Feb. 7, 1939. R. L. STEPHENSON 2,146,516

APPARATUS FOR PROCESSING GEARS

Filed Sept. 16, 1936 3 Sheets-Sheet 1

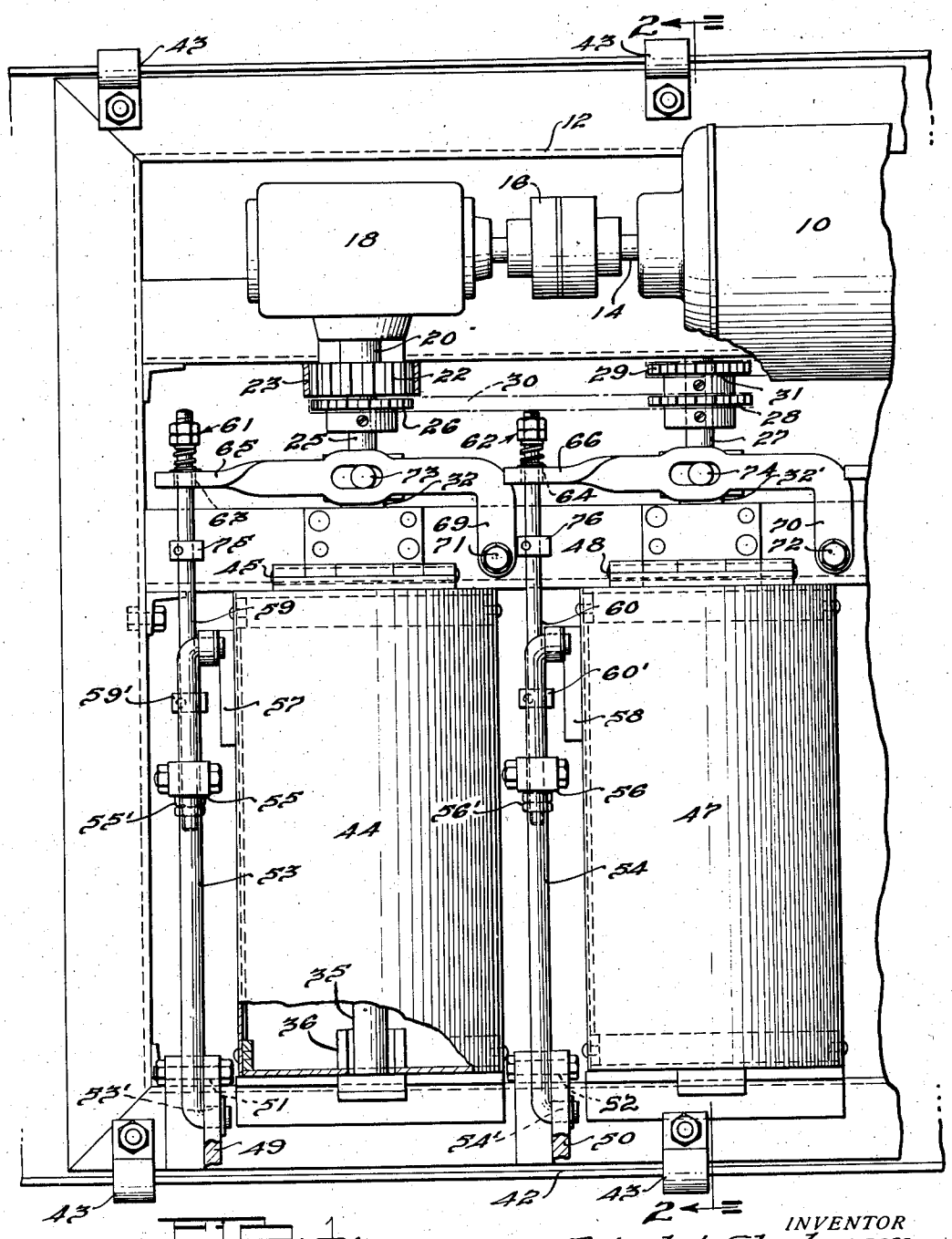


Fig. 1.

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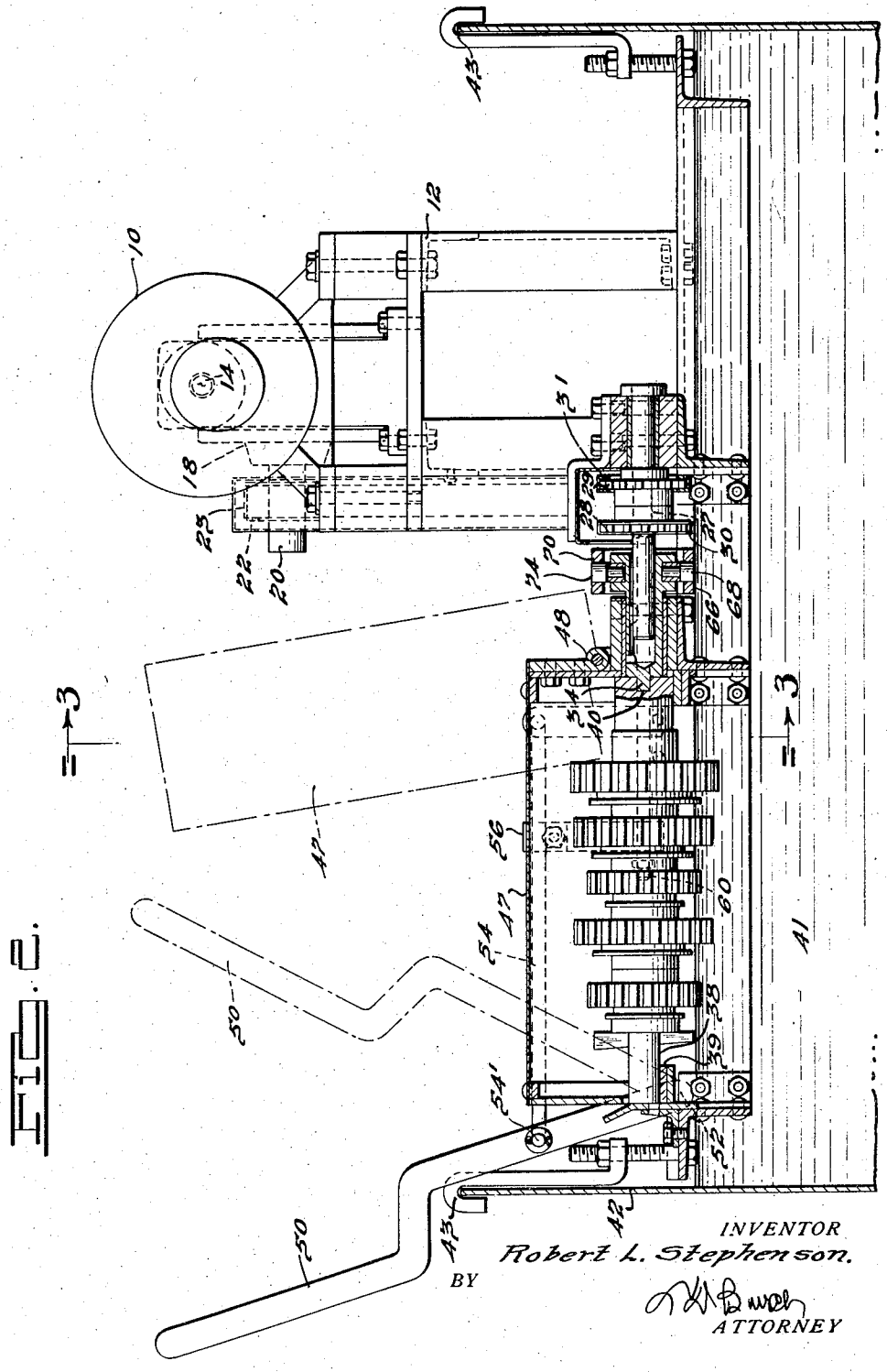


Fig. 2.

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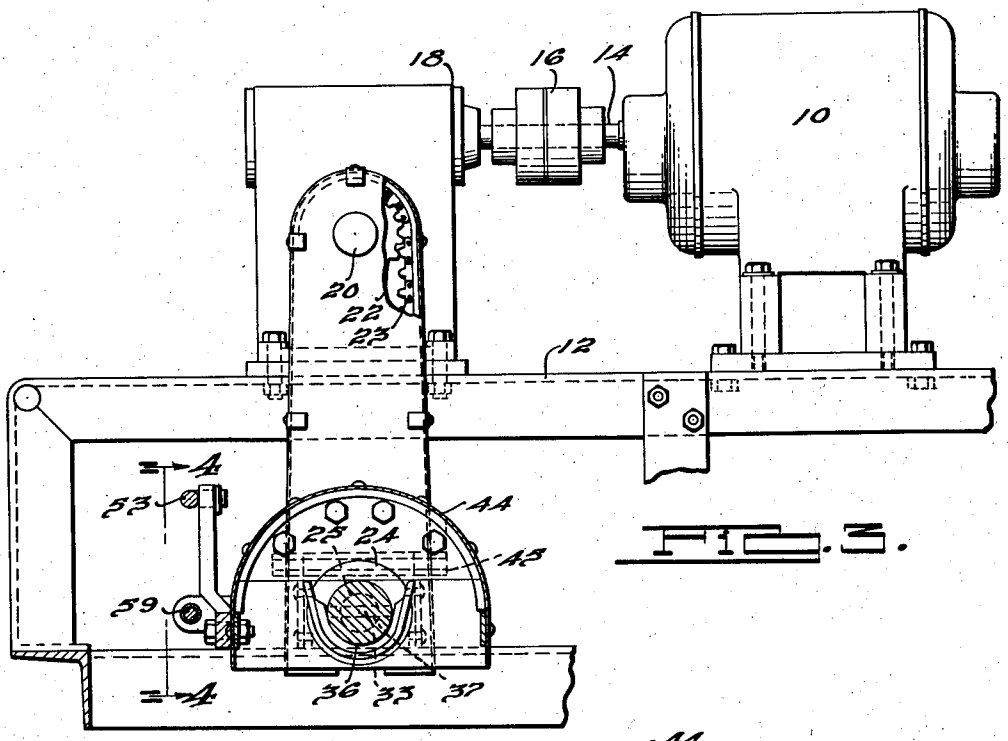


FIG. 3.

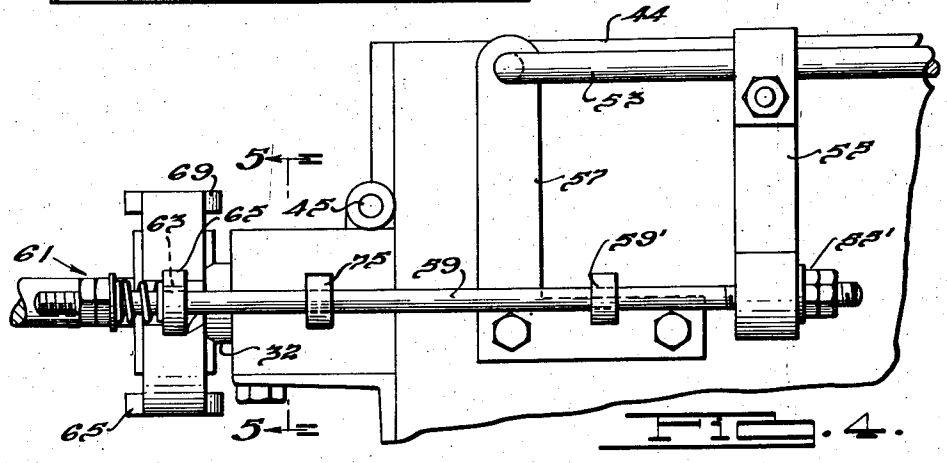


FIG. 4.

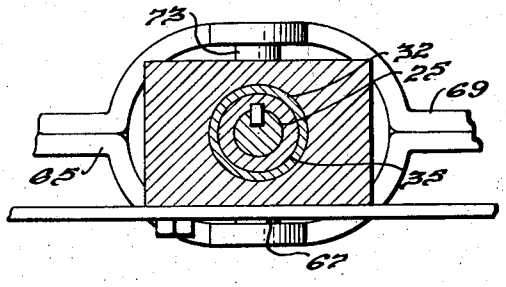


FIG. 5.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR PROCESSING GEARS

Robert L. Stephenson, Roseville, Mich., assignor to Borg-Warner Corporation, a corporation of Illinois

Application September 16, 1936, Serial No. 100,983

1 Claim. (Cl. 266—6)

This invention relates to a machine for quenching a hot gear which has just previously been subjected to and released from the intense heat within a heating medium.

The past has found little development in the field of quenching gears, and the subsequent and necessary process of broaching these gears has always presented difficulties involving much time and expense. The habit of gear manufacturers has been to take a gear directly from the heating medium and put it into a bath containing a quenching fluid, necessarily leaving it there until the temperature of the gear was brought far enough below the critical temperature of the type of steel used in the gear to allow the gear to attain a proper hardness. This progress would leave the gear, in its entirety, in a hardened state, so that the broaching thereof was intensely difficult, and, at least, expensive. Even the broaching means, as hard as it was, would break or chip during the broaching process, and the useful life of a broacher, as a result, was always unbelievably short. Each gear, no matter how carefully cut "in the green", had to be broached, and the time and expense required for the process per unit obviously cut down production, as well as costing the ultimate user a larger price for the gear, and neither of these undesirable elements has ever seemed warranted.

So, in order to provide a gear, the inner portion of which can be easily broached, it is necessary to leave the inner portion soft while, at the same time, the outer teeth are being hardened by quenching. This application provides a process for treating a gear in that fashion, and also a machine for doing same, and, a gear so treated has been found to possess the qualities claimed.

The gear, upon being taken, while hot, from the heating medium, is placed, for support, upon a spindle. The spindle, with the gear thereon, is then joined to the end of a drive shaft (while the shaft is not moving), assuming a horizontal and parallel relation with respect to the liquid level of a quenching bath disposed therebelow. The distance between the bath level and the spindle is sufficient to allow only the teeth of the gear to be immersed, and the spindle is then rotated by a driving means. The shaft which drives the spindle is equipped with a clutch mechanism which enables the operator to stop the rotation when he wants either to add hot gears to the spindle or take quenched gears therefrom. This clutch is associated with a pivoted hood, operated by a handle (for manual operation), and any movement of the handle for the purpose of lowering the hood over the quenching apparatus, also operates the clutch to cause the shaft and spindle to rotate; on the other hand, movement of the handle to raise the hood (so that gears may be taken from or added to the spindle), also operates the clutch to disengage the shaft from its rotating means. The hood, naturally, is for the purpose of covering the gears while they are being quenched, for, the centrifugal action imparted by the rotation of the gears to the oil in contact therewith has a tendency to throw the oil outwardly from the gear center; this tendency, incidentally, absolutely prevents the bath contents from contacting the gear core, as long as the bath level is correctly maintained.

The bath, naturally, offers most favorable results if comprised of a solution suitable for the type of steel to be quenched (in other words, if the heating medium consists of a cyanide, a saponifier should be used as a quencher). The cubical content thereof should be great enough so that the bath temperature remains practically constant during the gear-quenching operation. A means for agitating the bath, other than rotating the gear therein, is desirable for aiding the maintenance of a constant bath temperature. The bath temperature, if kept at about 100° (and if a mineral oil is used), has been found suitable to quench a gear (rotating about 100 R. P. M.) and leave the molecular organization thereof practically identical with that found to exist during the critical range; this 100° bath temperature requires about a two-minute quenching period. Changing the bath every five minutes, of course, enhances the maintenance of a constant bath temperature, and such is suggested.

This invention has as a principal object the provision of means for processing a gear in such a way as to insure a hardened outer tooth while the gear core is left relatively unhardened.

Another object of the invention is to provide a machine for processing a gear which will permit the gear to be thereafter easily broached, and, therefore, materially cut down the time required for such operation, as well as the cost.

Another object of the invention is to provide a machine for processing a gear by a partial quenching thereof so that the portion quenched will be hard, and the portion unquenched will be relatively soft.

Another object of the invention is to provide a machine for processing a gear which can be broached, but the outer teeth of which will be hard.

Another object of the invention is to provide a

machine of the class described which is adapted for partial quenching of hot gears on a production basis and which embodies means whereby said gears may be so quenched.

Another object of the invention is to provide a machine for receiving gears after they have been heated and subjecting them to a supporting means which is idle at the time of said subjection, but which has means associated therewith, both for lowering a hood over the quenching apparatus, and for simultaneously giving rotation to the supporting means after the gears have been so supported.

Other objects and advantages of the invention will be apparent from a reference to the following specification taken in conjunction with the accompanying drawings of which there are three sheets and wherein like characters are used to indicate like parts throughout the several views.

Fig. 1 is a top plan view showing a plurality of quenching machines which are embodied in this invention and the driving means and supporting means therefor;

Fig. 2 is a side elevational view of the apparatus of Fig. 1, shown partly in section, and taken along the lines 2—2 in Fig. 1;

Fig. 3 is an elevational view of part of the apparatus, partially broken away, and taken along the lines 3—3 in Fig. 2;

Fig. 4 is an elevational view of the clutch and hood-raising means, partially broken away, and taken along the lines 4—4 in Fig. 4; and

Fig. 5 is another elevational view of the clutch and taken along the lines 5—5 in Fig. 4.

A motor assembly 10 is suitably supported at its base in a rigid position by an appropriately located and supported angle-iron frame work 12. The power of said motor is transmitted by a shaft 14 through a universal joint 16 to and through an ordinary speed-reducing mechanism 18 (which is also supported by frame work 12), and thence to a shaft 20 which is perpendicularly disposed thereto. Mounted upon shaft 20, and adapted for rotation therewith, is a sprocket gear 22, which serves as a means for transmitting the power from said reducer to the illustrated quenching apparatus below by means of a chain-drive 23. Vertically disposed below gear 22 and driven by said chain-drive is a sprocket gear 24 which is mounted on a horizontal shaft 25 and adapted to rotate therewith. Forwardly disposed from gear 24, and mounted on shaft 25 for rotation therewith, is a sprocket gear 26. In parallel relation to shaft 25, and level therewith, is another shaft 27 on which sprocket gears 28 and 29 are mounted for rotation therewith. Gear 26 drives gear 28 by means of a chain-drive 30, and gear 29 is capable of driving a third shaft (not shown) by means of a chain-drive 31. It seems unnecessary to show another (or more) quenching means, for two are already disclosed; to use less or more than the two already shown is obviously possible, but it is also obviously superfluous; it has, therefore, been chosen to discuss only that which has been disclosed, for, to do more, seems uncalled for.

Shaft 25 terminates at its forward end into an enlarged portion or shoulder 32 and a slot-engager 33, and shaft 27 terminates at its forward end into an enlarged portion or shoulder 32' and a slot-engager 34. A shaft 35 (or 38), removably mounted on bearing 36 (or 39) and slotted at 37 (or 40), is adapted to rotate with shaft 25 (or 27) and to carry a plurality of gears therewith for quenching same. Disposed below shafts 35 and 38 is a saponified mineral oil quenching bath 41 which is contained in a metal tank 42; this tank serves also as a supporting means for the apparatus as shown at 43. The bath contents are agitated by an ordinary agitating means (not shown); they are changed regularly at intervals (preferably every 5 minutes); they are maintained at a constant temperature (about 95° to 100° F.); the level is kept constant by regulating the ingress and egress of fluid to and from the tank so that only the teeth of the gears being quenched therein are immersed; and, the cubical content of the fluid is sufficient so as to be substantially unaffected by the hot gears being introduced thereinto. A hood 44 (or 47), hinged at the center of its rear face by a pivot hinge 45 (or 48) which is integral with the frame structure of the apparatus, is removably supported at the front end thereof on the frame structure; thus supported, said hood is capable of covering the gears while same are being quenched, and thus hinged, said hood is capable of being raised or lowered at the front end thereof to facilitate the removal of the gears after they have been quenched, or the introduction of same prior to quenching.

Raising and lowering of hood 44 (or 47) is accomplished by means of a bent and elongated handle 49 (or 50) which is pivotally secured, at 51 (or 52), to the rigid frame structure of the apparatus. Practically on a level with, but disposed therefrom, is a horizontal rod 53 (or 54) which is pivotally connected to handle 49 (or 50) at 53' (or 54') and has suitably secured thereto a connecting arm 55 (or 56), said arm being downwardly extensible from said rod. Rod 53 (or 54) continues rearwardly to a pivotal point located and disposed in a bracket 57 (or 58) which is fixedly secured to and is a part of hood 44 (or 47). The lower portion of connecting arm 55 (or 56) is adapted to be engaged with and slidably receive a rod 59 (or 60), said rod having rigidly and adjustably mounted thereon a plurality of set-screws 55' (or 56') and a stop 59' or (60'). The end of rod 59 (or 60) which is farther remote from arm 55 (or 56) terminates in a spring and set-screw unit generally indicated at 61 (or 62), after having passed through a hole in a clutch member (to be discussed). It can be seen therefore, that rearward motion of the upper portion of handle 49 (or 50) causes hood 44 (or 47) to move about its pivotal point 45 (or 48), and bracket 57 (or 58) to slide along rod 59 (or 60) till it strikes stop 59' (or 60'). In having bracket 57 (or 58) strike stop 59' (or 60'), rod 59 (or 60) is given a rearward motion, the effect of which will be discussed presently.

Rod 59 (or 60), near the end thereof, slidably passes through a hole 63 (or 64) in a twisted clutch member 65 (or 66) which extends from, underlies, and is slidably fixed to the enlarged portion of shaft 25 (or 27) by means of a slidable engagement with a lug 67 (or 68) which projects downwardly from the bottom of the enlarged portion of said shaft 25 (or 27) and into and through an elliptical hole in member 65 (or 66). Another clutch member 69 (or 70), which is pivotally secured to the rigid frame structure of the apparatus at 71 (or 72), is adapted to extend from said pivotal point 71 (or 72), and overlie and be slidably fixed to the enlarged portion of shaft 25 (or 27) by means of a slidable engagement with a lug 73 (or 74) which projects upwardly from the top of the enlarged portion of said shaft 25 (or 27) and into and through

an elliptical hole in member 69 (or 70). Forwardly disposed from the point of contact between rod 59 (or 60) and clutch member 65 (or 66), and at a distance equal to that between arm 55 (or 56) and stop 59' (or 60'), is a stop 75 (or 76) which is adjustably and fixedly mounted on rod 59 (or 60). It can be seen, therefore, that not only does a rearward movement of the upper portion of handle 49 (or 50) raise hood 44 (or 47) about an axis 45 (or 48), but it also causes stop 75 (or 76) on rod 59 (or 60) to strike and rearwardly move clutch member 65 (or 66) and bring about a disengagement between shaft 25 (or 27) and shaft 35 (or 38) which carries the treated gears, or those which are to be treated. It is apparent that the raised hood and the idle shaft lend accessibility to the apparatus either when it is desirable to place hot gears on said shaft or take off those which have been quenched.

One of the important things about this invention, and the apparatus embodied herein, is to regulate the bath volume so that the level thereof is no higher than the level which is assumed by the base of the gear teeth at a time when the hood is down and the shaft rotating. However, there can be some variation in this fluid level (as there will be, on account of the human element involved in adjusting same), because the partially immersed gears, in rotating, set up a centrifugal force which tends to throw the oil away from the gear core, and any momentary contact between the oil and core will be insufficient, because of the time element, to quench the gear core. And, a gear, properly treated by use of the means and apparatus provided for in this invention, will be turned out into the field with a hard tooth and a soft and ductile core.

While the invention has been described in some detail it is to be understood that the description given is for the purposes of illustration only and is not to be construed as being definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claim.

I claim:

In a device of the type described, a tank for receiving quenching fluid, a frame, a shaft mounted on said frame, means for rapidly rotating said shaft mounted on said frame, a removable spindle for receiving several gears to be quenched mounted on said frame, a hood movably mounted on said spindle, clutch means for connecting said spindle to said shaft, means for disconnecting said clutch means and raising said hood by the same operation, and means for suspending said frame in said tank.

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