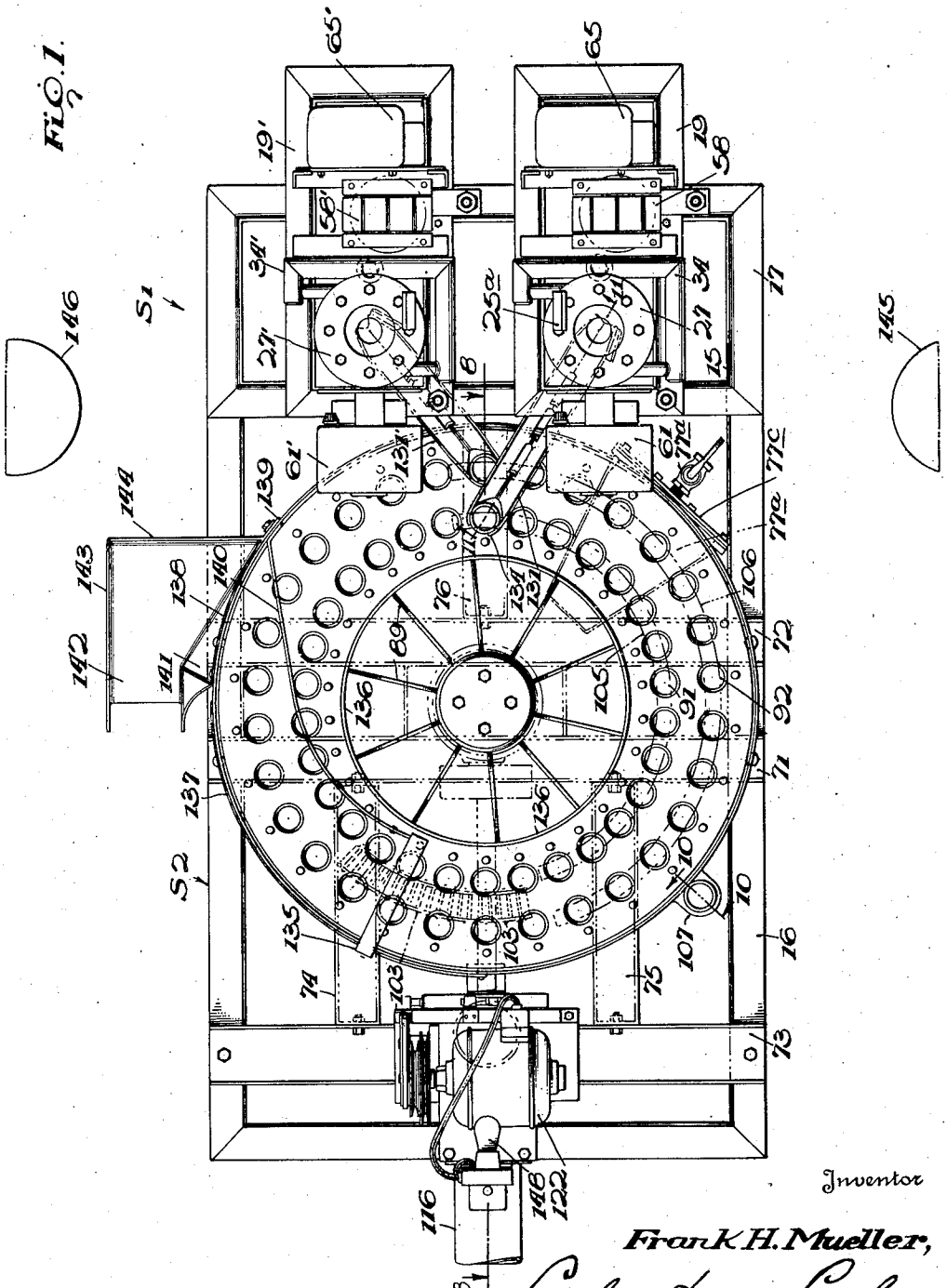
Dec. 21, 1948. F. H. MUELLER 2,456,984

APPARATUS FOR QUENCHING METALLIC ARTICLES

Filed Dec. 8, 1942 7 Sheets-Sheet 1

FIG. 1.



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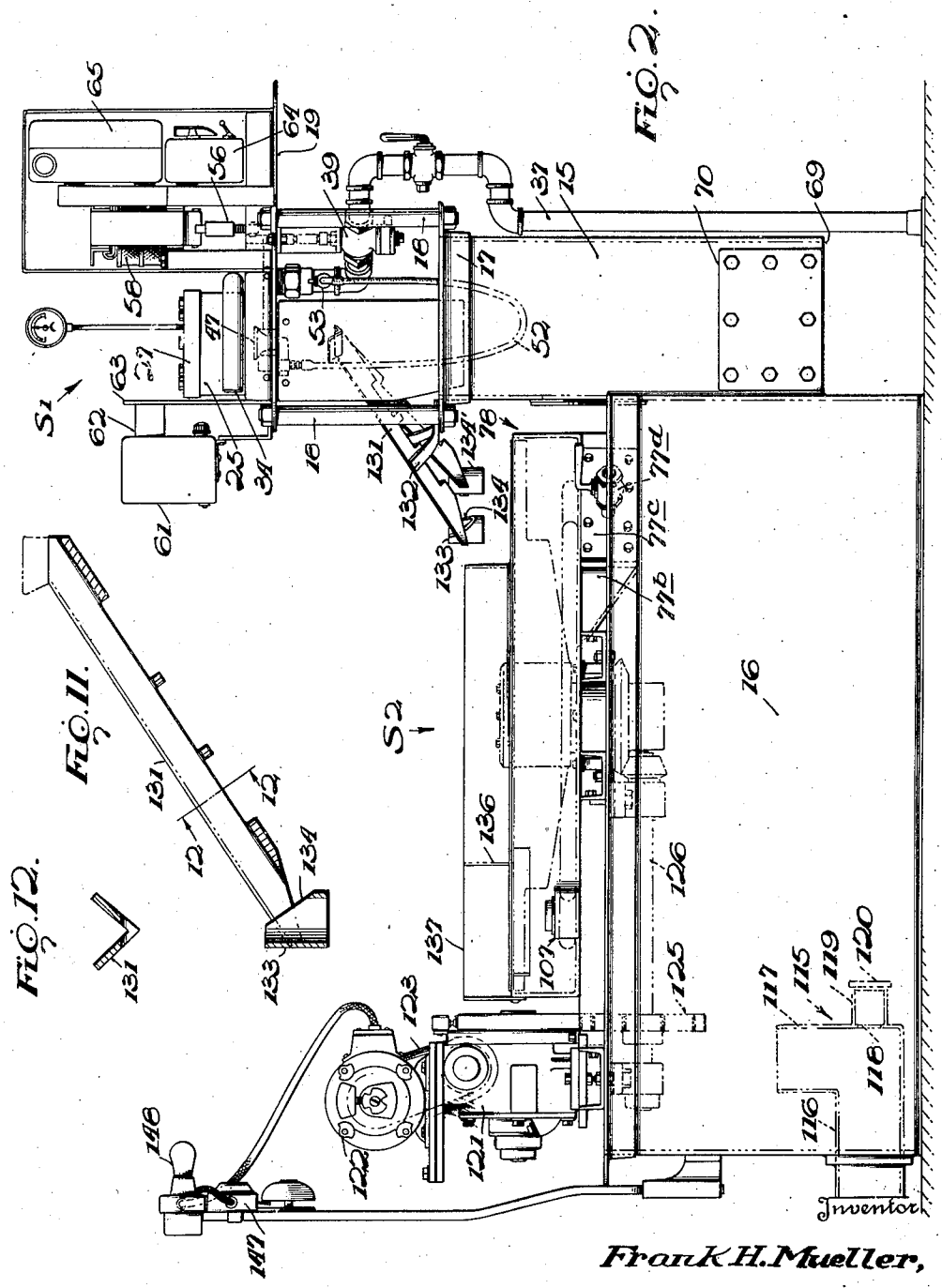

FIG. 2.

FIG. 11.

FIG. 12.

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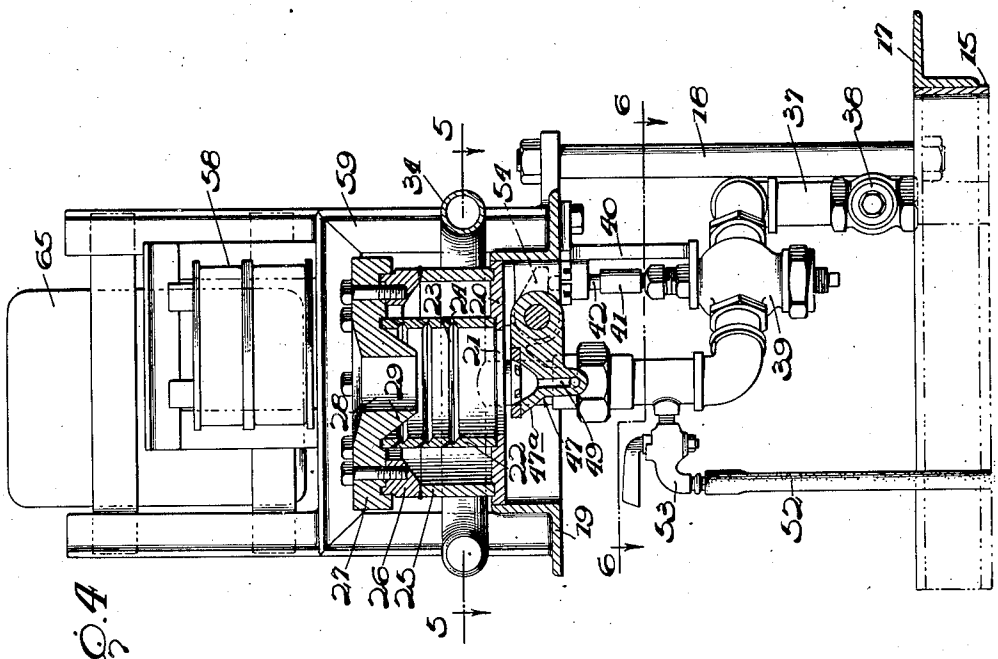

Fig. 4.

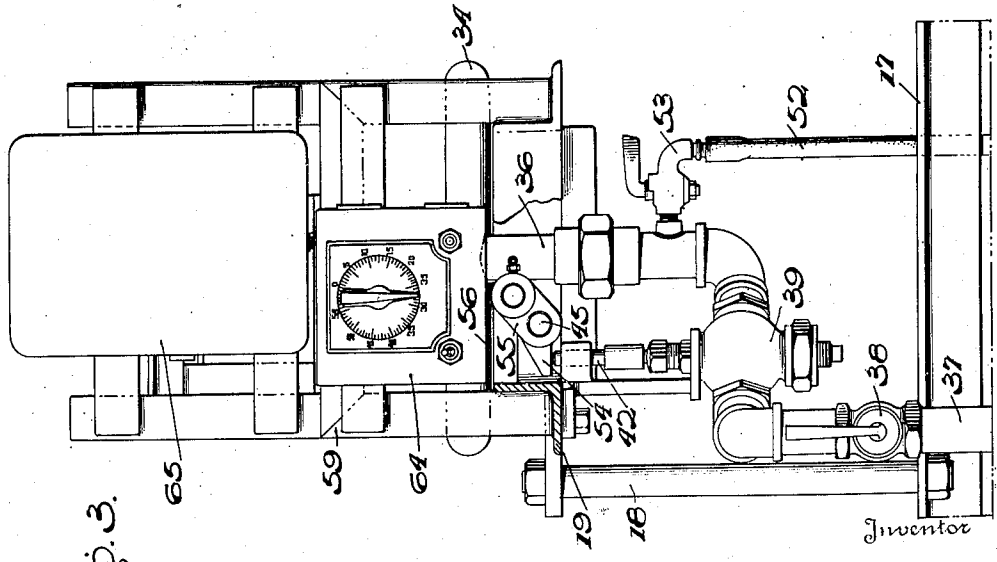

Fig. 3.

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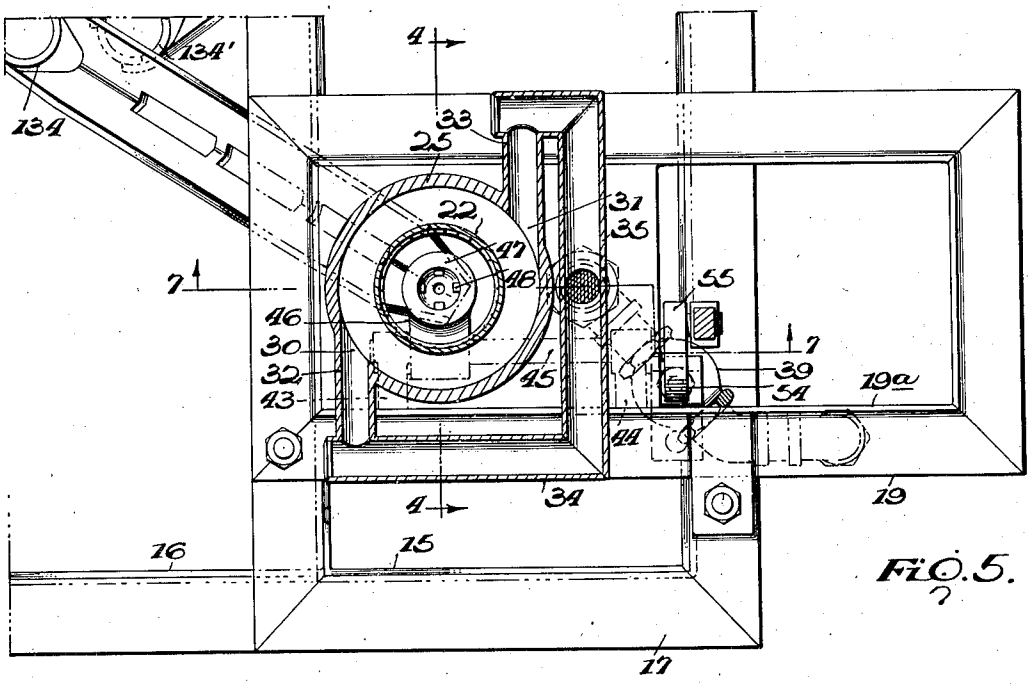

FIG. 5.

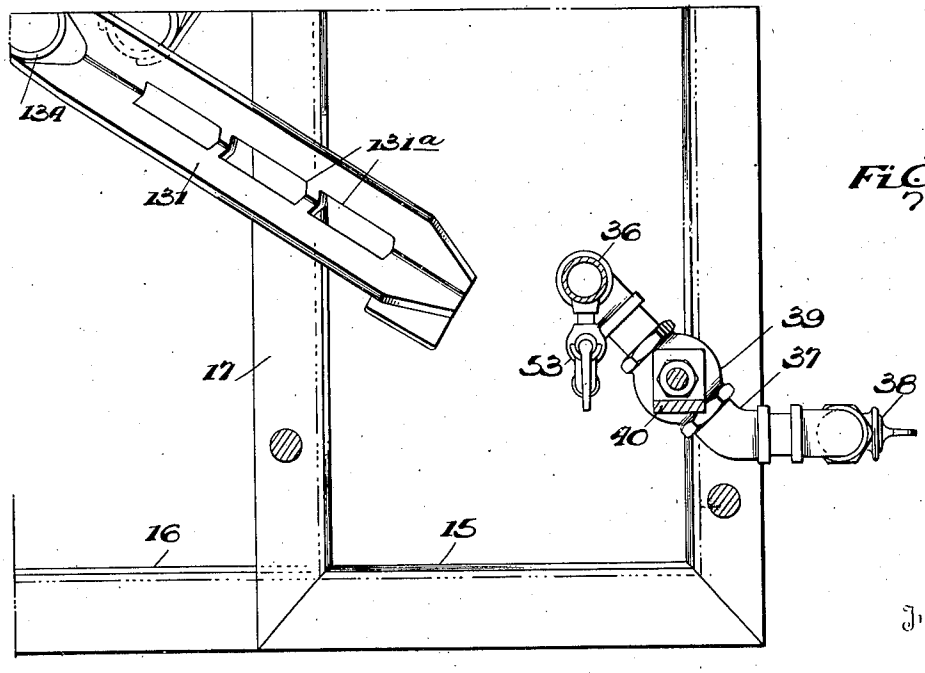

FIG. 6.

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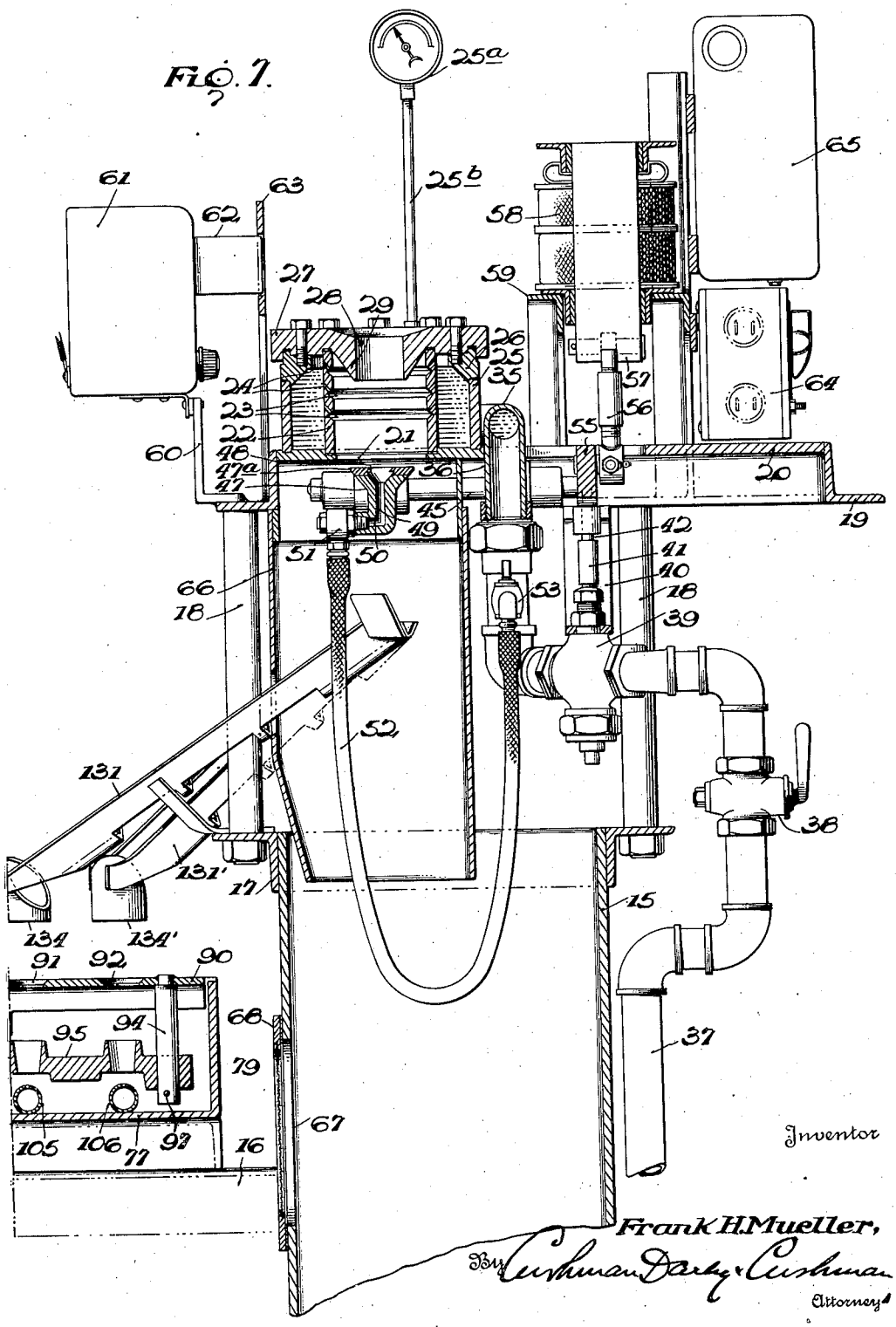
FIG. 7.



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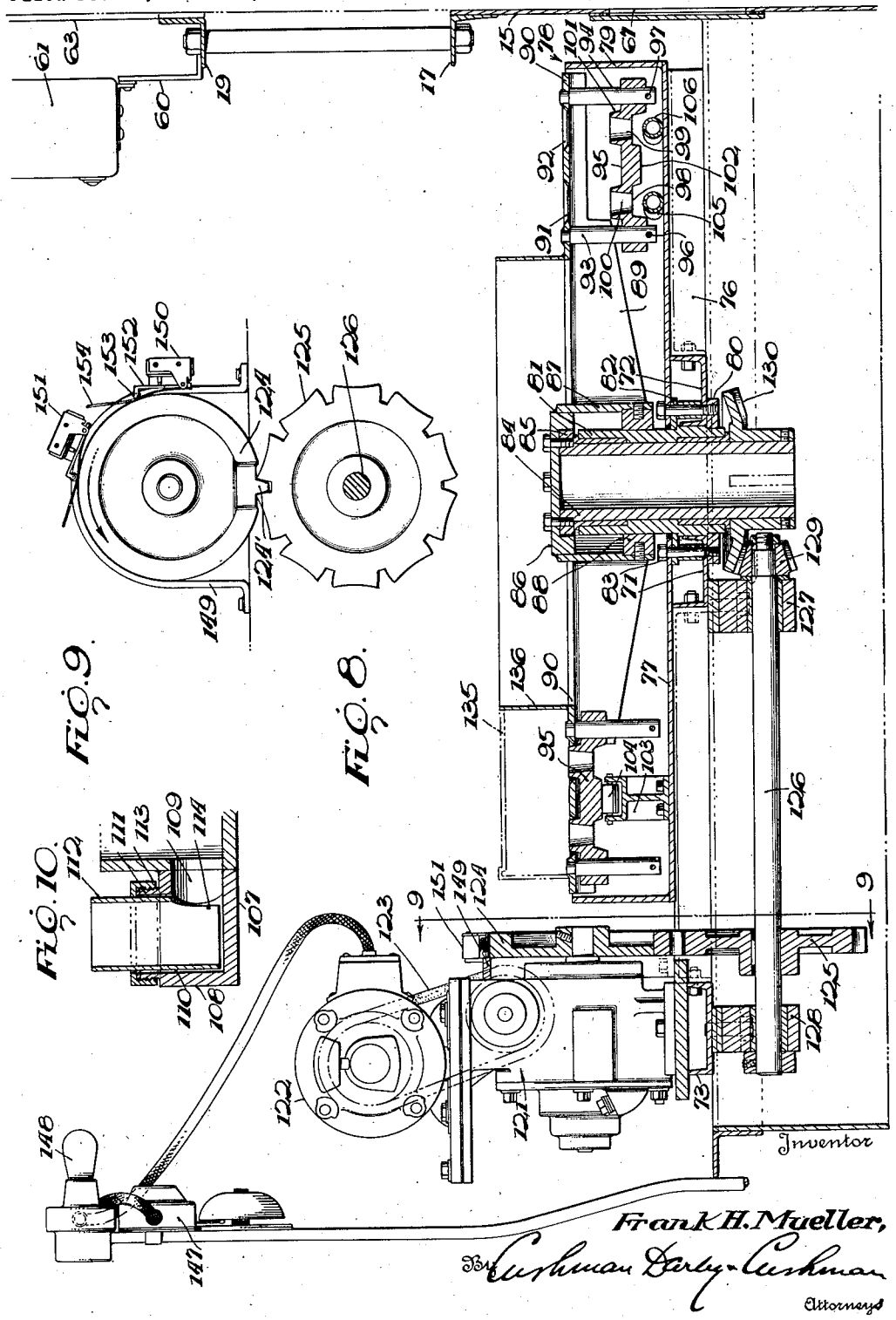

FIG. 9.

FIG. 8.

FIG. 10.

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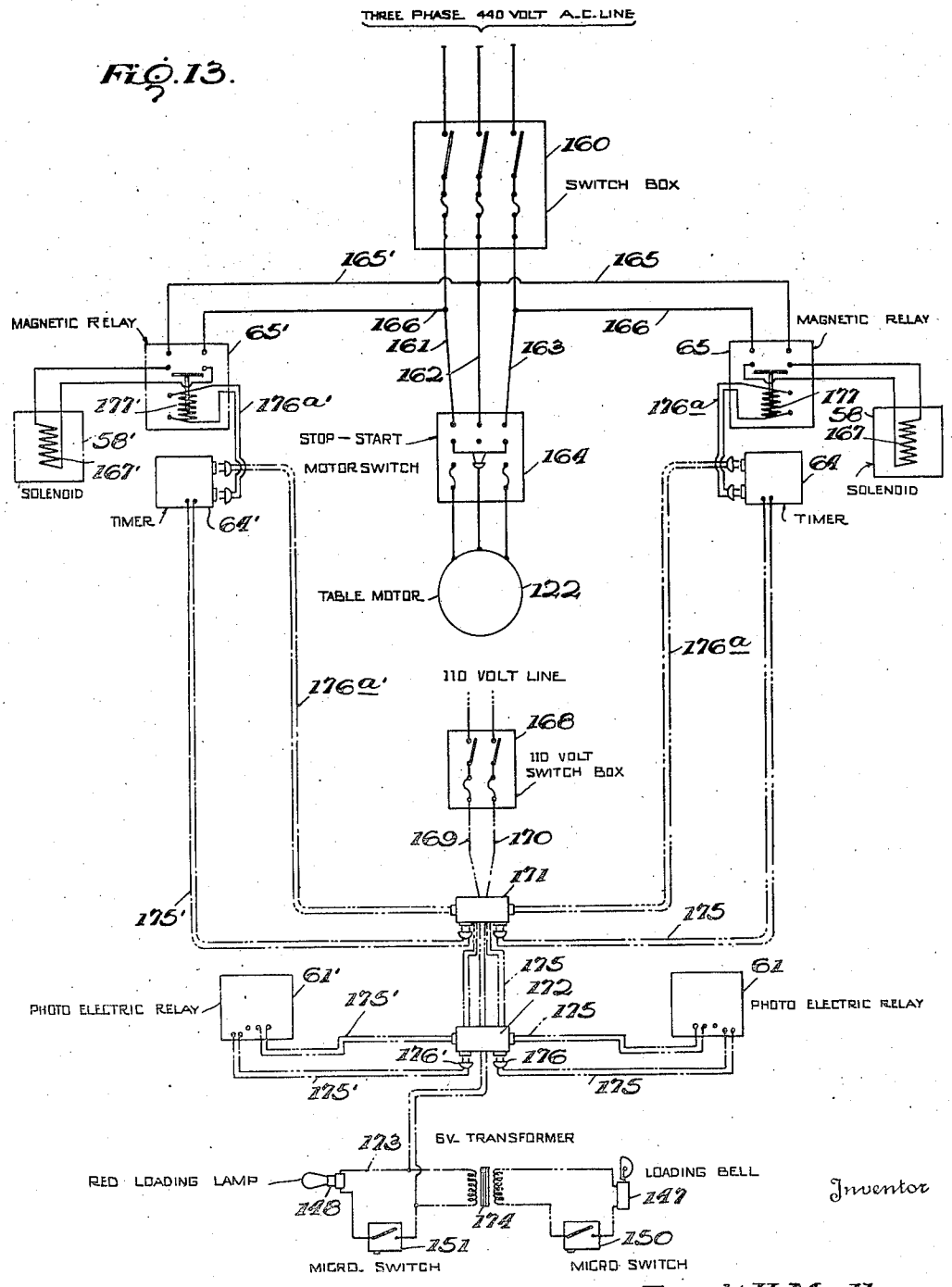
FIG. 13.



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Patented Dec. 21, 1948 2,456,984

UNITED STATES PATENT OFFICE

2,456,984

APPARATUS FOR QUENCHING METALLIC ARTICLES

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Application December 8, 1942, Serial No. 468,280

15 Claims. (Cl. 134—57)

1

This invention relates to method and apparatus for the heat treatment of articles of steel, and particularly articles of oblong shape, i. e., longer than broad, to provide therein successive longitudinal zones of different characteristics.

In the case of armor piercing steel projectiles or shot the metal at the head or nose must be extremely hard, whereas the metal in the forward portion of the projectile body must be of a toughness to withstand shattering forces, and the metal at the base may be relatively softer, but characterized by toughness. The main object of the present invention is to provide method and apparatus by which these characteristics can be readily imparted with speed and accuracy. According to the invention the suitably heated projectile is passed to a primary quenching station where it is subjected to a quenching action from its point back for a distance short of the band seat, and is then quickly passed to a secondary quenching station where the head only is subjected to a quenching action. The heat of the unquenched portion is then permitted to equalize throughout the quenched portion, the heat of equalization being such as to draw or temper the quenched portion. While the invention will be hereinafter described as applied in the treatment of projectiles, it is not limited in this respect and, as stated at the outset, is useful wherever the differential quenching of an oblong steel article is required. Other articles susceptible of treatment in accordance with the invention are chisels, bits and the like.

In the drawings, which show the apparatus of the invention in practical example:

Figure 1 is a plan view of the apparatus.

Figure 2 is a side elevation of the apparatus.

Figure 3 is an end elevation, on an enlarged scale of a part of the primary quenching station as seen from the right of Figure 2.

Figure 4 is a section substantially on line 4—4 of Figure 5.

Figure 5 is a section substantially on line 5—5 of Figure 4.

Figure 6 is a section substantially on line 6—6 of Figure 4.

Figure 7 is a section on line 7—7 of Figure 5.

Figure 8 is a section substantially on line 8—8 of Figure 1.

Figure 9 is a section substantially on line 9—9 of Figure 8.

Figure 10 is a section on line 10—10 of Figure 1.

Figure 11 is a section on line 11—11 of Figure 1.

Figure 12 is a section on line 12—12 of Figure 11, and

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Figure 13 is a wiring diagram.

The foundation for the apparatus, Figures 1 and 2, is provided by a rectangular tank 15 at the primary station S', this tank being supported in upwardly projecting relation by the end wall of a rectangular tank 16 at the secondary station S². The tank 15 is rimmed at its upper end by a rectangular formation 17 of angles from the outturned flanges of which rise pedestals 18 which support horizontal rectangular frames 19 and 19', each of which supports a primary quenching unit. The unit supported by the left hand frame 19 is detailed in Figures 2 to 7, and will be described. The right hand unit is a duplicate, and visible parts corresponding to those of the left hand unit will be given the primed reference numerals of the latter.

Frame 19 includes a top plate 20 provided with a circular opening 21 above tank 15, the upper margin of the opening being rabbetted and receiving on an interposed gasket the lower end of a cylinder 22. Interiorly cylinder 22 is provided with three vertically spaced annular grooves 23, these being angular in cross section with top and bottom walls at 45° to the horizontal planes in which their apices lie. Extending through the cylinder walls into the grooves are a plurality of small spray apertures 24, these meeting the upper groove walls at right angles. In other words, the perforations 24 are directed inwardly and downwardly at an angle of 45° to the vertical, and toward the axis of the cylinder.

Surrounding cylinder 22 in concentric relation thereto, is a cylinder 25 whose lower end is sealed in a groove in the top of plate 20. An anchoring ring 26 is welded to the top of cylinder 25 and secured to ring 26 is an annular lid 27 provided with concentric grooves in which are secured, through suitable gaskets, the end of cylinder 22 and an upstanding rib of ring 26. Lid 27 has a central vertical opening 28 whose diameter is slightly greater than the body diameter of the projectile to be quenched. Cylinder 25 and the portions of plate 20 and lid 27 included between it and cylinder 22, constitute a jacket for the latter. Downwardly, the opening 28 is rimmed by an annular flange or lip 29 which extends somewhat below the top groove 23 and whose outer wall tapers downwardly to a bottom edge. The upper margins of opening 28 are beveled.

Referring particularly to Figure 5, cylinder 25 has ports 30 and 31 substantially tangential to cylinder 22 and into which are connected pipe sections 32 and 33 which connect into a three-sided manifold 34. Section 35 of the manifold

has a bottom opening substantially midway between the points of connection of sections 32 and 33 with the manifold and depending from section 35 in communication with the said opening is a short pipe section 36, Figure 7.

Reference numeral 37 designates a supply pipe for quenching fluid, which may here be assumed to be cold water, this line being in connection with pipe section 36 through a throttling valve 38 and a reciprocating shut-off valve 39 supported on a bracket 40 depending from the frame 19 and having a vertically reciprocable actuating plunger which, through a collar 41, is connected to a push rod 42 guided in an ear at the upper end of bracket 40. The valve plunger is normally spring-urged to an upper position in which valve 39 is closed. In the drawings the plunger is shown as depressed, which means that the valve is open. Under these circumstances, quenching fluid, in volume determined by the adjustment of valve 38, is lead to the manifold 34 and thence to the annular chamber between cylinders 22 and 25. Due to the tangential arrangement of the ports 30 and 31, the fluid is given a swirling motion in the annular chamber, and is sprayed downwardly into the quenching chamber defined by cylinder 22 through the downwardly directed perforations 24 so as to quickly supply a large number of quenching streams directed downwardly toward the axis of the quenching chamber. Pressure in the jacket is controlled by reference to a gauge 25a in communication with the jacket interior through a tube 25b.

Mounted in bearing blocks 43 and 44 which project inwardly from frame member 19a, is a rock shaft 45 to which is fixed a holder 47 including radial arm 46 which terminates in a bowl 47a which in one limit position of the rock shaft assumes a position in which it is coaxial with the opening 28 of the lid 27 just below plate 20, as shown. The downwardly tapering cavity or chamber of the bowl is provided with a number of inwardly projecting lugs 48 and a passage 49 leads from the bottom of the bowl to a lateral port 50 into which is threaded a coupling member 51 to which is connected one end of a loose length of flexible hose 52 whose other end is in connection with a cock 53 inserted in the supply line 37 on the discharge side of valve 39. In the illustrated position of bowl 47, it is adapted to receive the head of a projectile passed through the opening 29 and to support the projectile for quenching throughout a certain length, i. e., up to lip 29. The valve 39 being open, it will be seen that quenching fluid will be supplied to the passage 49, as controlled by cock 53, and will be directed upwardly against and around the head of a supported shot whereby it is deflected outwardly, any splashing of the fluid upwardly beyond a certain length of the projectile being prevented by the lip 29. Thus, fluid being simultaneously supplied through perforations 24, the forward portion of the projectile will be thoroughly quenched, whereas the portion of the projectile upwardly of the lower edge of flange 29 will be thoroughly protected against the quenching fluid and will substantially retain its heat.

The supply of quenching fluid through the holder has also the important effect of preventing overheating of the latter.

Rock shaft 45 has fixed thereto a radially projecting finger 54 which overlies the push rod 42 of valve 39 as most clearly seen in Figure 3 wherein the finger is holding the push rod depressed so that valve 39 is open, the holder 47 being at the same time in the illustrated supporting position. Finger 54, as here shown, is part of a generally oppositely projecting arm 55 which through a longitudinally adjustable link 56 is pivoted to the vertically reciprocable element 57 of a solenoid 58 supported on a frame 59 which rises from frame 19. In the various views the solenoid is considered to be energized so that its core is in its upper limit position and thus has rocked shaft 45 so as to bring the holder 47 into operative position beneath the quenching chamber and to depress push rod 42 through finger 54. Upon deenergization of the solenoid, the holder 47 swings downwardly under the weight of the shot until arm 46 is in a substantially vertical position so that the projectile is released, its verticality being maintained by the longitudinally extended walls of openings 28, and immediately drops straight down from the quenching chamber. At the same time, finger 54 releases push rod 42 and valve 39 closes. Quenching fluid is thus supplied only when the holder is in operative relation with respect to the quenching chamber.

It is a feature of the invention that the holder 47 will automatically move to operative position and valve 39 open when a projectile is passing into the charging opening 28. The projectile itself activates means as a result of which the solenoid is energized and maintained so for a predetermined period.

Mounted on a bracket 60 rising from frame 19 on the opposite side of the quenching fixture from solenoid 58, is a housing 61 from which a tube 62 projects toward the quenching fixture with its extremity received in an opening in a guard 63, the axis of tube 62 substantially intersecting the axis of opening 28 of the quenching fixture lid. Within housing 61 is disposed a photoelectric cell in a position to be affected by an incandescent projectile passing by the open end of tube 62 to the quenching fixture. Activation of the photo-electric cell operates a relay to close a feeding circuit to a timer 64 which in turn closes, for a period determined by the setting of the timer, a circuit to a relay in the housing 65, which in turn establishes a circuit to the solenoid. The timer 64 and magnetic relay 65 are supported by frame 59 as most clearly shown in Figure 7. The various circuits will be particularly described later on with reference to the diagram of Figure 13.

Thus each time an incandescent shot is passed before the photo-electric cell, the solenoid will be operated, holder 47 will assume its operative position, and valve 39 will be simultaneously opened so that the forward end of the supported projectile will be quenched for the period determined by the timer. The quenching fluid escapes downwardly, confined by a guard 66 which depends from frame 19, into tank 15. The latter is provided with an overflow opening 67 to tank 16, escape being through a screen mounted in a holder 68 surrounding opening 67. The tank 15 extends downwardly and below the overflow opening to a bottom wall 69 to provide a settling sump having a clean-out opening closed by a removable plate 70, Figure 2.

Supported on top of tank 16 is a pair of transverse channels 71 and 72, Figures 1 and 8, these being located relatively close together in parallel relation. Spaced to the left of channel 71, Figures 1 and 8, is a further transverse channel 73

which is connected to channel 71 through longitudinals 74 and 75. A longitudinal 76 projects from channel 72 toward tank 15. Supported on elements 71, 72, and 74 to 76 is the bottom 77 of a pan 78 which has a cylindrical side wall 79. Bolted to the adjacent lower margins of channels 71 and 72 is a horizontal ring 80 which supports the shouldered lower end of a vertical tubular bearing 81 which rises into pan 78 through a central opening in the bottom 77. Through a sealing ring 82 the bottom is sealed to bearing 81 and is secured to channels 71 and 72 through bolts 83 and spacers. A hollow vertical shaft 84 is journaled in sleeve 81 through top and bottom bushings, the shaft having thrust bearing with the upper edge of sleeve 81, through an out-turned annular flange 85, integral with the upper end of shaft 84, and an out-turned annular portion of the upper bushing.

A circular cap 86 secured to the top of shaft 84 has a cylindrical depending skirt 87 to whose lower inner margin is secured a spacing ring 88 which bears against the exterior of sleeve 81. Radial arms or spokes 89 project from the hub 87 and at their outer ends support an annular table 90 concentrically with shaft 84.

Table 90 is provided with two circular series of circular openings 91 and 92 concentric with the table axis. The openings of each individual series are equally spaced apart and each opening of each series is on a table radius with an opening of the other series. All the openings have the same diameter which, in the present instance, is somewhat greater than that necessary to freely pass the projectile bodies. On the same table radius as each set of inner and outer openings 91 and 92, vertically depending pins 93 and 94 have reduced ends welded in apertures in the table, pins 93 being disposed inwardly of openings 91 and pins 94 outwardly of openings 92. Each set of pins 93, 94 guides for vertical reciprocation a carrier in the form of an elongated block 95 which has bores slidingly receiving the pins, the carriers being supported by the pins in lower limit position on abutments 96 and 97 at the lower ends of the pins. Each carrier 95 has vertical openings 98 and 99 aligned with openings 91 and 92, respectively. The openings are somewhat upwardly flared through rimming flanges 100 and 101 to a top diameter substantially less than the body diameter of the projectile so as to be able to receive the tip portion of the projectile head and to support the projectile as steadied in the table openings. Beneath the openings 98 and 99 the blocks are upwardly offset to provide a central bottom follower portion 102. Located in the path of the latter, substantially opposite tank 15, is a ramp 103 having rollers 104 and as each carrier comes to the ramp as the table is rotated in clockwise direction, Figure 1, it will be lifted from the lower limit position shown at the right, Figure 8, to the upper limit position shown at the left, Figure 8, wherein the flanges 100 and 101 project through openings 91 and 92 substantially to the top level of the plate.

Arcuate pipes 105 and 106 are arranged on the bottom of the tank and extend beneath the carrier openings from a point adjacent tank 15 clockwise substantially up to the ramp 103. Valved supply lines for cold water lead to pipes 105 and 106 and the latter are provided along their length with top perforations through which the water enters the pan with agitating effect on the body of water maintained therein by an overflow fitting 107, Figures 1, 2 and 10.

Referring to Figure 10 in particular, the fitting 107 comprises a body 108 having a horizontal port 109 leading to an upwardly extending cavity 110 which is rimmed by a top threaded flange 111. The fitting is welded to the lower side wall 79 of the pan in a position above tank 16 and with its port 109 in communication with an opening in the pan side wall just above the bottom 77. A tube 112 projects upwardly from cavity 110 and is adapted to be locked in vertically adjusted position through a packing including a gland nut 113 threaded on flange 111. The lower end of tube 112 is recessed at 114 so as not to block flow through port 109. The tube is adjusted so that the liquid is maintained at such level in the tank that only the head portion of the projectiles will be in the water when the carriers are in their lower limit positions. When the carriers are in their disclosed upper limit positions the projectiles are entirely above the level of the water in the pan. The bottom 77 of the pan is cut away at 77*a*, Figure 1, above a sump 77*b*, Figure 2, which has a clean-out opening closed by a removable plate 77*c* which is equipped with a drain cock 77*d*.

Overflow from fitting 107 goes to tank 16, the latter being provided with an overflow fitting 115 which appears most clearly at the lower left of Figure 2. The fitting comprises a tubular horizontal portion 116 and a vertical portion 117, the former being welded in an opening in a wall of the tank adjacent the tank bottom. Portion 117 has an aperture 118 adjacent its bottom and welded around this opening, externally thereof, is a collar 119 which is threaded to take a plug 120. With plug 120 applied, the liquid draining into tank 16 will rise until it can escape over the top of the vertical fitting portion 117, so that foreign matter can settle out and not be carried over. When it is desired to clean out the tank, plug 120 is removed to permit the water to drain out through opening 118. The sludge can then be readily removed. These settling provisions are desirable inasmuch as for economical operation the water draining from tank 16 is collected and recirculated.

In Figures 1, 2 and 8, reference numeral 121 designates a variable speed reducer supported on angle 73 and in turn supporting an electric motor 122 whose armature shaft is connected to the input shaft of the reducer through a belt 123. Fixed on the out-put shaft of the reducer is the single toother drive element 124 of Geneva gearing which includes the ten-toother driven element 125 fixed on a shaft 126 journaled in hangers 127 and 128 beneath frame members 71 and 73. Shaft 126 has fixed thereon a bevel pinion 129 which is in operative engagement with a bevel gear 130 fixed on the lower end of shaft 84. Thus, when motor 122 is in operation, the table 90 is indexed or stepped at intervals determined by the out-put speed of the reducer.

An inclined chute 131, Figures 1, 2, 11 and 12, supported from an angle 17 at the upper end of tank 15 by means of a bracket 132, has its upper end disposed on the axis of the quenching chamber defined by cylinder 22 and out of the path of swing of the holder 47 so as to be able to receive the shot released by the latter. The chute is in the form of an angular trough and terminates downwardly above the circle of the inner series of table perforations 91. The lower end of the chute is split to provide extensions which are welded to a tubular deflector 133 which is disposed on a vertical axis, the inner side of

the deflector being cut away at 134 to permit access of the shot thereto. When a quenched projectile is released by the holder 47 it drops into the upper end of the chute and slides down the chute head first to be directed vertically downwardly by the deflector 133 into a table opening 91. The chute is provided with bottom drainage openings 131a, Figure 6, so that hot fluid from the primary quencher will not dilute the fluid in pan 78. The table drive is so coordinated with the delivery periods of the primary quencher, that upon each delivery by the latter an opening 91 will be directly below the deflector 133 and the table will have been indexed to bring a succeeding opening 91 into register with the deflector prior to the next delivery. The other primary quenching unit delivers in the same manner and simultaneously to chute 131' which is arranged to transfer the received projectile to the table openings 92 of the outer series.

The projectiles thus delivered in pairs to successive carriers 95 move around the pan step by step and are eventually elevated by the ramp to the position shown at the left of Figure 8. Since only the lower tapered portion of the head is received in the carrier openings, the projectiles are freely tiltable when thus elevated and at this point they engage a horizontal bar 135 which extends across the table and are forced to tip backwardly into the table. To prevent them from rolling off, a cylindrical guard 136 is fixed in upwardly extending relation to the inner edge of the table and a guard 137 is provided on the upper edge of the pan, extending from the ramp to one side of a discharge opening 138, Figure 1. The other side of the opening 138 is defined by an upwardly extending bar 139 to which is fixed a deflector plate 140 whose other end terminates adjacent the guard 136 at the bar 135. Consequently, as the table moves around the projectiles lying on the table are forced by the deflector through the opening 138 and down an apron 141 to a receiving table 142 which as retaining walls 143 and 144.

Proper coordination of the delivery by the primary quenching units to the table of the secondary unit requires that the projectiles be charged with fairly accurate timing into the primary units. The charging is done manually by workmen standing at the sides of the primary station, one withdrawing heated projectiles from heating apparatus 145, which is preferably a lead pot, and delivering them to the left hand primary quenching unit, and the other withdrawing heated projectiles from the lead pot 146 and passing them to the right hand quenching unit.

In order that the workmen may be enabled to charge the primary units at the proper intervals, I provide signalling apparatus in the form of an electric bell 147 and an electric lamp 148, upper right, Figure 8. Just before it is time to recharge the units, the bell rings and the workmen are thus notified to withdraw shot from the pots. After an interval giving them time for this operation, the light shows, indicating that the shots should be charged into the units. The operation of the signalling means is effected from the drive element 124 of the Geneva gearing, this element, of course, making one revolution between each indexing of the table 90.

Referring to Figures 8 and 9, a bowed support 149, disposed between wheel 124 and the speed reducer, carries brackets on which are mounted a pair of normally open micro-switches 150 and 151. The switch 150 has an operating arm 152 which carries a roller 153 resting on a spring finger 154 which is in the path of the tooth 124' of wheel 124. Switch 151 is of identical construction and includes a spring arm 155 likewise in the path of tooth 124' and beyond finger 154, since tooth 124' is moving in the direction of the arrow. In Figure 9 the indexing of wheel 125 is half completed and when it is completed a new set of openings 91 and 92 will be in receiving relation to chutes 131 and 131'. Between this time and the next indexing movement the primary units must be charged, the primary quench completed, and the quenched projectiles delivered to the table of the secondary unit. As tooth 124' continues its circuit, it strikes finger 154 and closes switch 150 and the bell 147 will ring until the tooth has passed beyond the finger. As the tooth continues its travel it will similarly close switch 151 so that light 148 will show for a short period and by the end of this period the primary units should have been charged. Primary quenching and delivery to the table of the secondary unit are completed prior to the time tooth 124' again engages wheel 125.

In Figure 13, a three-phase 400-volt A. C. line is shown as led into a main line switch box 160. Leads 161, 162 and 163 go to the table motor 122 through a stop and start motor switch 164. Wires 165 and 166 go from leads 162 and 163 respectively to the coil 167 of solenoid 58 through the relay 65.

A 110-volt line is led into a switch box 168 whence conductors 169 and 170 go to junction boxes 171 and 172 and to a circuit 173 which includes lamp 148 and micro-switch 151. Conductors 169 and 170 also go to the primary coil of a 6-volt transformer 174 whose secondary is in circuit with bell 147 and micro-switch 150.

A feeder line 175 for the timer starts at a plug 176 at junction box 172, goes to the photo-electric relay in the housing 61, thence back to box 172, thence to box 171, and thence to the timer. The feeder line for the timer is closed when the cell associated with the photo-electric relay is activated, the timer thereupon closing a circuit 176a leading from junction box 171 to the coil 177 of relay 65, and maintaining the circuit for an exact period as determined by the timer setting. Energization of coil 177 closes the circuit including the coil 167 of solenoid 58 for the period determined by the timer.

As timed by the signalling devices 147 and 148, the workmen deliver the projectiles from the lead pots to the primary quenching devices. The lead pot is a preferred form of heating apparatus for the reason that the projectiles can be readily brought thereby to a uniform temperature. This temperature is above the transformation point, for example, from 1500 to 1700° F.

As red hot projectiles are passed in front of the photo-electric cells, the solenoids 58 and 58' are energized so that the holders swing instantaneously to holding position and the valves as at 39 are opened. After a predetermined relatively short period during which only the projectile head and forward body portions are quenched, the timers cause the deenergization of the solenoids so that the projectiles are released and the valves as at 39 are closed. The period of this preliminary quenching is variable but in the case of a 37 millimeter shot may be about 17 seconds. The period will alter in accordance with such factors as the type of steel of which the shot are made. At the end of the quench, the head of the shot may be at

a temperature of around 150° F., with the base still red hot, or substantially so.

After the release of the projectiles from the primary units, they quickly pass by gravity to the inner and outer openings of the table of the secondary apparatus and are supported by the carriers with only their head portions below the level of the quenching fluid. The secondary quench is maintained for a longer period than the primary quench and may last for several minutes. It is terminated when the ramp lifts the carriers to their upper limit, and, of course, the disposition of the ramp relative to the chutes determines the length of the re-quenching period, which can be varied to some extent without altering the setting of the timers.

During re-quenching, the heat of the unquenched portion of the shot starts to equalize as far as possible, and this equalization is allowed to continue throughout the quenched portion after the termination of the secondary quench. Then the projectiles are permitted to cool to room temperature. Equalization occurs from around 325 to 350° F., so that a drawing or tempering of the quenched portion of the projectile is effected, and a superior article with the required differential zones is produced. It is a feature of the invention that quenching and re-quenching are carried out in such quick succession that thereafter the unquenched portion is enabled to furnish sufficient heat to draw or temper the quenched portion of the article.

It will be understood that the invention is susceptible of variations without departure from the scope of the claims which follow. The apparatus may be adapted for the handling of articles other than projectiles, where such adaptation is necessary. In the case of articles of considerable length, it is only necessary to heat such a length thereof, in addition to the portion to be quenched, that the heat of the unquenched portion will suffice to draw or temper the quenched portion upon equalization.

I claim:

1. Quenching apparatus comprising a quenching chamber having a charging opening and a bottom opening, a support movable to and from a fixed position under said bottom opening wherein it is adapted to support an article immovably in said chamber, means for moving said support to supporting position and for holding the same against relative movement in said position, means activated by an article which is being passed into said charging opening for initiating operation of said moving means, and means for removing the support to a non-supporting position after a predetermined period to release the article.

2. Quenching apparatus comprising a quenching chamber having a charging opening and bottom opening, a support movable to and from a fixed position under said bottom opening wherein it is adapted to support an article against relative movement in said chamber, means for moving said support from an inoperative position to supporting position, means for actuating said moving means to shift the support from the inoperative position to the supporting position, the last mentioned means including a photo-electric cell disposed adjacent said charging opening so as to be affected by an incandescent article which is being passed into said charging opening, and means for moving the support to the inoperative position after a predetermined period to release the article.

3. Quenching apparatus comprising a quenching chamber having a charging opening and a bottom opening, a support movable to and from a fixed position under said bottom opening wherein it is adapted to support an article in said chamber, means including a solenoid mechanically connected to the support for moving said support to and maintaining it immovably in supporting position, a circuit for said solenoid, and a timer controlling said circuit to move the support from the supporting position after a predetermined time interval.

4. Quenching apparatus comprising a quenching chamber having a charging opening and a bottom opening, a support movable to and from a fixed position under said bottom opening wherein it is adapted to support an article in said chamber, means including a solenoid mechanically connected to the support for moving said support to and maintaining it immovably in supporting position, a circuit for said solenoid, a timer controlling said circuit, and a photoelectric cell for initiating the operation of said timer and disposed adjacent said charging opening so as to be affected by an incandescent article which is being passed into said charging opening, said timer, after a predetermined time, being effective in the solenoid circuit to permit said support to move from supporting position to release the article.

5. Quenching apparatus comprising a quenching chamber having a charging opening and a bottom opening, a support movable to a fixed position under said bottom opening wherein it is adapted to support an article in said chamber and to a fixed position out of supporting relation to the article, means for directing a spray of quenching fluid into said chamber, a valve controlling the supply of quenching fluid, and means for periodically moving said support to supporting position and simultaneously opening said valve, said valve being automatically closed upon movement of said support to the other position out of supporting relation to the article.

6. Apparatus according to claim 5 wherein the support moving and valve opening means includes a rock shaft on which the support is mounted and a finger on the rock shaft for operating the valve.

7. Quenching apparatus comprising a quenching chamber having a charging opening, means including a solenoid-operated valve for supplying quenching fluid to said chamber, a circuit for said valve, and means for closing said circuit to open the valve including a photo-electric cell disposed adjacent said opening so as to be affected by an incandescent article which is being passed into said opening.

8. Quenching apparatus comprising a quenching chamber having a charging opening and a bottom opening and perforate side walls, a support movable to and from a position under said bottom opening wherein it is adapted to support an article in said chamber, said support having a passage which is upwardly directed toward a supported article when the support is in supporting position, and means for supplying quenching fluid under pressure to the chamber perforations and to said passage.

9. Apparatus according to claim 8 wherein the fluid supplying means includes a normally closed valve, and wherein means are provided for automatically opening the valve when the support moves to supporting position.

10. Quenching apparatus comprising a quench-

ing chamber including an upright cylinder, vertically spaced circumferentially extending internal grooves in said cylinder, perforations extending through the cylinder walls and directed downwardly and inwardly through the top walls of said grooves, a jacket for said cylinder, and means for supplying quenching fluid to said jacket.

11. Quenching apparatus comprising a quenching chamber including an upright cylinder, vertically spaced circumferentially extending internal grooves in said cylinder, perforations extending through the cylinder walls and directed downwardly and inwardly through the top walls of said grooves, a jacket for said cylinder, said jacket having an inlet port for pressure fluid directed substantially tangentially with respect to said cylinder.

12. Quenching apparatus comprising a quenching chamber disposed on a vertical axis having a charging opening and a bottom opening, a support pivoted on a horizontal axis spaced laterally from the chamber axis and swingable from an inoperative position spaced from the chamber axis to a fixed supporting position coaxial with the chamber under the bottom opening wherein it is adapted fixedly to support an article in the chamber, means for swinging said support from the inoperative to the supporting position and for holding the same immovably in the latter position, means activated by an article entering the charging opening for initiating operation of the last mentioned means, and means for swinging the support to the inoperative position after a predetermined period to release the article.

13. Apparatus in accordance with claim 12 in which the means for swinging the support and for holding the same in supporting position includes a solenoid mechanically connected to the support.

14. Apparatus in accordance with claim 5 in which the means for supplying quenching fluid to the upwardly directed passage in the support includes a flexible conduit section, facilitating movement of the support.

15. Apparatus in accordance with claim 8 characterized in that the upwardly directed passage in the support terminates in an article engaging surface, whereby quenching fluid is delivered by the passage to the end face of the article.

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