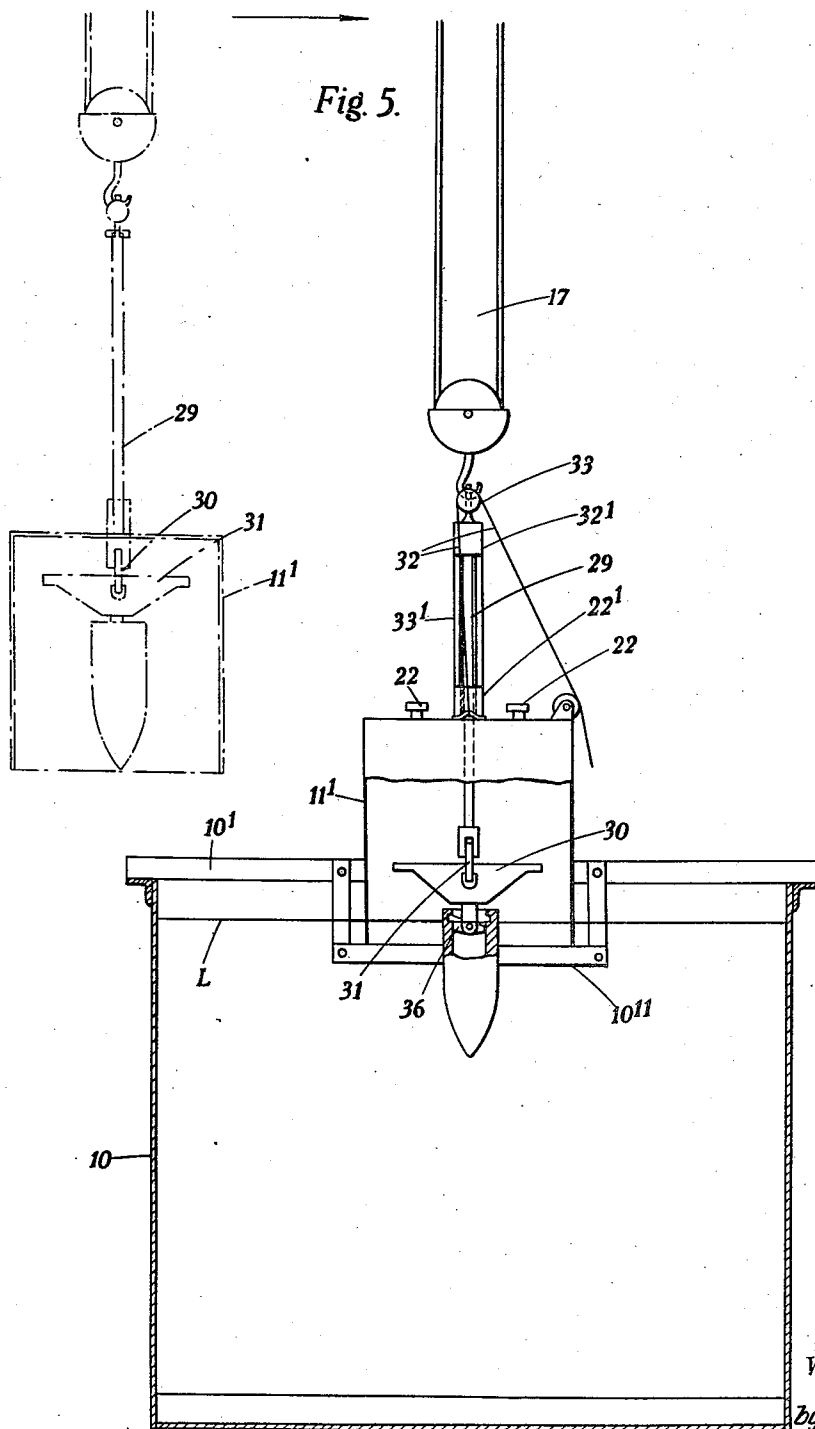
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TREATMENT OF METALS

2,280,470

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UNITED STATES PATENT OFFICE

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TREATMENT OF METALS

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In Great Britain July 12, 1939

7 Claims. (Cl. 148—21)

The invention relates to the heat treatment of metals and is more particularly concerned with the hardening, tempering, quenching or cooling of heated metals. The invention is especially applicable to the treatment of steel billets wherein they are heated and cooled for the purpose of producing the physical properties desired during or after forging operations.

A particular application of the invention is to the treatment of projectiles, especially armour-piercing projectiles.

It has been the practice in certain instances to heat the steel billet to a high temperature and to immerse the same in oil as a cooling or quenching medium. In this process considerable inconvenience has been caused when the temperature of the billet has been raised in excess of that at which the oil will fire. In those cases where the billet is only partly immersed in the oil there is a grave risk of the oil being fired by the heat of the un-immersed part of the billet. The main object of the present invention is to overcome the aforesaid difficulty and to ensure that in such circumstances the oil does not fire.

The present invention provides in the treatment of a billet or the like of metal (hereinafter referred to for the sake of convenience as a 'billet') a method or step of wholly or partly immersing said billet in oil in an atmosphere wholly or substantially devoid of oxygen. A feature of the present invention resides in utilising the heat of the billet for consuming the oxygen in said atmosphere. In carrying the invention into effect there may be employed a container which at its lower end affords access of the oil to the billet and at least during the immersion and preferably also prior to it the said lower end is sealed by the oil itself. For this purpose after the billet has been enclosed in the container, the two are lowered towards the oil until the seal is effected and the heated billet is further lowered within the container to effect the immersion. Alternatively, the billet and container may remain stationary whilst the oil (located in a drum or the like) is moved relatively thereto.

In a further alternative there may be employed a container that is open at the top and bottom and has its base immersed to effect the seal and the heated billet is lowered into the container, the top of the latter is closed, and the immersion is then effected.

Whichever method of immersion is employed cool oil is advantageously supplied to the region of immersion.

The invention also includes apparatus for carrying out the aforesaid treatment comprising an oil tank, a container for the billet, occupying or movable to occupy a position at which its lower end is immersed, and a billet support within the container which support is movable within the container to immerse the billet.

In order that the invention may be better understood reference will now be made to the accompanying drawings, in which

Figure 1 is a sectional elevation of one apparatus for carrying out the invention.

Figures 2 and 2a are sectional views on a larger scale of the container showing a number of billets immersed.

Figure 3 is a plan thereof, partly in section.

Figure 4 is a fragmentary sectional elevational view illustrating one of the clamps which may be employed for retaining the container cover in place.

Figure 5 is a section similar to Figure 1, but showing a modified form of the invention, and

Figure 6 is a fragmentary sectional elevational view illustrating a modified means for suspending the billets or projectiles.

The invention will be described as applied to the heat treatment of armour-piercing projectiles following which description its application to other billets will present no difficulties.

In the exercise of this invention employing the apparatus shown in Figures 1 to 4 there is a tank 10 provided at its upper open end with a supporting structure indicated at 10'. This structure may comprise two parallel angle irons 10'' and two stays 10''' at right angles thereto. By means of bolts indicated at B the height of the structure relatively to the tank may be varied. The tank is filled to level L with oil. At the top of this tank a container 11 open at the top and bottom is supported by said structure 10' and projects upwardly therefrom and downwardly therethrough so that its lower end is immersed in the oil to make an oil seal. The projectiles 12 prior or subsequent to their withdrawal from the furnace wherein they are treated are fastened to a carrier or spider 13 from which they are suspended, this spider 13 being of the skeleton form best shown in Figures 2 and 3. For example the projectiles may be secured thereto by screw-threaded spindles 14. The said carrier 13 is suspended by a ring 15 from a hook 16 itself carried by lifting tackle indicated generally at 17 that is adapted to run on an overhead conveyor 18. On the shank 16' of the hook 16 a cover or

lid 19 for the container 11 is slidably received. The loaded carrier is brought over the open top of the container and is then lowered by means of the lifting tackle 17 so that the carrier enters the container 11. In its downward passage the lid or closure 19 comes to rest on the top of the container and so closes it, a number of inclined projections 20 being provided around the top of the container for guiding the lid 19 to the correct attitude. The said lid may be clamped in its closed position by means of clamps such as are indicated at 21 in Figure 4 and an effective seal may be obtained by means of a V-shaped rim 19' on the underside of the plate 19 fitting into a corresponding groove formed in an annular ring 20' surrounding the upper part of the container 11. A sealing ring of asbestos or other suitable material may be provided as indicated at 20". At this stage it will be seen that the heated projectiles are enclosed in a container (container 11) which is completely sealed except for certain outlets 22 provided in the lid for the escape of the products of combustion. These outlets are desirably covered with wire gauze 28a. Since the volume of air within the closed container is comparatively restricted the heat of the projectiles deprives said air of oxygen by a process of combustion.

Continued downward movement of the carrier 13 subsequent to the closure of the lid 19 carries the projectiles down through the inert atmosphere in the container until they are partially immersed in the oil as illustrated in Figure 2. At this stage the carrier comes to rest on a ring 23 supported on suitable projections 23' placed to receive it inside the container. The height of the projections 23 may be adjustable to vary the depth to which the billets are immersed or alternatively the depth to which the billets are immersed is varied by the bolts B which as previously stated vary the height of the structure 10' relatively to the height of the tank 10; if desired the billets may be totally immersed.

The projectiles remain immersed until they are cooled to the required temperature and during the process of immersion and subsequent cooling (particularly during the initial stage of cooling) the oil is subjected to very considerable heat which results in partial vaporisation. The oil vapours rise up the container 11 but by virtue of the fact that such chamber is wholly or partially denuded of oxygen for the reasons stated the vapours are not ignited and the oil does not fire; the vapours exude to atmosphere through the gauze covered outlets 22, the effective size of which may if desired be adjustable.

During the immersion process it is preferred to supply cool oil to the region of immersion. For this purpose an oil tank (not shown) is provided with an outlet pipe 24 having a vertical branch 25 which leads by way of a cock 26 to a baffle 27 located immediately below the oil level L at a position centrally of the container 11. The oil under the action of gravity or a suitable pump in the pipe line passes by way of the open cock 26 and pipe line 25 and rises upwardly to the baffle 27 which functions to spread the oil outwardly. This ensures that the oil in this region is always kept fairly cool. The tank 10 may be filled from the pipe 24 through another cock 28.

In the apparatus illustrated in Figure 5 there is employed a container 11' which is separate from the tank 10 and has its top closed, said top being provided with small outlets 22, which are preferably covered with wire gauze. The com-

plete container is slidably mounted on a rod 29 suspended from lifting tackle 17 capable of being traversed along a gangway (not shown). The projectile or projectiles either prior or subsequent to removal from the furnace is or are attached to a carrier 30. In Figure 5 a single projectile is shown as being thus attached. This carrier is secured by means of a hook 31 to the lower end of the rod 29 with the container 11' in a raised position, whereafter and preferably immediately prior to immersion the container is lowered so that the projectile is enclosed therein as is illustrated in chain dotted lines at the left-hand side of Figure 5. This relative movement of the container 11' on the rod 29 may be effected by means of a cable or the like 32 held by the hand or secured to the container when it is desired to hold the latter in a raised position on the rod 29.

The projectile having itself been enclosed in the container its heat subsequent to such enclosure tends to denude the atmosphere within the container of oxygen especially after the container has been lowered as hereinafter described until its lower end is sealed by the oil in the tank 10. The container is traversed to a position above the tank 10 which tank is provided with a skeleton supporting structure 10' of drop frame section the central portion of which extends to below the surface L of the oil, and the container is lowered by means of the tackle 17 on to this central portion, which thus forms a supporting cradle 10a for its reception, and a limit for its downward movement. The container then occupies the position best illustrated in Figure 5. Continued lowering of the rod 29 relatively to the container results in the projectile being lowered within the container until it is immersed in the oil. The extent to which the projectile is immersed in the oil is preferably variable and may readily be determined by controlling the extent of downward movement of the rod 29. To this end a collar 32' is formed at the upper extremity of such rod or is otherwise conveniently located thereon and an upstanding boss 22' is formed exteriorly of the top of the container 11'. After the container in its downward movement has come to rest on the cradle 10a a distance piece 33' of predetermined length is inserted between the collar 32' and the boss 22' so that as the rod 29 is lowered the said distance piece is wedged between the collar and boss and the downward movement of the rod is arrested. It will thus be seen that by using distance pieces of different length the extent of the downward movement of the rod 29 and therefore the extent to which the projectile extends beyond the skeleton cradle 10a and is immersed in the oil is varied. Each of the distance pieces 33' may conveniently be of U section so that they embrace the rod 29 when positioned between the collar 32' and boss 22'. It will be appreciated that, as in the first example, the immersion of the heated projectile takes place in an atmosphere which is substantially devoid of oxygen with the advantageous results hereinbefore set forth.

The projectile may be secured to the carrier 30 in any suitable manner; for example the carrier may be provided with a lazy-tongs or toggle adapted to be expanded in the interior of the projectile. In the construction shown in Figure 5 a cross-piece 36 is pivoted to the carrier and when said cross-piece is received in the projectile one end of it engages an annular recess or groove

in the interior of the projectile and the other end of it wedges against the interior peripheral wall of the projectile, so that the projectile is itself firmly suspended.

Other means for attaching the projectile to the carrier may be employed. In particular a small boss or projection 37 (Figure 6) may be formed on the base of the projectile which boss is bored for the reception of a plain rod 38. Transverse holes in the rod and boss are brought into alignment and a pin 39 is inserted which locks the rod to the projectile. A flange 40 on the rod is adapted to bear on the underside of the carrier 13 and the rod projects upwardly through the carrier and is secured by a taper pin 41.

Any of the aforementioned means of attaching the projectiles to the carrier may of course be employed irrespective of whether one or a plurality of projectiles is attached to each carrier and irrespective of which of the methods of immersing the projectile in the oil is employed.

The foregoing embodiments of the invention are described merely by way of example and are not to be construed in a limiting sense; numerous other embodiments within the scope of the appended claims may be employed.

I claim:

1. In the heat treatment of metal billets wherein the billets are heated and then at least partially immersed in oil, the method of preventing ignition of the oil by the heat of the billets which comprises surrounding the heated billets with an air-containing enclosure; impoverishing the air within said enclosure by combustion; and effecting the immersion of the billets in the oil in the presence of such impoverished air.

2. In the heat treatment of metal billets wherein the billets are heated and then at least partially immersed in oil, the method of preventing ignition or flashing of the oil by the heat of the billets which comprises materially reducing the oxygen content of the air immediately surrounding the heated billets by combustion induced by the heat of the billets; and effecting the immersion of the billets in the oil in the presence of the impoverished air.

3. In the heat treatment of metal billets wherein the billets are heated and then at least partially immersed in oil, the method of preventing ignition or flashing of the oil by the heat of the billets which comprises segregating the air adjacent the heated billets from the surrounding atmosphere, whereby combustion induced by the heat of the billets will impoverish such segregated air; bringing said impoverished air into

proximity to the oil; and effecting the immersion of the billets in the oil in the presence of said impoverished air.

4. In the heat treatment of metal billets wherein the billets, subsequent to heating, are at least partially dipped into an oil bath, the method of preventing ignition or flashing of the oil by the heat of the billets which comprises mantling the billets in an enclosure having an open lower end, whereby the heat of the billets will effect a material reduction in the oxygen content of the air in said enclosure; immersing said open end of the enclosure in the oil bath to provide a restricted area of contact between the surface of the oil and the impoverished air in the enclosure; and dipping the billets into the oil within said restricted area.

5. A treatment according to claim 1, wherein the enclosure for the billets has an open top and an open base adjacent the oil surface and the heated billets are lowered into said enclosure through said open top; the top is then closed to confine the combustion; and relative movement is produced between the billets and the surface of the oil to effect the immersion.

6. In the heat treatment of a billet of metal, wherein the billet subsequent to heating is at least partly immersed in oil, the method of preventing combustion or flashing of the oil under the heat of the billet, which comprises introducing the heated billet into a comparatively cold container of restricted volume providing an air space, whereby the heat of the billet will impoverish the restricted volume of air in said container without raising the temperature of the latter above the flash point of the oil; blanketing the oil by said impoverished air; and immersing the heated billet in the blanketed oil.

7. In the heat treatment of a billet of metal, wherein the billet subsequent to heating is at least partially submerged beneath the surface of an oil bath, the process for the prevention of ignition or flashing of the oil due to the heat of the billet upon said submersion, which comprises heating the billet; then introducing it into a relatively cold mantle of restricted volume containing air, whereby the heat of the billet will impoverish the air in said mantle to an extent insufficient to support combustion or flashing of the oil of the bath without raising the temperature of the mantle above the flash point of the oil; blanketing the surface of the oil by said impoverished atmosphere; and effecting said submersion through the blanketed oil surface.

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