

May 1, 1945.

R. G. LE TOURNEAU

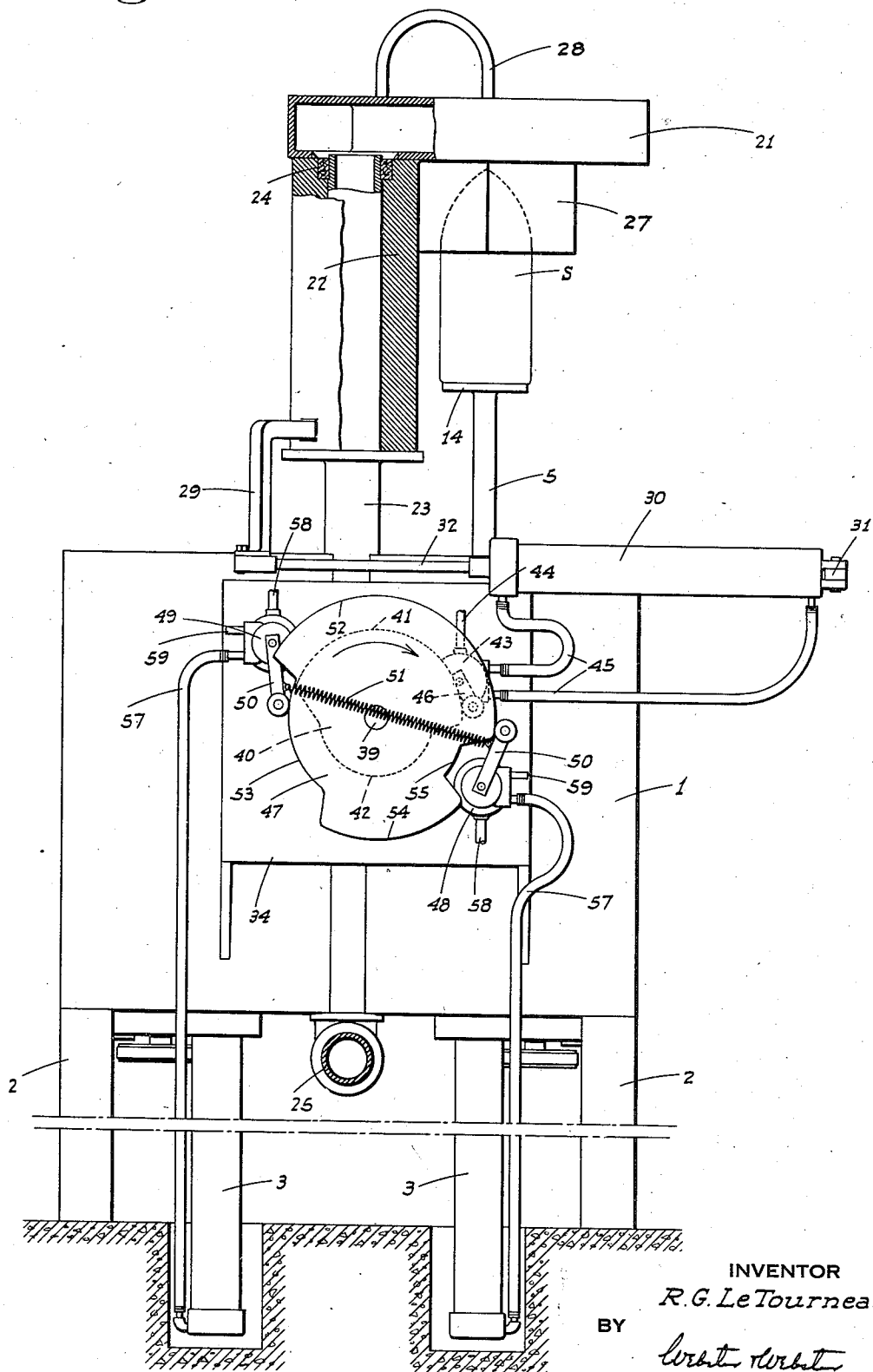
2,375,119

FLAME HARDENING APPARATUS

Filed Aug. 25, 1942

3 Sheets-Sheet 1

Fig. 1



May 1, 1945.

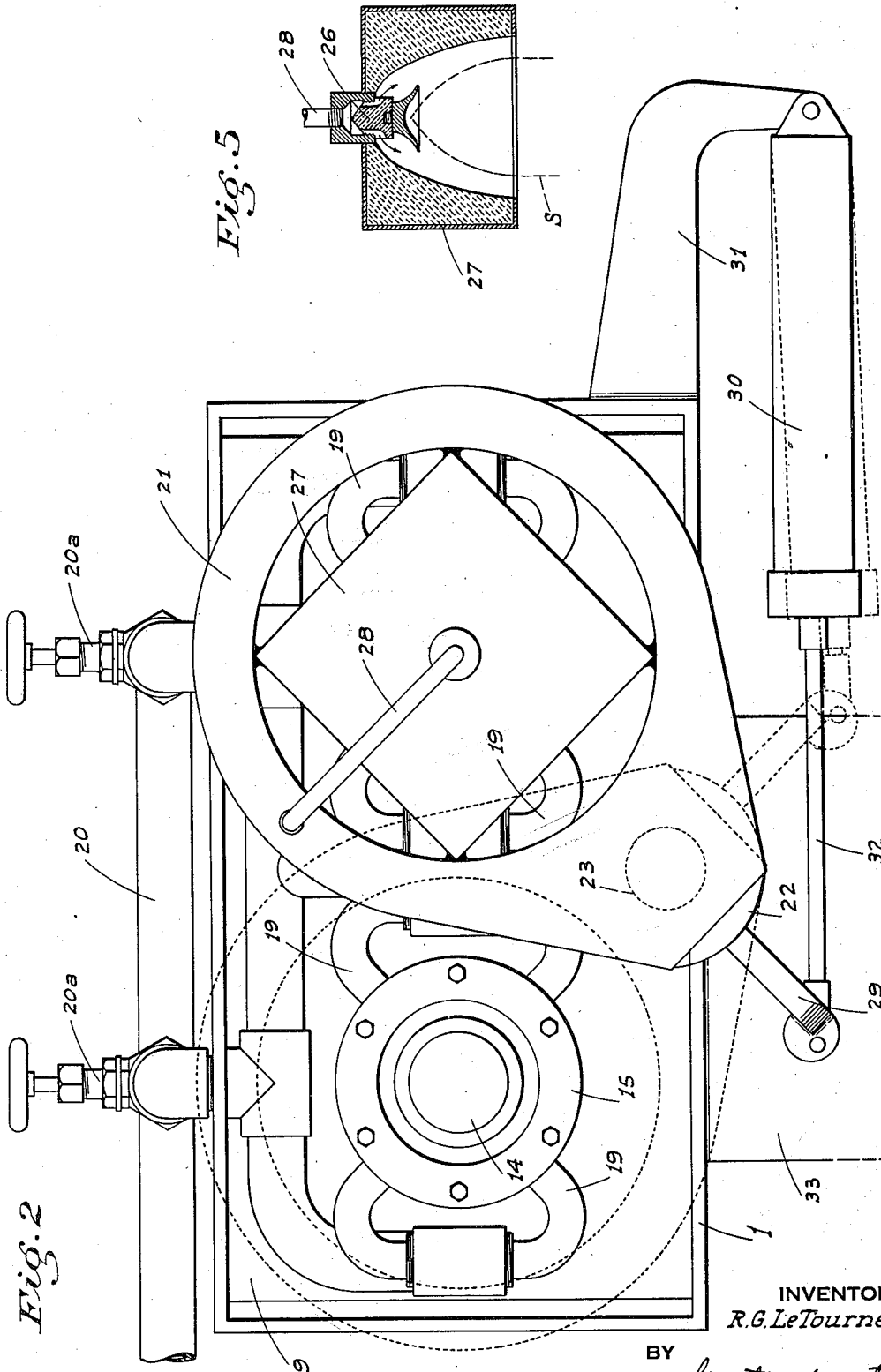
R. G. LE TOURNEAU

2,375,119

FLAME HARDENING APPARATUS

Filed Aug. 25, 1942

3 Sheets-Sheet 2



INVENTOR
R.G. LeTourneau

BY

Walter R. Webster
ATTYS

May 1, 1945.

R. G. LE TOURNEAU
FLAME HARDENING APPARATUS

2,375,119

Filed Aug. 25, 1942

3 Sheets-Sheet 3

Fig. 3

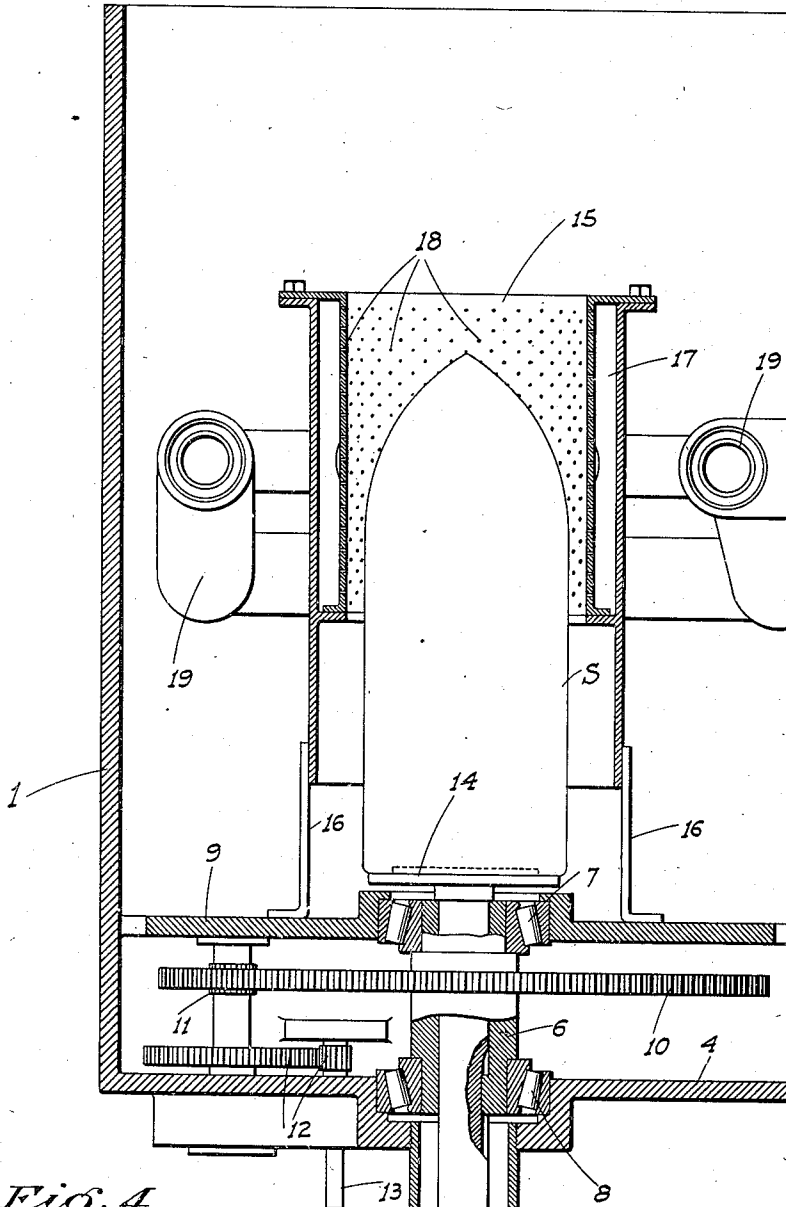
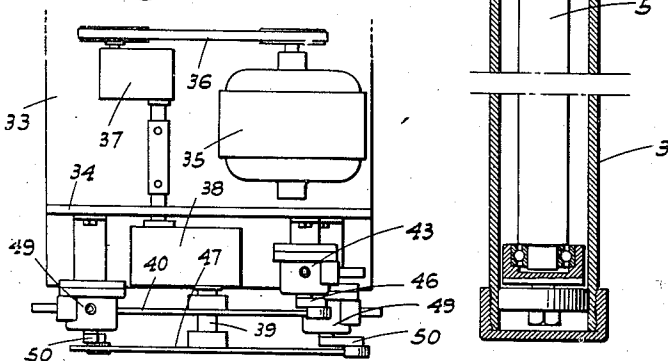


Fig. 4



INVENTOR
R. G. LeTourneau
BY
W. H. Smith
ATTYS

UNITED STATES PATENT OFFICE

2,375,119

FLAME HARDENING APPARATUS

Robert G. Le Tourneau, Peoria, Ill., assignor to
R. G. Le Tourneau, Inc., Stockton, Calif., a
corporation of California

Application August 25, 1942, Serial No. 456,023

12 Claims. (Cl. 266—4)

This invention relates in general to flame hardening apparatus, and in particular the invention is directed to, and it is an object to provide, automatic flame hardening apparatus which is operative to heat and subsequently quench steel objects.

The apparatus, while being suited for use to harden other objects, is especially designed to harden the nose of ordnance shells.

Another object of this invention is to provide, in flame hardening apparatus, a vertically movable support for a metal member to be hardened; the member when the support is moved to a raised position being disposed in a heating zone, and the member when the support is moved to a lowered position being disposed in a quenching zone.

A further object of this invention is to provide, in flame hardening apparatus, a pair of spaced vertically movable supports for members to be hardened, a horizontal flame or burner unit mounted in a plane above said supports for horizontal movement between positions in vertical alinement with said supports, and actuating means arranged to swing said burner unit alternately from one such position to the other, with a predetermined time lapse between each movement, and during which lapse the burner unit is stationary; there being means to move the corresponding support vertically to a raised position and to project the member thereon into the unit when the latter is in alined stationary position thereabove, the supported members being disposed in a quenching zone when the supports are moved to a lowered position. An advantage of this arrangement is that only a single burner unit is required, which is being constantly used without any material non-use and waste of the heating means being had.

An additional object of this invention is to provide flame hardening apparatus, as in the preceding paragraph, in which said support moving means is actuated in timed relation to the alternate movement of the burner unit; the raised support for a member disposed within the unit being moved to lowered position immediately prior to the end of said predetermined time lapse whereby to clear said member from the unit before the next swinging movement of the latter.

It is also an object of the invention to provide flame hardening apparatus in which, in addition to the above features, the moving means for said supports is operative to effect timed movement of each support to a raised position to permit unloading and loading of said support, and subsequent return movement to a lowered

position, when said support is out of alinement with the burner unit.

A further object of the invention is to provide, in novel assembly, a motor actuated cam mechanism arranged in controlling relation with the flame ring unit actuating means, and the separate actuating means for the pedestals which support the members.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by the perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views:

Figure 1 is a side elevation of the apparatus partly in section.

Figure 2 is a top plan view of the apparatus.

Fig. 3 is a fragmentary sectional elevation of the oil tank illustrating one of the air cylinder and pedestal assemblies in lowered position; the ordnance shell supported thereon being disposed with its nose in the corresponding quenching ring.

Figure 4 is a reduced size, somewhat diagrammatic plan view of the motor actuated cam mechanism which controls the flame ring unit actuating means, and the separate air cylinder and pedestal assemblies.

Figure 5 is a detached sectional elevation of a shell-nose heating or burner unit.

Referring now more particularly to the characters of reference on the drawings, the apparatus comprises an open-topped tank 1 which is rectangular in plan and of substantial depth; this tank being supported some distance above the floor by legs 2.

A pair of vertically disposed, single acting air type power cylinders 3 are secured at the upper end to and depend from the bottom 4 of the tank in alined spaced relation longitudinally of said tank. The piston rods 5 of said cylinders project upwardly into the tank to a termination some distance above said bottom 4 thereof. A hub 6 is fixed on each piston rod 5 within the tank adjacent the bottom 4, and this hub is journaled in bearings 7 and 8; the bearings 7 being mounted in a horizontal platform 9 within the tank above the bottom 4, while the bearing 8 is suitably mounted in said bottom of the tank. A relatively large diameter, horizontal gear 10 is formed with each hub 6 below the correspond-

ing platform 9 and is driven by a pinion 11 of a gear train, indicated generally at 12, which includes a vertical drive shaft 13 projecting downwardly through the bottom of the tank; this shaft 13 being driven by any suitable means (not shown).

The piston rods 5 above the corresponding platform 9 are each fitted with a horizontal circular disc or support 14 on which the object to be hardened is adapted to seat, such object in the present instance being shown as an ordnance shell S. The piston rods 5 and pedestals are constantly driven from the gear train 12.

A quenching ring 15 is mounted in tank 1 in centered relation about each disc 14; each ring being supported by legs 16 from the adjacent platform 9, and being open top and bottom. The quenching rings 15 are of substantial height and each is formed to include a surrounding and annular chamber 17 from which the quenching oil is discharged inwardly through a multiplicity of relatively small holes 18 in the ring. Oil under pressure is fed from pipes 19 into the chamber 17 at four points in its circumference. The pipes 19 are fed from a supply pipe 20 which is disposed outside tank 1 and which connects with a reservoir tank and pump assembly (not shown). The small, relatively high velocity streams of oil from holes 18 strike the nose of shell S when the latter and its support are in lowered position, and then the oil falls into the tank wherein a predetermined oil level is maintained; the excess oil flowing out of a suitable drain back to the reservoir tank.

A gas manifold 21 is disposed horizontally some distance above the top of tank 1, and this manifold is swingably mounted, by means of a depending insulated sleeve 22, on a post 23 for alternate movement between positions in vertical concentric alignment with the quenching rings 15 and corresponding supports 14. The post 23 is tubular and at its upper end communicates with the interior of manifold 21; there being a gas seal 24 between the post and said manifold, and the lower end of the post connecting with a gas supply pipe 25.

A burner or flame unit 26 of suitable type is disposed within a depending hood 27 heavily lined with fireclay plaster or the like and adapted to surround the nose of a shell projecting into the hood in clearance relation thereto, as indicated in Fig. 5. The burner and hood as a unit are supported within manifold 21 in centralized relation to the shell support below, gas for the burner being supplied from the manifold by a pipe 28.

The heating unit is alternately moved between centered positions over the supports 14 by means of the following mechanism: A radial arm 29 is secured to and projects from the manifold supporting sleeve 22 adjacent the lower end of the latter. A double acting air cylinder 30 is disposed horizontally and in offset relation to the radial arm, such cylinder being pivoted at one end on a horizontal bracket 31 which projects from one end of tank 1. The piston rod 32 of cylinder 30 is pivoted at its outer end in connection with radial arm 29. The rod 32, when actuated in one direction, swings the heating unit over one support 14 in centered relation, and when actuated in the other direction swings said heating unit over the other support in centered relation.

The piston rod 32 is alternately actuated at predetermined intervals by means of the following described mechanism:

A horizontal platform 33 projects from the side

of tank 1 below cylinder 30, and this platform is fitted with an upstanding wall 34. An electric motor 35 is mounted on platform 33 and by means of a belt 36 drives a pair of coupled speed reduction boxes 37 and 38; the output shaft of speed reduction box 38 being indicated at 39, which is outwardly of wall 34, as shown in Fig. 4.

A rotary cam 40 is secured on shaft 39 outwardly of wall 34, and is formed with a high cam surface 41 and a low cam surface 42; such cam surfaces being of equal length. A two-way valve 43 is supported by and in front of wall 34 adjacent rotary cam 40; a source of air pressure being connected to valve 43 by a conduit 44, while conduits 45 connect the valve 43 with opposite ends of the heating unit actuating cylinder 30. The valve 43 includes a cam engaging lever 46 which rides cam 40, and with rotation of said cam the high and low cam surfaces 41 and 42 respectively cause the valve 43 to alternately supply air to opposite ends of cylinder 30, resulting in alternate swinging movement of the flame ring unit from centered position over one work support to centered position over the other support. The rotation of shaft 39 is very slow, the speed in the present embodiment being one revolution every sixteen minutes. The heating unit thus remains in each centered position with a support for approximately eight minutes.

The rods 5 of air cylinders 3 are each actuated in a predetermined sequence of raising and lowering movements by the following arrangement:

Another rotary cam 47 is fixed on shaft 39 outwardly of rotary cam 40. A pair of one-way valves 48 and 49 are supported from wall 34 adjacent said rotary cam 47 but on opposite sides thereof, said valves 48 and 49 including valve actuating levers 50 riding the periphery of cam 47 at points 180° apart. The levers 50 are maintained in frictional contact with the periphery of rotary cam 47 by a tension spring 51, which extends across the face of said cam and connects between said levers.

Rotary cam 47 likewise rotates once every sixteen minutes, and the periphery of this cam is formed as a high cam surface 52 of seven minutes' relative length, a following low cam surface 53 of four minutes' relative length, then a high cam surface 54 of four minutes' relative length, and finally a low cam surface 55 of one minute relative length.

The valves 48 and 49 are each connected by a conduit 57 with the lower end of corresponding ones of power cylinders 3, and a source of air pressure is connected to each of such valves by a conduit 58. The valves 48 and 49 each vent through an outlet 59.

As the levers 50 of valves 48 and 49 ride rotary cam 47 180° apart, the valves operate the corresponding cylinders 3 to move pedestals 14 through like sequences of movement, but one-half cycle apart.

The sequence of movement of each shell supporting disc 14 is as follows: the sequence for the cylinder 3 and pedestal 14 corresponding to valve 48 being described for the purpose of clarity.

With each revolution of rotary cam 47, the high cam surface 52 operates the valve 48 so that the corresponding cylinder rod 5 is actuated and raises the disc 14 for a shell heating period of seven minutes; the disc, when in fully raised position, being disposed so that the nose only of a shell S seated on the disc projects within the heating zone of the heating unit which is then centered thereabove. At the end of the seven

minute heating period, the low cam surface 53 comes into play, whereupon the valve 48 vents and the disc and the supported shell lowers by gravity; the heating unit by action of cam 40 then swinging to the alternate heating position over the other disc, as will hereafter appear. The heated nose of the shell, when the disc is in fully lowered position, is disposed within and treated by the corresponding quenching ring 15. The shell support remains lowered and the nose of the shell remains within the quenching ring for the four minute length of low cam surface 53, and then the high cam surface 54 functions to cause the support to again be raised to permit of removal of the treated shell from the disc and placement of an untreated shell in its place. At the end of this unloading and loading period of four minutes' duration, the low cam surface 55 vents the valve 48 and causes the support to drop for one minute; this one minute in lowered position being for the purpose of permitting the heating unit to swing into centered position over said support for another heating period, which will immediately follow.

The heating unit control cam 40 is set in such relation to disc control cam 47 as to effect swinging of the flame ring unit into centered position over each disc, while the latter is in lowered position corresponding to low cam surface 55 and which is immediately prior to raising movement of the pedestal for a shell heating period corresponding to high cam surface 52; and to effect swinging movement of the heating unit away from each centered position over a disc to the alternate centered position immediately after the heating period and when the disc lowers to shell quenching position corresponding to low cam surface 53. It will thus be seen that as each disc is subsequently raised by the influence of high cam surface 54 for unloading and loading, the heating unit is in an alternate and out-of-the-way position.

This relative setting of the cams 40 and 47 is easily accomplished, as the sequence of movements of the two shell supports are, as previously indicated, alike and exactly one-half cycle apart, and the heating unit is swung between its alternate positions after equal time lapses of eight minutes.

The advantages of the apparatus reside in the automatic and timed control of the heating, quenching of the shells S which result in a uniform product hardened within predetermined limits; and, in addition, the dual supporting disc arrangement and alternately positioned heating unit facilitate production as one support is unloaded and reloaded while the shell on the other support is being heated.

When the shell is lowered for one minute as stated, the oil flow is temporarily shut off by closing the valves 20a in the oil supply pipe system manually or otherwise.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. Flame hardening apparatus comprising a

pair of spaced supports for an object to be treated, means mounting the supports for separate vertical movement to and from a raised position with the object in a heating zone and a lowered position with the object in a quenching zone, means to control such movements of the supports in alternating cycles, the cycle of each support including raising said support for a predetermined time lapse, a single flame unit for cooperation one at a time with said pair of supports, means mounting the flame unit for alternate horizontal movement between positions adjacent the supports, said flame unit when in either of said positions being in heating relation to the object on the corresponding support when the latter is raised, and means to move said flame unit between said positions in such predetermined timed relation to the cycles of the supports as to position said flame unit in heating relation to the corresponding object when the supports are raised for said time lapse.

2. Flame hardening apparatus comprising a pair of spaced supports for an object to be treated, means mounting the supports for separate vertical movement to and from a raised position with the object in a heating zone and a lowered position with the object in a quenching zone, means to control such movements of the supports in alternating cycles, said cycles half overlapping and the cycle of each support including raising said support for a predetermined time lapse, a single flame unit for cooperation one at a time with said pair of supports, means mounting said flame unit for horizontal movement between positions in heating relation to the objects on the supports when raised, and means to move said flame unit into heating relation to the corresponding object before each support is raised for said time lapse.

3. A flame hardening apparatus as in claim 2 in which said last named means is arranged to function in such predetermined timed relation to movement of said supports that the flame unit moves into object heating position to an object immediately prior to raising of each support for said time lapse, and moves out of said position immediately after lowering of said support at the end of said time lapse.

4. Flame hardening apparatus comprising a pair of spaced supports for an object to be treated, means mounting the supports for separate vertical movement to and from a raised position with the object in a heating zone and a lowered position with the object in a quenching zone, means to control such movements of the supports in alternating overlapping cycles, the cycle of each support comprising two movements at spaced intervals to raised position, and there held for predetermined periods of time, a single horizontal flame unit for cooperation one at a time with said pair of supports, means mounting said unit for horizontal horizontal swinging movement between centered object heating positions above said supports, and means to swing said flame unit to centered position above each support prior to the initial one of said movements thereof to raised position and to swing said flame unit away from said centered position after the corresponding and following time lapse, each support upon the second of said movements thereof to raised position being out of alignment relative to the flame ring unit whereby to permit unloading and loading of said support.

5. Flame hardening apparatus comprising a pair of horizontally spaced vertically and sepa-

rately movable work supports, a single flame unit for cooperation one at a time with said pair of supports, said flame unit being disposed in a horizontal plane above the highest level of the supports, means mounting the flame unit for swinging movement through a horizontal path between positions directly over the supports, means to control the vertical movement of the supports in alternating order but in overlapping cycles whereby at one period in their cycles of movement both supports will be lowered at the same time, and means to swing the flame unit from one position to the other when the supports are both lowered.

6. Flame hardening apparatus comprising a pair of spaced vertically and separately movable supports adapted to support objects to be treated, a power cylinder operative to move each support to and from a raised position with the object in a heating zone and a lowered position with the object in a quenching zone, a single, horizontal flame unit for cooperation one at a time with said pair of supports, means mounting said unit for horizontal swinging movement between positions centered above said supports and adjacent the latter when raised whereby to heat supported objects, a power cylinder connected with said unit and operative to move the same between said centered positions, and control means arranged to effect operation of the support and flame unit actuating cylinders in predetermined timed order.

7. Flame hardening apparatus comprising a pair of spaced vertically and separately movable supports adapted to support objects to be treated, a power cylinder operative to move each support to and from a raised position with the object in a heating zone and a lowered position with the object in a quenching zone, a horizontal flame unit, means mounting said unit for swinging movement between positions centered above said supports and adjacent the latter when raised whereby to heat supported objects, a power cylinder connected with said unit and operative to move the same between said centered positions, means to actuate each cylinder including a conduit assembly having a control valve interposed therein, and timed control means arranged to operate said valves so as to effect movement of said supports in alternating cycles, the cycle of each support including movement to a raised object-heating position for a predetermined time lapse, said control means functioning to effect alternate swinging movement of the flame unit to centered position above each support immediately prior to movement of the latter to its object-heating position and to swing the flame unit away from said centered position after lowering of said support.

8. Flame hardening apparatus as in claim 7 in which said control means for said valves comprises a driven shaft, a pair of cam plates fixed on said shaft; the separate valves for the support actuating cylinders being operated by one cam, and the separate valve for the flame ring unit actuating cylinder being operated by the other

9. Flame hardening apparatus as in claim 7 in which said control means for said valves comprises a driven shaft, a pair of cam plates fixed on said shaft; the separate valves for the pedestal actuating cylinders being operated by one cam at points 180° apart whereby the cycles of movement of the supports overlap by one-half cycle, and the separate valve for the flame unit actuating cylinder being operated by the other cam.

10. Object heating mechanism for flame hardening apparatus which includes an object support mounted for controlled vertical movement between a raised position with the object in a heating zone and lowered position with the object in a quenching zone; said mechanism comprising a flame unit, means mounting said flame unit for horizontal movement alternately to and from a position wherein, upon movement of said support to raised position, the object is disposed in heating relation to said flame unit, and power means automatically operative to cause such alternate movements of the flame unit in timed relation to said controlled vertical movement of the object support.

11. Object heating mechanism for flame hardening apparatus which includes an object support mounted for controlled vertical movement between a raised position with the object in a heating zone and lowered position with the object in a quenching zone; said mechanism comprising a flame unit, means mounting said flame unit for horizontal movement alternately to and from a position wherein, upon movement of said support to raised position, the object is disposed in heating relation to said flame unit, and power means automatically operative to cause such alternate movements of the flame unit in timed relation to said controlled vertical movement of the object support; said power means functioning to move said flame unit into said position prior to but only upon alternate movements of said support to raised position.

12. Object heating mechanism for flame hardening apparatus which includes an object support mounted for controlled vertical movement between a raised position with the object in a heating zone and lowered position with the object in a quenching zone; said mechanism comprising a flame unit, means mounting said flame unit for horizontal movement alternately to and from a position wherein, upon movement of said support to raised position, the object is disposed in heating relation to said flame unit, and power means automatically operative to cause such alternate movements of the flame unit in timed relation to said controlled vertical movement of the object support; said power means functioning to move said flame unit into said position prior to but only upon alternate movements of said support to raised position, and to move said flame unit away from said position immediately after movement of said support to lowered position following each of said alternate movements thereof to raised position.

ROBERT G. LE TOURNEAU.