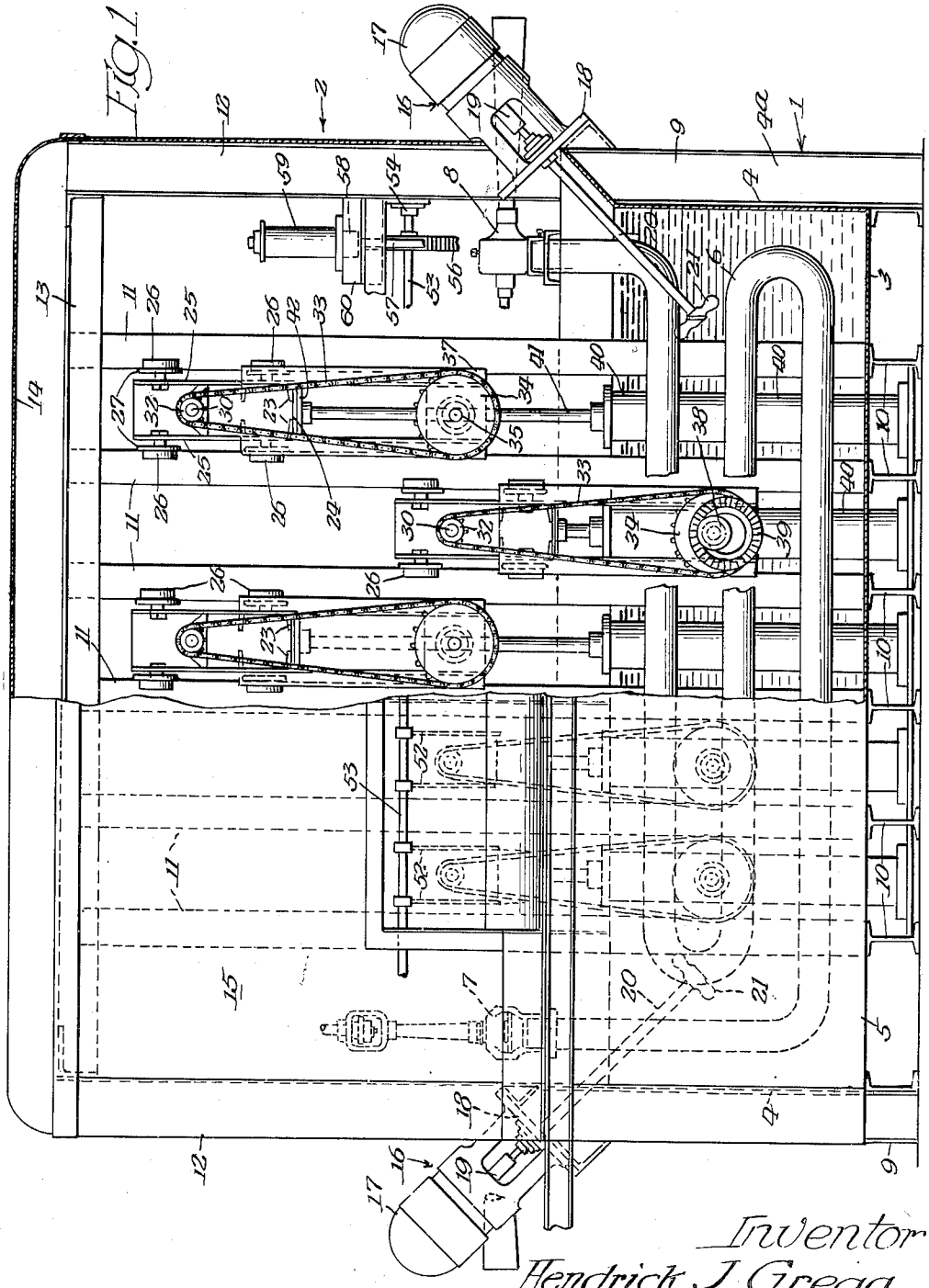
July 20, 1954 H. J. GREGG 2,684,073

QUENCHING MACHINE

Filed April 23, 1948 3 Sheets-Sheet 1

FIG. 1.



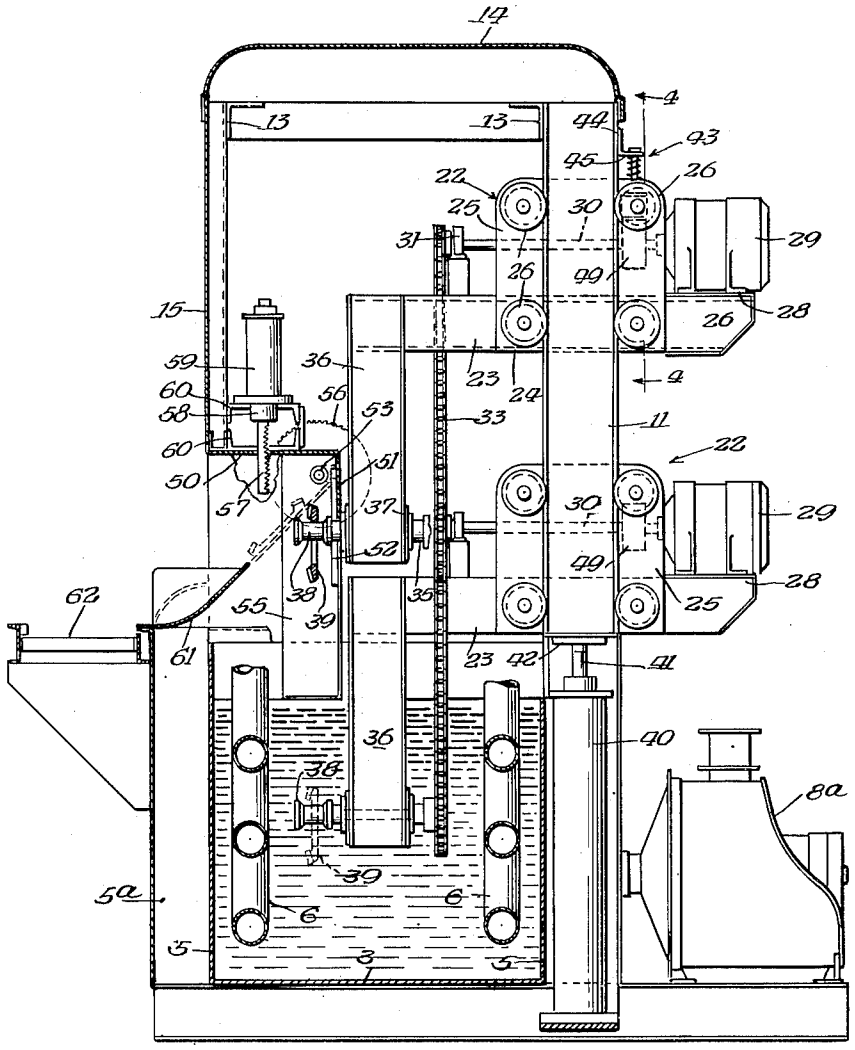
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Fig. 2.



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QUENCHING MACHINE

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FIG. 3.

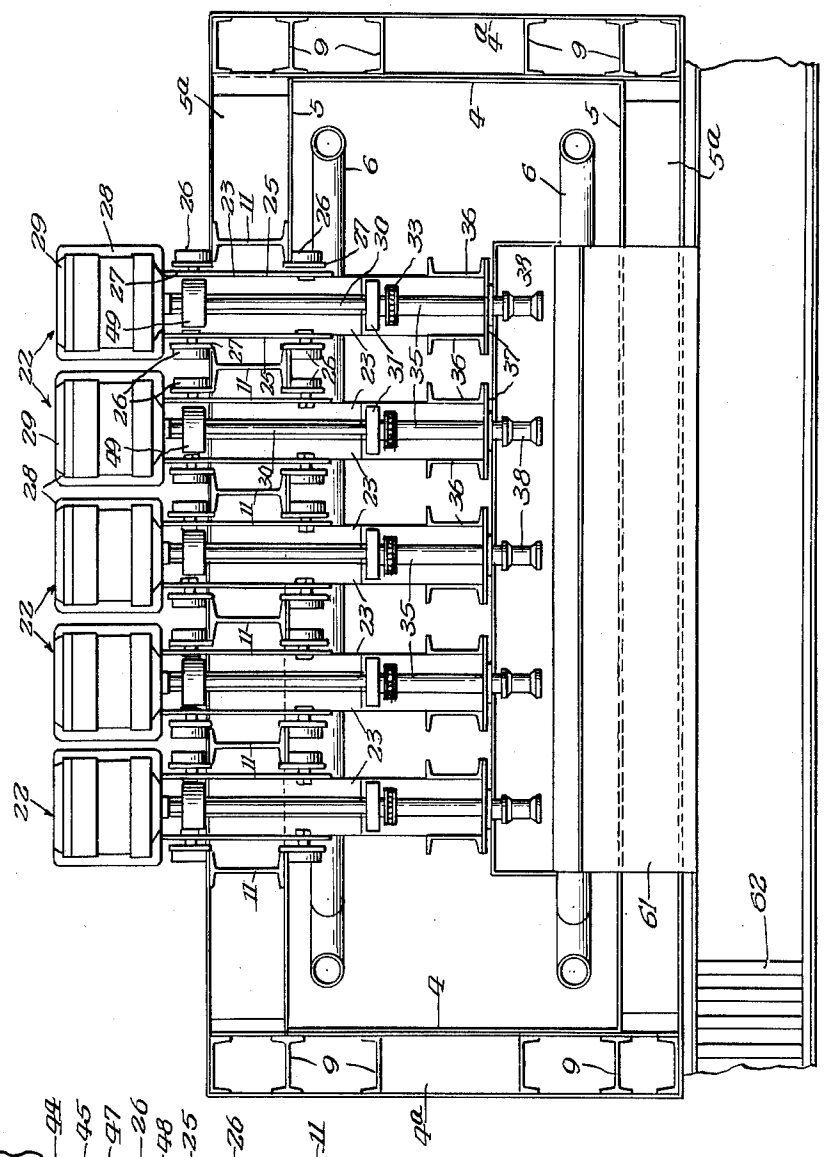
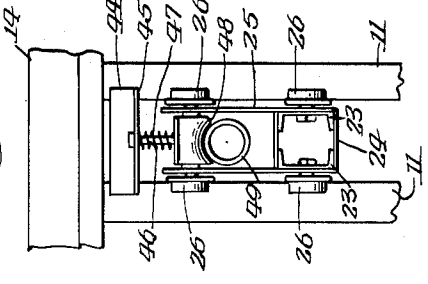


FIG. 4.



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QUENCHING MACHINE

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Application April 23, 1948, Serial No. 22,793

4 Claims. (Cl. 134—195)

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This invention relates, in general, to quenching machines particularly adapted for use in quenching hot pieces of metal such as large tractor and automotive ring gears, large size bearing races or the like which usually call for press quenching machines.

In the past, the process of quenching items like those mentioned above has required presses which include elaborate and expensive dies to control the distortion of the hot pieces and usually only one work piece is quenched at a time. The quench media is generally oil which is maintained at a temperature between 110 degrees and 130 degrees F., and the machine must be connected to elaborate auxiliary cooling, conditioning, storage, pump and piping facilities.

The new and improved type of quenching machine involved in the present invention preferably employs the art of what is commercially known as mar-tempering which lends itself to a new principle of quench machine design with many attendant advantages. While the invention disclosed herein, for purposes of illustration shows a machine which is capable of quenching a plurality of hot work pieces at a time or in succession, it will be understood that a similar machine embodying mechanism for the quenching of but a single piece may be produced and still embody many of the principles involved in this invention.

One of the principal objects of this invention is to provide a new and improved type of quenching machine which is particularly designed to overcome the disadvantages of present methods of quenching as outlined above, and which may be much more simple in operation.

Another object of the invention is to provide a quenching machine capable of quenching hot pieces of material such as ring gears and the like in a manner which will minimize warpage or distortion and thus produce a higher quality gear more economically.

A further object of the invention is to provide a quenching machine wherein one or more pieces of hot metal may be charged onto one or more spindles and means are provided to rotate the spindle and lower the hot piece into a quench media which is automatically controlled as to temperature and agitation, thereby to properly quench the hot piece.

Still another object of the invention is to provide a quenching machine wherein hot pieces of metal are charged onto one or more spindles, which spindles are rotated and immersed in a quench media, and means are provided to eject the quenched pieces after they are removed from the bath.

Still another object of the invention is to provide a quenching machine wherein automatic braking means are actuated to prevent rotation of the spindles onto which hot pieces of metal are

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charged and to permit rotation thereof after they begin their descent into the quench bath.

Other objects will appear hereinafter.

Fig. 1 is a front elevational view of one form of the quench machine embodying the invention with parts thereof broken away for the sake of clarity;

Fig. 2 is a vertical transverse sectional view through the machine as shown in Fig. 1;

Fig. 3 is a top plan view of the machine with the cover removed to disclose more clearly the details thereof; and

Fig. 4 is an enlarged fragmentary vertical sectional view of the braking means taken along the plane of lines 4—4 of Fig. 2.

Briefly described, the invention involves the use of a generous size tank which is adapted to contain a volume of a quenching media which may be a special salt bath or a mar-tempering oil. The present invention enables this tank to be wholly devoid of the conventional external auxiliary coolers, pumps, storage tank, and piping facilities. The novel form of heating, cooling and agitating means are all more fully described hereinafter and are so arranged as to maintain the bath at the proper temperature, this temperature usually being within the range of from 375 degrees to 400 degrees F. One or more rotatably mounted spindles are provided onto which the hot gear or other work piece is charged. The spindle is then allowed to rotate and carry the work piece with it, as it is moved downwardly and immersed into the quench media. After quenching for a predetermined period of time, which will depend upon the article being quenched, the spindle will then be automatically elevated whereupon an ejector device will remove the quenched article from the spindle and deposit it onto a conveyor. Although the work piece may be charged onto the spindle while it is rotating if so desired, it has been determined that a greater control of the warpage and distortion may be had if the spindle is dead or not rotating at the time the work piece is charged thereon. For this reason, a novel form of braking means is provided to stop rotation of the spindle when the carriage means on which the spindle is mounted reaches its uppermost position. This means is so designed that the spindle is permitted to begin its rotation after the carriage has started its movement downwardly to immerse the article in the bath.

Referring now more particularly to the drawings, one of the preferred forms which the invention may take will include a tank generally indicated by the numeral 1. A super-structure or frame 2 may be built as a part of the machine and extend above the tank to either partially or completely enclose the working parts of the machine.

The tank 1 includes a bottom 3, ends 4 and

sides 5. The heating and cooling means includes one or more pipes or conduits 6 each of which extends downwardly into the tank and is so constructed that one end 7 thereof extends above the tank at one end thereof and the other end will extend above the tank at the opposite end thereof. The end 7 constitutes a burner and the opposite end is provided with an eductor 8. Any suitable and conventional means may be utilized for automatically igniting the gas entering the burner 7, and the eductor 8 is utilized for drawing air through the pipes 6, whereupon a combustible mixture is formed and carried through the pipes 6 for the purpose of heating the quench media contained within the tank. The embodiment of the invention disclosed herein illustrates two of these pipes 6 but it will be evident that the number of these pipes is not an important consideration as long as the design is such that the temperature of the quench media can be properly and accurately controlled within certain predetermined limits.

A fan or blower device 8*a* is mounted at a suitable location beside the tank 1 and is connected to a shell surrounding the tank for the purpose of forced cooling and further controlling the temperature of the quench media. The shell surrounding the tank includes communicating air passages and may be formed by placing a plurality of channel members and I-beams 9 around the ends 4 and sides 5. The outer covering around these spacer members 9 will then provide an air space 4*a* at each end of the tank and another air space 5*a* at each side of the tank.

In some instances it may be desirable to have such communicating air space also provided on the bottom of the tank, although in the particular form of the invention shown herein the I-beams 10 are located below the bottom 3 of the tank and act as a support therefor. If desired, another plate or part of the shell can be placed beneath the I-beams 10 and the space between the bottom and this lower shelf would then act as an additional communicating air space. The fan or blower 8*a* is so connected to the shell of the tank as to forcefully circulate external cool intake air throughout the various connecting passages 4*a* and 5*a* and discharge the circulated air to the atmosphere. The heat passing through the pipes 6 will initially raise the temperature of the quench media to the proper and predetermined degree. Suitable thermostatic controls may be utilized for then cutting off the main flame from the burner 7, and at this point the blower 8*a* will cause cool air to circulate around the tank and thus prevent the temperature of the bath from exceeding that which is necessary for quenching purposes. At the same time, the eductor 8 will be drawing air through the pipes 6 for additional cooling for the reason that the hot work pieces when quenched will tend to raise the temperature of the bath. This tendency to raise the temperature of the bath will be counteracted by both the blower 8*a* and the eductor 8 to thus maintain a lower temperature in the bath. When the temperature of the bath then reaches the predetermined low point the burner 7 will again become active and the eductor 8 will then draw hot air and combustion gases through the pipes 6 to elevate the temperature of the bath and return it to the proper point.

The foregoing means and method of heating, cooling and containing the bath represent conventional methods and apparatus used in the art of mar-tempering.

A plurality of I-beams 11 extend upwardly at the rear of the machine and considerable distances beyond the top of the tank 1, and these I-beams 11 have the functions of not only providing a support for the super-structure but also of providing tracks for guiding the carriages in their vertical reciprocating movement. The superstructure may take any one of a number of desirable forms and in the embodiment shown includes end supporting members 12 which extend vertically upwardly and supporting cross-members in the form of angles 13. This structure then supports a cover-plate 14 for the top and a cover member 15 at the front of the machine which extends downwardly and covers most of the operating mechanism.

It is highly important that the quench media be agitated at least during the quenching period so as to maintain the entire bath at a substantially even temperature. For this reason, agitators generally indicated at 16 are provided, each of which may include a driving motor 17 mounted on an angularly disposed supporting plate 18. The motor shaft 19 is mounted in a suitable bearing and is connected to an elongated rod 20 having a propeller 21 on the lower end thereof. The motor 17 rotates the propeller 21 rapidly and thus causes agitation within the media. Two of these agitators have been shown in the drawings, but it will be quite evident that if the tank is made smaller for the quenching of a single pieec of work only one agitator might be necessary; or if the tank is made larger for the purpose of successively quenching a greater number of hot pieces of work, it may be advisable to have more than two such agitators. These agitators may be so controlled as to continually agitate the bath or control means may be utilized to agitate the bath only at the time or times that work pieces are being quenched. This is a mere matter of control and such control means are commercially available and may be utilized if so desired.

Since the present design of the quenching machine illustrates a plurality of vertical reciprocating carriages, which carry the hot work pieces into the bath, five of such carriages have been illustrated, although the exact number is not an important consideration. These carriages are generally indicated herein by the numeral 22, and since they are all identical in structure and operation a description of one will suffice for all. Each carriage 22 includes a pair of spaced, horizontally extending channel members 23. These channel members are disposed so that the flanges thereon face toward each other. A bottom plate 24 is secured to the lower facing flanges of the channels 23 to thereby form a unitary structure. A pair of spaced, roller supporting plates 25 is secured also to the opposing channels 23, and each plate 25 is adapted to rotatably support four roller members 26. Each of the rollers 26 is provided with a flange 27 to thereby enable these rollers to bear against the front and rear faces of the I-beams 11. This construction is more clearly shown in Figs. 1 and 3, where it will be noted that the two rollers 26, on each plate 25, bear against the forward faces of the I-beams 11 and the two rear rollers 26 on each plate 25 will bear against the rear faces of the I-beams 11. Thus the carriage 22 will be guided in its reciprocating movement with the I-beams 11 acting as tracks to permit vertical reciprocation of the carriage.

A platform 28 is provided at the rear of each pair of opposing channels 23 which platform is

adapted to support a motor 29. This motor 29 has an elongated shaft 30 extending forwardly therefrom in a horizontal plane and is supported at its forward end in a suitable bearing 31. The outer end of the shaft 30 has a sprocket wheel 32 mounted thereon and is adapted to drive a sprocket chain 33 which passes around a larger sprocket wheel 34 therebelow mounted on a stub shaft 35. This stub shaft 35 is mounted in bearings provided by the vertically extending channels 36, which extend downwardly on opposite sides of the horizontal channels 23. These channels 36 extend downwardly in pairs and have the front and rear plates 37 secured thereto which thereby form bearings for the shaft 35. The forward end of shaft 35 is adapted to have a spindle 38 mounted thereon which in turn is adapted to support a work piece 39. The spindle 38 may take any one of a number of different forms and shapes depending upon the type of work piece which is being quenched. The spindle 38 shown herein is particularly adapted for receiving and quenching a ring gear as shown at 39, but if a different type of ring gear or other work piece such as a bearing race were to be quenched it may be desirable to change the form and shape of the spindle 38 somewhat. This feature, however, is a mere matter of design and the particular shape of the spindle 38 forms no part of the present invention. It will thus be evident that the motor 29 on each of the carriages 22 will drive the shaft 30 and the shaft 35 by means of the sprocket chain 33. The spindle 38 will thus be rotated by reason of its connection with the shaft 35.

Compressed fluid means are preferably employed for causing the vertical reciprocation of the carriages 22. This fluid means may be either air or a hydraulic liquid and may include a vertically extending cylinder 40 for each carriage 22 having a piston therein and a piston rod 41 extending through the upper end of the cylinder. The upper end of the rod 41 may be connected to a plate 42 secured to the under side of the spaced channel members 23 so that any upward or downward movement of the rod 41 will carry with it the carriage 22 and all of the parts connected therewith. It will thus be evident that when the rod 41 is in its upper extended position the carriage 22 connected therewith will be elevated and the spindle 38 on the carriage will also be in its elevated position out of the quench media. After the hot work piece has been charged onto the spindle 38 a compressed fluid then causes the rod 41 to lower which thus carries with it the carriage 22 and will thereby immerse the hot work piece into the quench media.

As stated herebefore, it is deisrable in most instances to charge the hot work piece onto a dead spindle, and for this reason a suitable braking means has been designed to automatically stop rotation of the spindle when the carriage reaches its uppermost position. This braking means may take any one of a number of forms including commercial solenoid motor brakes, but the type shown here for purposes of illustration is generally indicated by the numeral 43 and is shown in greater detail in Fig. 4. This consists primarily of a supporting member comprising an angle member 44 extending horizontally between two adjacent I-beams 11 and at the upper ends thereof. The horizontal leg 45 of the angle 44 supports the downwardly extending rod 46 which has a coiled compression spring 47 surrounding it. The brake member is indicated at 48 and consists merely in a block or shoe having an arcuate lower surface of substantially the same radius as the drum 49 mounted on the shaft 30 of the motor 29. When the carriage 22 is elevated to its uppermost position the rotating drum 49 will come against the under arcuate surface of the brake shoe 48 carried by the rod 46. The brake shoe 48 will then be moved upwardly against the compression of the spring 47 and thus urge the shoe 48 against the drum 49. Suitable means (not shown) are provided to automatically turn off the motor just before the carriage reaches its uppermost position and the brake will then act to immediately stop rotation due to momentum of the shaft 30. When the shaft 30 stops rotating it will be obvious that the spindle 38, which is drivingly connected thereto, will also cease rotating. After a hot work piece has been freshly charged onto the dead spindle 38 and the carriage 22 begins its descent to carry the work piece into the quench media, the drum will be moved away from the brake shoe and the motor switch will be turned on whereupon the spindle 38 will begin rotation.

A splash guard is also provided at the front of the machine and includes a horizontal plate 50 having a down-turned rear side 51. This splash guard has a definite advantage in a machine of this character because the spindle and quenched work piece will be rotating rapidly as they leave the bath. This rapid rotation of the spindle and work piece will throw off a considerable amount of the excess quench media normally adhering to the treated work piece and will be caught by the splash guard and allowed to drain back into the bath. Thus, a minimum amount of cleaning of the work piece is necessary since most of the excess media will have already been removed therefrom.

The invention herein also contemplates a novel form of ejection mechanism for the purpose of ejecting the quenched work piece from the spindle. This ejector includes a pair of spaced arms 52 for each spindle, one on each side thereof. The arms 52 are each adjustably secured to a shaft 53 which extends between the ends of the machine and may be suitably mounted in bearings 54 at each end thereof. The arms 52 are made adjustable to take care of different size work pieces. The bearings 54 may be mounted on any suitable part of the device such as the end plates 55. At one end of the shaft 53 a gear or pinion 56 is mounted and is adapted to be in mesh with a rack 57. The rack 57 is connected to the piston rod 58 of a fluid cylinder 59 which is in turn mounted on a support formed by a pair of spaced channel members 60. The rack 57 is mounted for vertical reciprocation when the fluid of the system moves the piston within the cylinder 59 upwardly or downwardly. This vertical reciprocation of the rack 57 will rotate the pinion 56 and the shaft 53 connected thereto. Rotation of the shaft 53 will carry with it the arms 51 and will move these arms to their dotted line position shown in Fig. 2, which is the ejecting position. The work piece 39 is always of sufficient diameter as to be greater than the distance between the adjacent adjustable arms 52 so that as these arms rotate in a clockwise direction as viewed in Fig. 2, they will lift the work piece off of the spindle 38 and permit the work piece to slide downwardly onto a chute 61 and to a conveyor 62.

The operation of a single carriage will be substantially as follows: The carriage is normally in

its uppermost position in contact with the brake shoe 48 and the motor has been turned off so that the spindle 38 is not rotating. A hot work piece is then charged onto the spindle 38 whereupon the fluid system acts on the piston within the cylinder 40 to lower the carriage 22 and move the work piece into the quench media. The quench media has previously been brought up to a predetermined temperature depending upon the type of media being used, and this temperature is always being maintained within a predetermined range by means of the heating and cooling system described above. After the carriage 22 has descended a short distance sufficient to separate the drum and brake shoe, the switch to the motor 29 will be turned on and cause the spindle 38 to rotate and carry with it the hot work piece. The carriage is then moved to its lowermost position where the work piece is completely immersed in the bath and is then properly quenched in such a way as to minimize any warpage or distortion of the work piece. After a predetermined time period the fluid system will elevate the piston in the cylinder 40 to raise the carriage 22 upwardly which then withdraws the quenched work piece from the bath. The spindle and work piece will be continually rotating during descent, quenching, and elevation. Before the carriage 22 reaches its uppermost position the motor will be turned off and the drum 49 on the motor shaft 30 will come against the brake shoe 48 immediately thereafter to stop rotation of the spindle 38. The fluid system then acts upon the piston within the cylinder 59 to actuate the ejector arms 52 and eject the quenched work piece onto the conveyor 62.

When a plurality of these carriages 22 are provided, the fluid system which actuates and controls the movement of the carriages may be so designed as to actuate the carriages either successively or in pairs or in any other way which may seem desirable. The greater number of carriages provided, the greater will be the output of the quenched work pieces.

It will be quite evident from the foregoing description that this multiple type quenching machine is devoid of all tooling or dies usually necessary in this type of machine. It requires only a small and simple spindle to adapt the shape of work or type of gear being quenched. Martempering will minimize the warpage and distortion only if the bath is held at a uniform temperature and if the work is properly immersed, and this machine is so designed as to satisfy these requirements. The gear teeth in the automotive ring gear shown lends itself to additional self-agitation when immersed in the media. This type of machine has many other advantages relative to high productivity, compactness and lower cost with complete absence of expensive dies.

Changes may be made in the form of construction and arrangement of the parts from that disclosed herein without in any way departing from the spirit of the invention or sacrificing any of the attendant advantages thereof, provided, however, that such changes fall within the scope of the claims appended hereto.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A quenching machine of the class described, comprising a tank adapted to have a quenching bath therein, a rotatably mounted support for supporting an article to be quenched, means rigidly associated with said support for moving said support into and out of said bath, means for rotating said support about its horizontal axis while in the bath, and means for controlling the temperature of said bath including conduits in said tank, heating means associated with said conduits, means for drawing the hot combustion gases through said conduits for elevating the temperature of the bath, and means for cooling said bath when it reaches a predetermined high temperature.

2. A quenching machine of the class described, comprising a tank adapted to have a quenching bath therein, a carriage mounted for vertical reciprocation into and out of the bath in said tank, means on said carriage and movable therewith for supporting an article to be quenched, means for rotating said article about its horizontal axis while it is in the bath and for a predetermined time after it leaves the bath, and a hood disposed about said article in a position to drain intercepted liquid back into the bath whereby the excess of the quenching bath on the article will be removed therefrom by centrifugal force and will be caught by said hood and thereafter be returned to the bath.

3. A quenching machine of the class described, comprising a tank adapted to have a quenching bath therein, a carriage movably mounted adjacent said tank, an article support rotatably mounted on said carriage and movable therewith for supporting an article to be quenched and immersing the article in said bath, means mounted on said carriage for rotating said support about its horizontal axis, means for moving said carriage to upper and lower positions, and brake means for stopping rotation of said article support when said carriage is in its upper position.

4. A quenching machine of the class described, comprising a tank adapted to have a quenching bath therein, a rotatably mounted article support adjacent said tank adapted to have an article to be quenched charged thereon, means for moving said article support from charging position to immersing position within said bath, means for rotating said support about its horizontal axis when in immersing position, and brake means for stopping rotation of said support when in charging position, said brake means comprising a brake member disposed at the upper extremity of the path of an element driven by the article support rotating means.

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