July 31, 1956

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2,756,985

GUIDE MEANS FOR INDUCTION HEAT-TREATING DEVICE

Filed Dec. 13, 1954

2 Sheets-Sheet 1

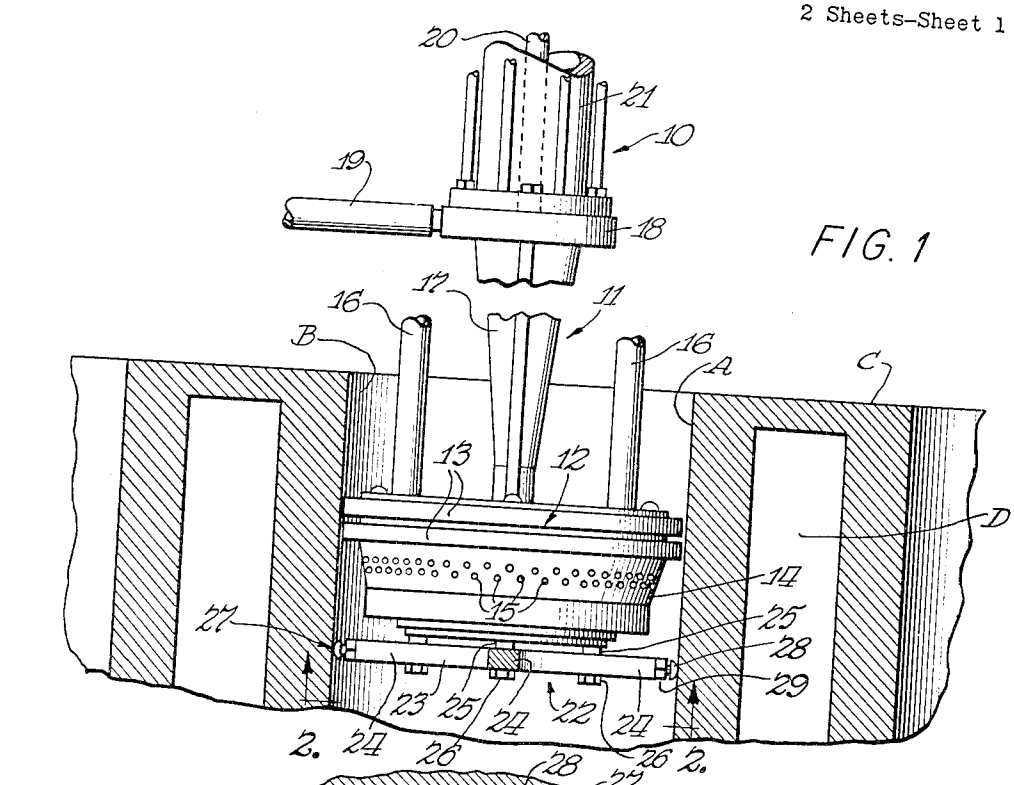


FIG. 1

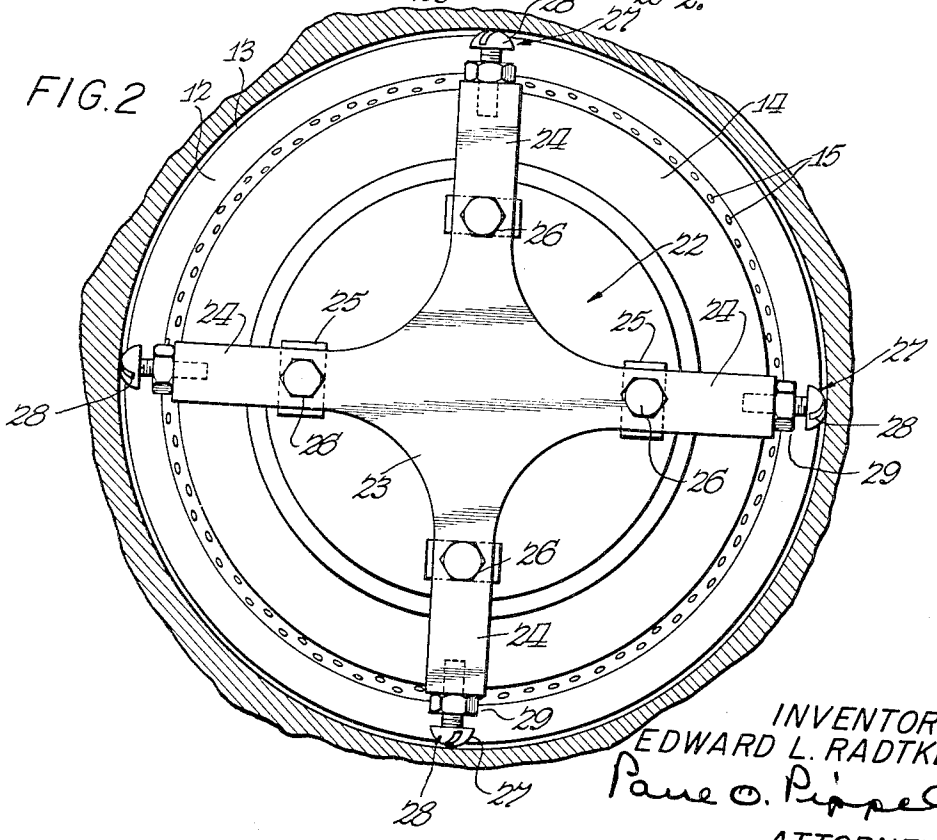


FIG. 2

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2 Sheets-Sheet 2

FIG. 3

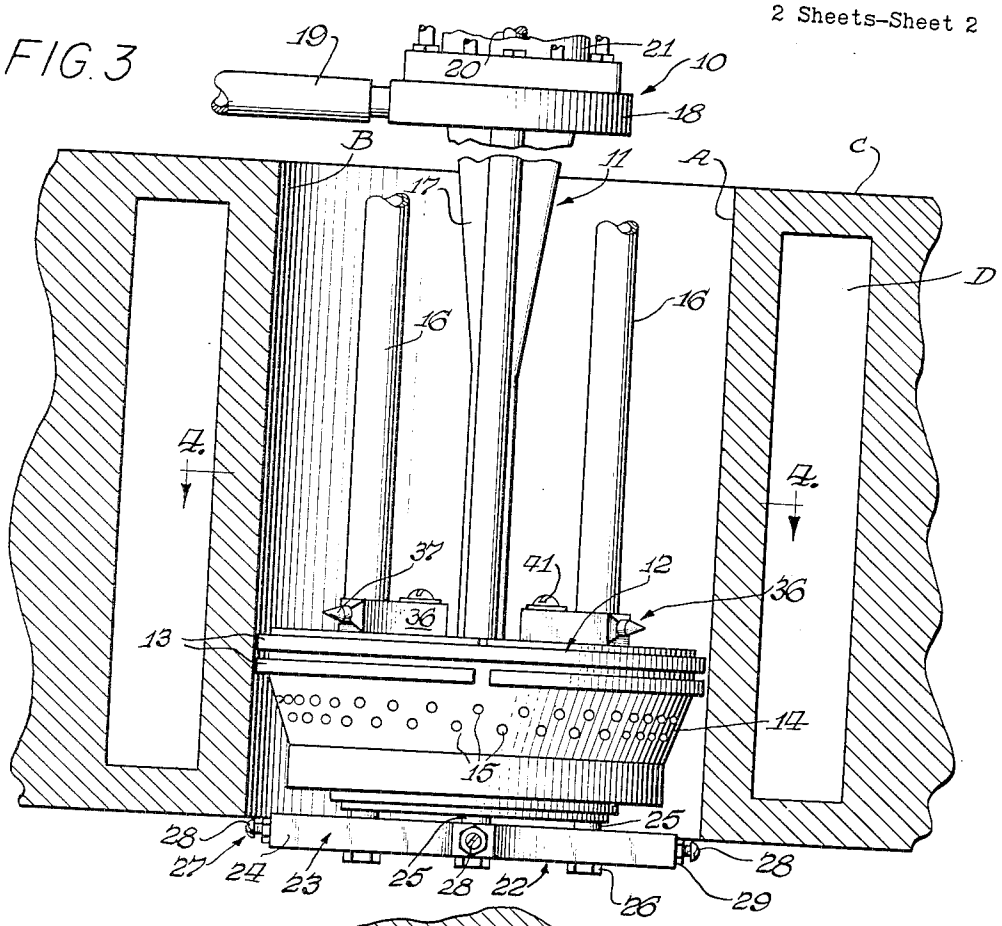


FIG. 4

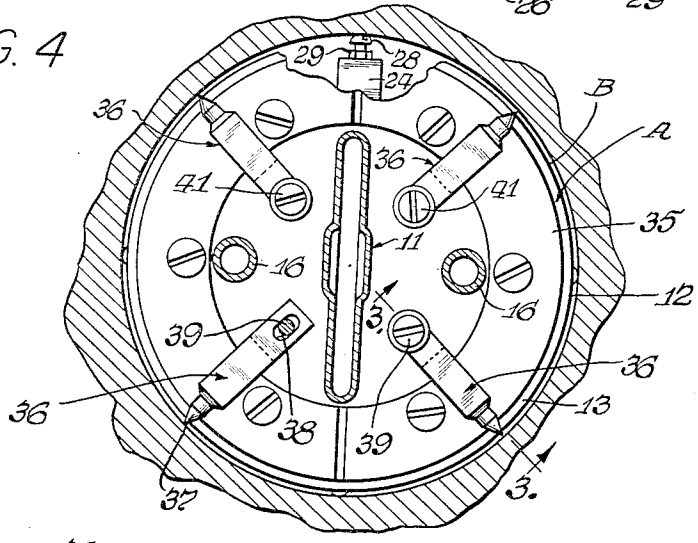
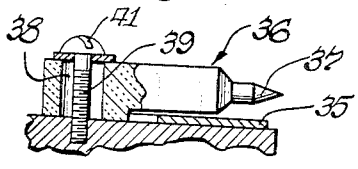


FIG. 5



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GUIDE MEANS FOR INDUCTION HEAT-TREATING DEVICE

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Application December 13, 1954, Serial No. 475,526

1 Claim. (Cl. 266—4)

This invention relates to a heat-treating apparatus of a type particularly adapted for the heat treating of inner walls of elongated cylindrical objects. More specifically, this invention relates to an induction coil device having adjustable guide means for centering the coil during heat treatment of elongated bores. This application is a continuation-in-part of applicant's co-pending application Serial No. 382,824, filed September 28, 1953, now abandoned.

During the heat treatment of elongated bores it is desirable, in order to effect proper heat treatment, to maintain the induction coil which is progressively movable within the bore in properly spaced relation with respect to the inner wall of the bore. This is particularly true during the heat treatment of elongated bores, of a type such as may be found in engine blocks. Since the induction coil must be progressively moved in an axial direction within the bore throughout a considerable length, there is a tendency for the induction coil to become improperly centered whereupon the spacing of the annular face of the induction coil varies with respect to the inner wall of the bore. As a consequence, it is found that the hardness of the cylinder bores is not consistent and undesirable metallurgical patterns are produced unless the inductor block is consistently maintained in proper spaced relation throughout the progressive axial movement and heating operation of the unit.

Generally the induction device is moved axially by means of a hydraulic cylinder or screw which is rigidly attached to a conventional supporting means. In view of the length of the cylinder or screw, the piston rod, the bracket and the induction assembly, any side movement of the cylinder at the point of its attachment is magnified many times at the tip of the inductor, and consequently, it is very difficult to maintain the induction device in proper consistently spaced relation with respect to the inner wall of the bore. It is a prime object of this invention, therefore, to provide an improved induction device for heat treating the inner walls of cylindrical members, the device including a guide means which engages the inner wall for properly centering the device during its progressive heating operation.

A still further object of the invention is to provide a guide member for an induction heat-treating device, the guide member being connected for movement with a heating coil, the said guide member including adjustable elements which may be adjusted to properly center the coil with respect to the inner wall of a cylindrical work-piece, the adjustable elements being adapted to engage the inner wall of the work-piece during progressive axial movement of the induction device whereupon the induction coil is maintained in proper spaced relation with respect to the inner wall throughout the progressive heating operation.

A still further object of the invention is to provide a guide member for an induction heating coil adapted to be moved progressively with respect to the inner wall of a cylindrical object, the guide means including a spider-shaped bracket which is attached to the heating coil, the spider-shaped bracket including arms to which a plurality of adjustable elements are connected, the elements being adjustable for centering the induction coil and being movable with the coil and in engagement with the inner wall of the work-piece whereupon the coil is maintained in proper lateral spaced relation with respect to the inner wall.

A still further object is to provide an improvement in a guide construction for an induction heating and quench coil, the improvement including guide means adapted to maintain the coil in spaced relation to the wall of a cylindrical bore when the coil has reached its lowermost position in heating relation to the lowermost extremity of the bore.

These and further objects will become more readily apparent from a reading of the specification when taken in connection with the accompanying sheet of drawings.

In the drawing:

Figure 1 is a cross-sectional view through a portion of an internal combustion engine block showing a portion of an elongated bore, and disclosing in side elevation, an apparatus for heat treating the inner wall of the bore;

Figure 2 is an enlarged view taken along the line 2—2 of Figure 1, showing a guide member connected to a heat-treating device.

Figure 3 is a cross-sectional view through a portion of an internal combustion engine block showing a portion of an elongated bore, and disclosing in side elevation, a modified apparatus for heat treating the inner wall of the bore;

Figure 4 is a view of the modification shown in Figure 3, the view being taken along the line 4—4 of Figure 3; and

Figure 5 is an enlarged sectional view taken along the line 5—5 of Figure 4.

As best indicated in Figure 1, an induction heat-treating apparatus is generally designated by the reference character 10. The heat-treating apparatus comprises an induction heating device, generally designated by the reference character 11. The induction heat-treating device 11 may be of conventional construction, including an induction coil 12. The induction coil 12 comprises axially spaced annular faces 13. A quench head 14 is suitably connected to the induction coil 12, the quench head 14 being made of a fiber-like material and including quench openings 15. The quench openings 15 may be conventionally positioned to direct a quench liquid in a radially outward direction against the inner wall A of an elongated bore B formed in a cylinder block or work-piece C. The cylinder or motor block C is provided with water jackets D in a conventional manner. It is desired to inductively harden the inner wall A, thus eliminating the need for cylinder inserts. Quench liquid conduits 16 are provided to suitably direct quench liquid to the quench head 14.

A support 17 is suitably connected to the induction coil 12, the support 17 in turn being connected to a collar 18 which is connected to a cooling water conduit 19. Suitable passage means (not shown) are provided in the collar 18 and in the support 17 for directing cooling liquid from the conduit 19 to the hollow induction coil 12. This practice is conventional and need not be further described.

A piston rod 20 is suitably connected to the collar 18 for reciprocating the support 17 with respect to the inner wall A of the block C. The piston rod 20 is suitably actuated from a cylinder 21, the cylinder in turn being suitably connected in a conventional manner (not shown) to a support.

A guide member for the induction device 11 is generally indicated by the reference character 22. The guide mem-

ber 22 comprises a bracket 23 having a plurality of radially extending or spider-shaped arms 24. The arms 24 are suitably connected to the quench head 14 by means of circumferentially spaced spacers 25. Bolts 26 extend through the arms 24 through the spacers 25 and are suitably threaded into a lower portion of the quench head 14. Each arm 24 is provided at its outermost tip with a guide element, generally designated at 27. Each guide element 27 includes a screw 28 which is threaded into each respective arm 24. Jam nuts 29 are threaded onto the screws 28 for tightening the screws 27 against turning movement, once they have been set in the desired position.

During the operation the induction coil 12 is suitably connected to a source of electrical current in a conventional manner. Cooling liquid is circulated through the conduit 19 to the interior of the induction coil 12. The piston 20 is initially moved downwardly by means of the cylinder 21. The device 11 is then progressively moved upwardly within the bore B wherein heating and quenching take place. The induction coil 12 has its annular faces 13 disposed in laterally spaced relation with respect to the wall A. Conventional heating and quenching take place during progressive upward movement of the device 11 throughout the bore B. The adjustable guide elements 27 have been adjusted relative to the arms 24, so that the induction coil 12 is properly centered and so that the annular faces 13 are spaced an equal distance from the wall A. As the induction coil 12 moves down throughout the bore B, the heads of the screws 28 are in relative sliding engagement with the wall A of the bore B. The induction coil 12 is thus fixed against relative lateral movement with respect to the bore B and it is centered throughout the progressive heating operation. Thus it can be seen that consistent heat treatment of the wall A takes place and the depth of heat penetration remains constant, in view of the fact that the induction coil 12 is at all times in correct spacing with respect to the wall A of the bore B.

In Figures 3, 4, and 5, a modified embodiment of the invention is disclosed. As apparent from these views, the cylinder and engine block assembly C is the same as shown in Figures 1 and 2. Likewise, the induction coil 12, cyclinder 10, and guide member 22 are the same and therefore the same reference characters have been applied to the same parts.

In the modified embodiment of Figures 3, 4, and 5, the induction coil 12 is provided at its upper end with a flat plate 35 suitably connected to said coil 12 and quench head 14. A plurality of spacer elements 36 are supported on said plate in circumferentially spaced relation. The spacer elements 36 may be made of a good non-conductor material such as plastic, fibre-glass, etc. Each spacer element 36 includes a tip portion 37 adapted to engage the inner wall A of the bore B to suitably space the inducts 12 in like manner as the guide member 22 shown in Figures 1 and 2. Each element 36 is provided with an elongated slot 38, as best shown in Figure 5, through which an adjusting screw 39 extends. The screw 39 is threaded into the quench head 14, as indicated at 40. A washer 41 is disposed between the head of the screw 39 and the spacer element 36.

The spacer elements 36 further serve to maintain the coil 12 in proper alignment during its travel through the bore B. Thus, in the operation, which is the same as in the first embodiment shown, the coil 12 is held, against possible cocking in the bore, by virtue of the elements 36 and the guide element 22. Furthermore, the elements 36 serve to properly space the coil from the bore wall A when the coil has been moved to its lowermost position so that the lower extremity of the bore is heated. This is best shown in Figure 3 where it is apparent the coil is held in proper position prior to upward movement of the coil and resulting heating and quenching. Thus the coil may properly heat both the upper ends of the bore as well as the lower, since in either case either spacer elements 36 or the guide member 22 are within the bore to cause proper positioning.

It can thus be seen that the objects of the invention have been fully achieved and that an improved induction hardening device has been provided. It must be understood that changes may be made in both embodiments disclosed without departing from the spirit of the invention as disclosed nor the scope thereof as defined in the appended claim.

What is claimed is:

In a heat-treating apparatus for progressively heating the inner wall of a cylindrical work-piece; a treating device comprising an induction coil having its outer periperal surface disposed in close proximity with respect to the inner cylindrical wall, a quench head connected to said inductor, said quench head including means for directing quench liquid against said inner wall; guide means on said device comprising a spider shaped bracket connected to said quench head below said induction coil, arms on said spider shaped bracket projecting radially outwardly toward said inner wall, a first adjustable guide element rotatably connected to each arm and adapted to be adjusted relative thereto and said inner wall, means connecting said first guide elements to said device for locking the same in position, second adjustable guide elements circumferentially positioned on said treating device above said induction coil, said second guide elements each comprising a radially shiftable spacer element, means connecting said spacer elements to said device and for locking the same in a plurality of radially adjusted positions, said guide elements being positioned for engaging said inner wall in relative sliding engagement during movement of said device for maintaining said inductor in spaced relation with respect to the inner wall, and means for moving said device axially with respect to said wall.

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