

Sept. 14, 1948.

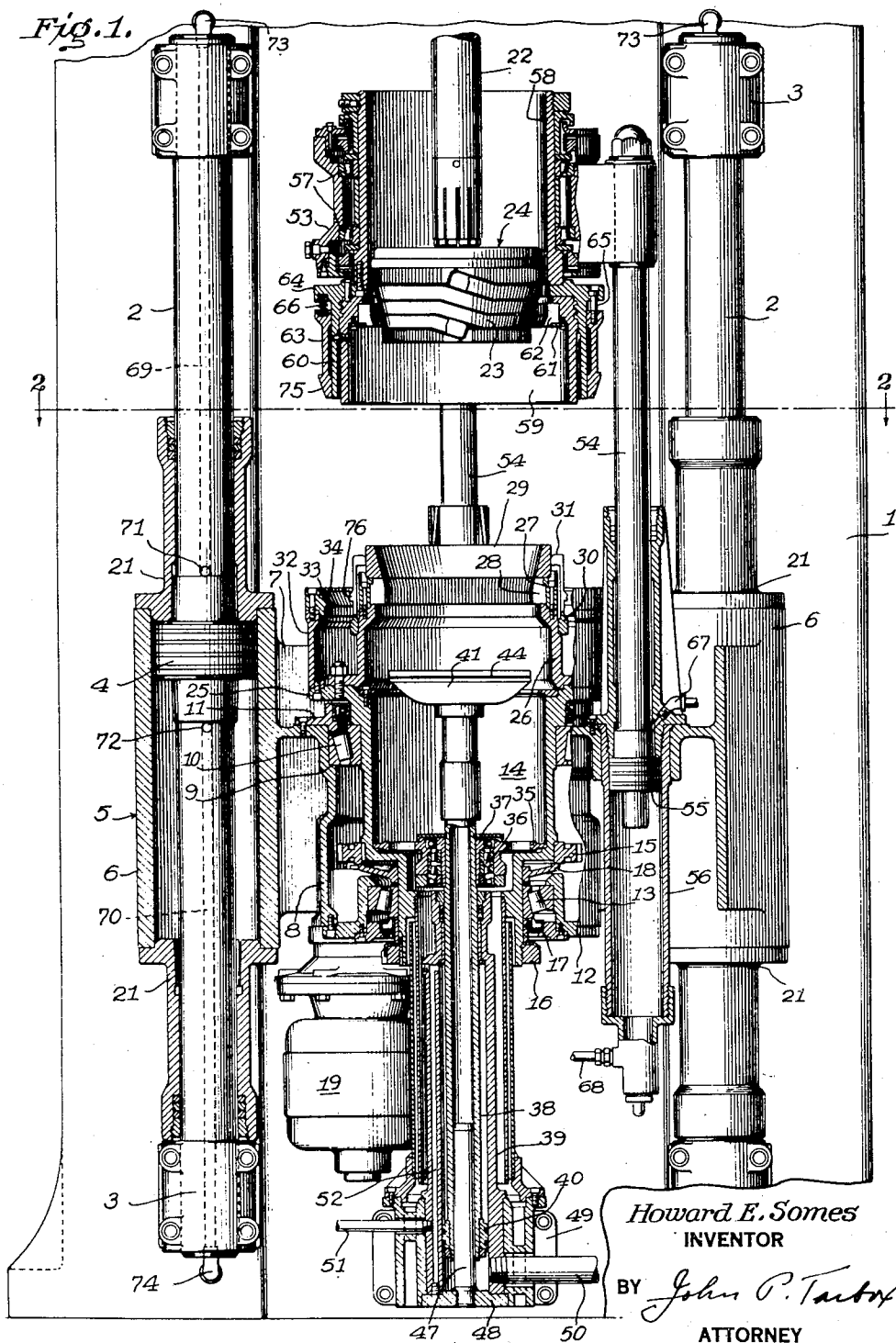
H. E. SOMES

2,449,089

HEAT-TREATING APPARATUS

Filed Oct. 7, 1944

3 Sheets-Sheet 1



Sept. 14, 1948.

H. E. SOMES

2,449,089

HEAT-TREATING APPARATUS

Filed Oct. 7, 1944

3 Sheets-Sheet 2

Fig. 2.

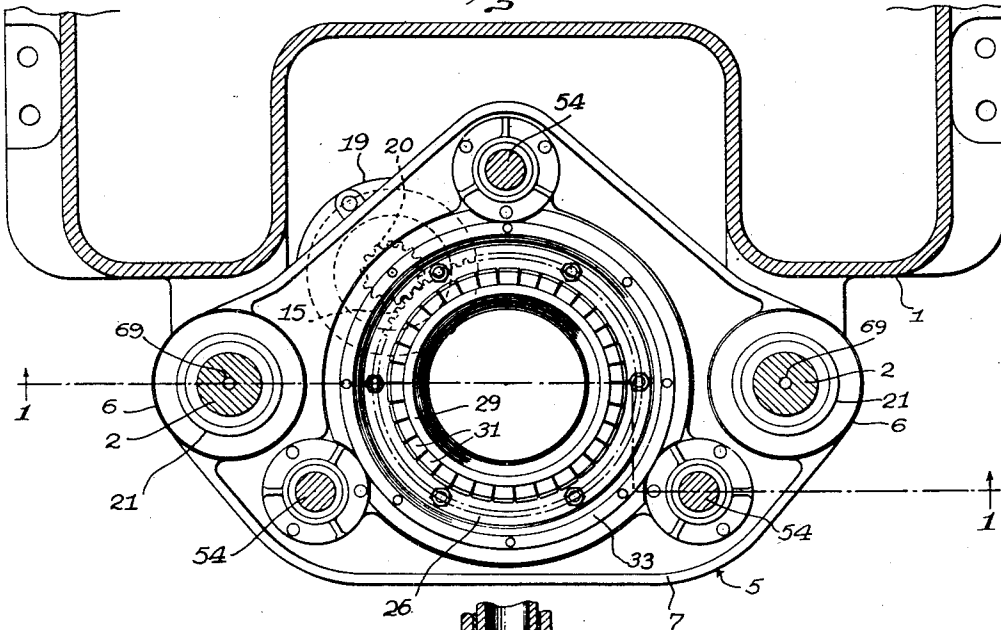
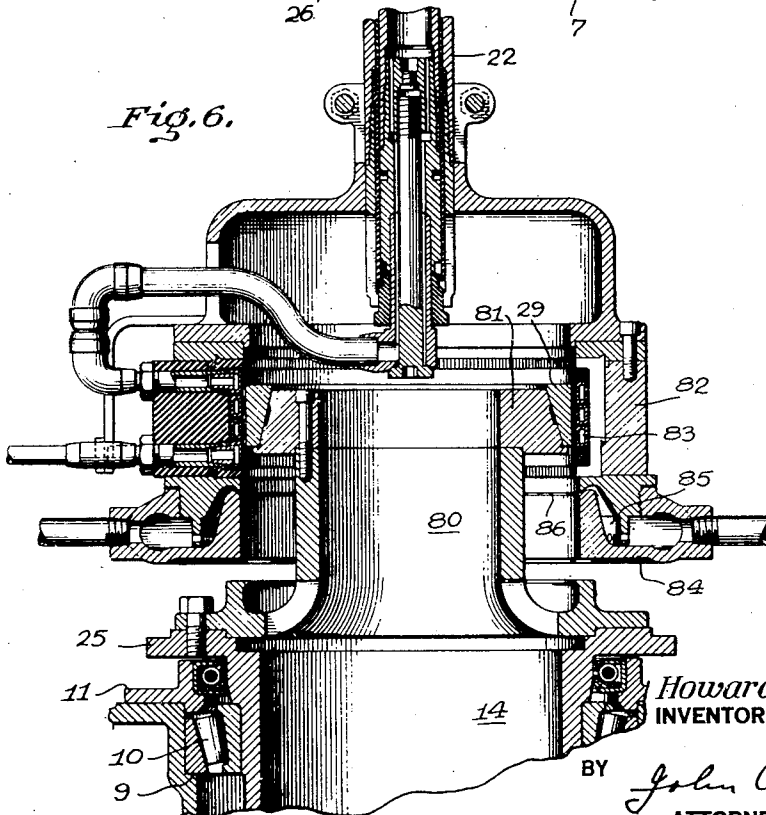


Fig. 6.



Howard E. Somes
INVENTOR

BY

John P. Tarbox
ATTORNEY

Sept. 14, 1948.

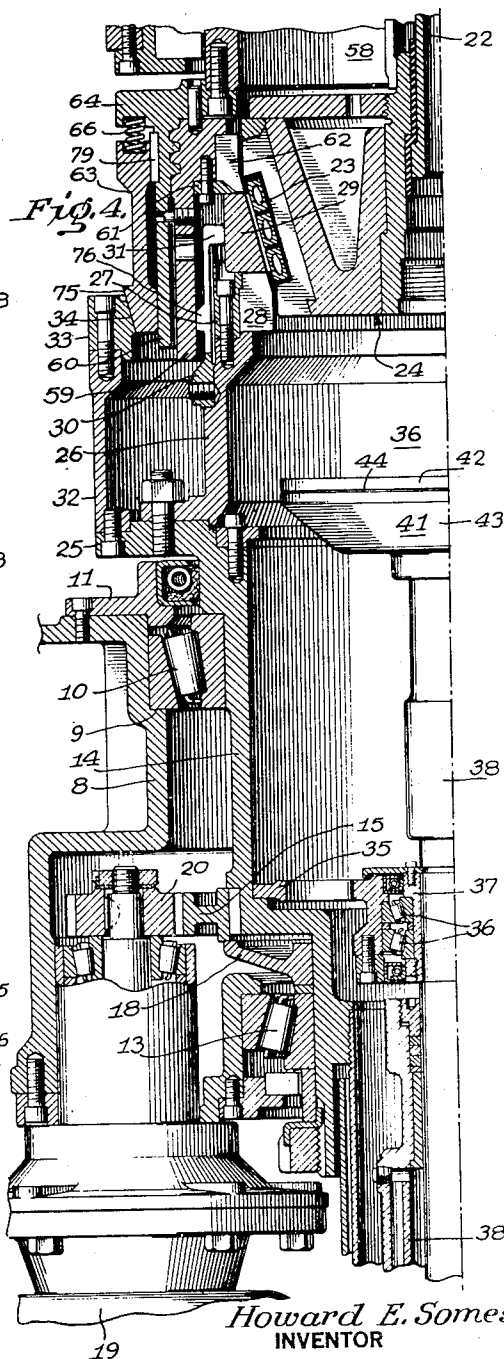
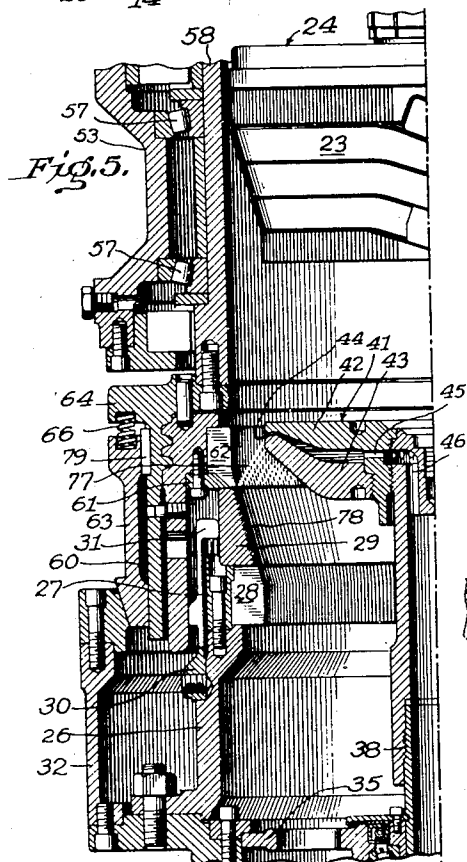
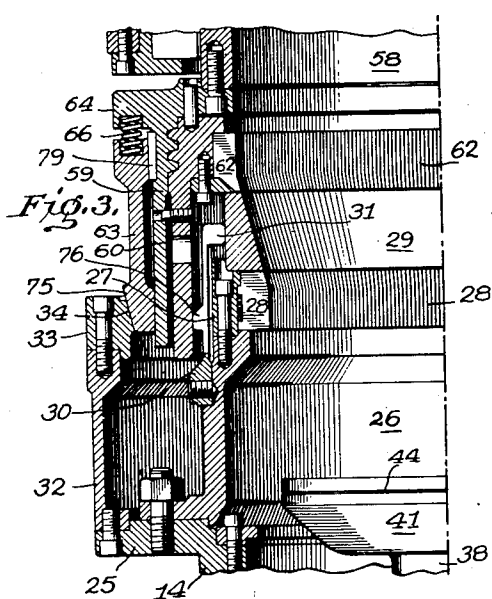
H. E. SOMES

2,449,089

HEAT-TREATING APPARATUS

Filed Oct. 7, 1944

3 Sheets-Sheet 3



Howard E. Somes
INVENTOR

BY *John P. Taft*
ATTORNEY

UNITED STATES PATENT OFFICE

2,449,089

HEAT-TREATING APPARATUS

Howard E. Somes, Detroit, Mich., assignor, by
mesne assignments, to The Ohio Crankshaft
Company, Cleveland, Ohio, a corporation of
Ohio

Application October 7, 1944, Serial No. 557,606

3 Claims. (Cl. 266-6)

1

This invention relates to heat treating apparatus, particularly to apparatus for hardening annular articles of relatively short length.

The primary object is to provide heat treating apparatus with a novel arrangement for supporting a workpiece in such position for heating by high frequency electromagnetic induction as to insure uniform heating from end to end.

Another object is to provide induction heat treating apparatus with a novel arrangement for clamping a relatively short workpiece in position for the heat treating operation in which provision is made for engaging the ends of the workpiece with magnetic circuit elements, and for rotating the workpiece so engaged.

With the above and other objects in view, which will be apparent from the description to those skilled in the art to which the invention appertains, the present invention consists in certain features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings and then claimed.

In the drawings which illustrate a suitable embodiment of the present invention:

Figure 1 is a partial front view of the apparatus, portions of the operative mechanism thereof being in section and other portions being broken away to better illustrate the construction of the same;

Figure 2 is a transverse section taken on line 2-2 of Figure 1;

Figure 3 is an enlarged fragmentary sectional view showing the workpiece in its clamped position;

Figure 4 is a view similar to Figure 3 but including additional mechanism and showing the heating head and workpiece in operative heating position;

Figure 5 is a fragmentary section similar to Figure 4 and showing the quenching head and workpiece in operative quenching position; and

Figure 6 is a section of a modification for heat treating the external surface of the article shown in Figure 1.

The apparatus about to be described is particularly suited for heat treating annular articles of relatively short length, such as a bearing race, and includes mechanism for clamping the workpiece in position, mechanism for elevating the workpiece into a position for the inducing of high-frequency heating currents in the inner surface of the workpiece to heat this surface to hardening temperature, and mechanism for lowering the workpiece immediately upon its reaching hardening temperature and raising a quenching head into position for directing a stream of quenching fluid against the heated surface.

Referring to the accompanying drawings in which like numerals refer to like parts throughout the several views, the apparatus of the present invention includes an upright supporting base 1

2

to which a pair of spaced, vertical, parallel rods 2 are secured at their ends by suitable clamps 3, the rods 2 being spaced outwardly from the base 1 and each being provided with a piston portion 4.

Mounted for vertical reciprocation is a carriage 5 comprised of cylinders 6 cooperatively associated with the piston portions 4 and inter-connected by a cross piece 7 having a central opening defined by an integral downwardly extending annular casing 8, the upper end of which is counterbored to provide a bearing seat 9.

Mounted on the seat 9 is the outer race of a tapered roller bearing 10, the outer race being disposed against the seat 9 being held against movement therefrom by an annular clamping ring 11. The lower open end of the annular casing 8 is closed by a removable annular member 12 having a shouldered portion which contains the outer race of a tapered roller bearing 13.

The inner races of the bearings 10 and 13 support an annular member 14 located within the casing 8 and provided with a gear 15, the member 14 having a nut 16 thereon which through an annular sleeve 17, the inner bearing race of the bearing 13 and an annular ring 18 clamps this inner race and the gear against axial movement relative to the annular member 14, as seen in Figure 1.

Secured to the casing 8 is a motor 19, the shaft of which extends into the casing 8 and is provided with a pinion 20 (Figure 2) meshed with the gear 15 to impart rotation to the annular member 14.

The outer ends of the cylinders 6 are closed by annular heads 21 having sealed bearing engagement with the rods 2 whereby upon the admission of fluid under pressure at the opposite sides of the piston portions the carriage is caused to move vertically downwardly or upwardly, as the case may be, depending on the side of the piston portions to which the fluid is admitted under pressure.

Depending from the upper end of the vertical base 1 is an arbor 22 (the supporting connections for which are not shown in the drawings) for conducting high frequency current to the inducing coil 23 of the head 24 which is secured to the lower end of the arbor 22.

Normally in the inoperative position of the apparatus the carriage 5 is disposed well below the head 24 as shown in Figure 1.

The annular member 14 is provided with a flange 25 at its upper end which overlies the clamping ring 11, and to which a removable annular work piece support 26 is secured. The support 26 has secured thereto by a clamping ring 27 an annular laminated magnetic circuit element 28 upon which ring the workpiece 29 to be heat treated (an outer bearing race) is supported. The workpiece 29 is accurately centered and held on the ring 27 closely adjacent the ele-

ment 28 by a ring 30 secured to the support 28 and having at its upper end an annulus of spring fingers 31 which resiliently grip the outer periphery of the workpiece.

Also secured to the flange 25 in surrounding concentric relation with the support 28 is an annular member 32 having a ring 33 removably secured to its upper end, the ring having a conical inner face 34 for a purpose to be presently described.

An annular perforate plate member 35 is axially movably supported within the rotatable member 14 and carries tapered bearings 36. The bearings 36 support a sleeve 37 which supports a tubular member 38 which below the plate member 35 extends into a cylinder 39 and is provided at its lower end with a piston 40 engaging the wall of the cylinder 39, the cylinder at its upper end having sealed engagement with the tubular member 38.

The upper end of the tubular member 38 is provided with a quench head 41 (Figure 5) comprised of spaced disks 42 and 43 to define an annular downwardly directed discharge passage 44, the space between the spaced disks 42 and 43 communicating through openings 45 and 46 with the interior of the tubular member 38.

In the position shown in Figure 1, the lower end of the tubular member 38 is telescoped with a cylindrical member 47 carried by the closure plate 48 of the cylinder 39, the cylinder being secured to the base by a suitable clamping bracket 49.

Quenching liquid under pressure from a suitable supply source is admitted into the lower end of the cylinder 39 through conduit 50. The quenching liquid acts against the piston 40, causing it to move to the upper end of the cylinder, thus elevating the tubular member 38 and quench head 41. The plate 35 which is slidable in the rotary member 14, accurately axially guides the upper end of the tubular member 38. As soon as the tubular member 38 clears the cylindrical member 47 the quenching liquid flows through the tubular member to the quench head 41.

Fluid under pressure admitted through conduit 51 flows through passage 52 to the upper end of the cylinder 39 to lower the member 38 to the position shown in Figure 1.

Associated with the carriage 5 in axial alignment with the rotary member 14 is an annular casing 53 which is supported by depending piston rod member 54 having pistons 55 at their lower ends, the pistons being reciprocally mounted in upright fluid pressure cylinders 56 carried by the cross piece 7.

Rotatably supported within the casing 53 by tapered roller bearings 57 is an annular member 58 to which inner and outer concentric sleeves 59 and 60, respectively, are secured, the inner sleeve being threaded in the outer and locked against rotation. The inner sleeve 59 through a clamping ring 61 supports an annular laminated magnetic circuit element 62 which is similar to the lower element 28. The outer sleeve 60 is surrounded by a collar 63 having its lower end tapered at 75 to correspond with the conical end face of the ring 33. The collar 63 is axially slidable on the outer sleeve 60 and is supported from a flanged portion 64 thereof by bolts 65 slidable through the flanged portion 64. Suitable compression springs 66 urge the collar 63 downwardly away from the flanged portion 64.

Fluid under pressure is admitted to each of the cylinders 56 through upper and lower con-

nections 67 and 68 which are connected through suitable control mechanism (not shown) with a source of fluid supply.

The guide rods 2 for the carriage 5 are each drilled from their opposite ends, as indicated at 69 and 70, and provided with ports 71 and 72, respectively, at opposite sides of the pistons 4, the openings 69 and 70 being provided with connections 73 and 74 connected through suitable control mechanism (not shown) with the source of fluid supply for controlling the carriage movement.

In the operation of the mechanism described, the workpiece 29, here shown as a tapered roller bearing race for the purpose of illustration, is placed within the spring fingers 31 and upon the ring 27, as shown in Figure 1.

The apparatus is set in operation by suitable control mechanism (not shown) and during the first stage fluid under pressure is admitted to the cylinders 56 through the connectors 67 thereby causing the pistons 55 to lower the annular casing 53 and its associated mechanism to the position shown in Figure 3. As the lowered position is approximated the inner sleeve 59 engages outwardly extending cam portions 76 on the spring fingers 31 to urge the fingers radially inwardly to securely clamp the outer periphery of the workpiece 29, and the conical face 75 of the collar 63 resiliently contacts the conical face 34 of the ring 33 in clutching engagement to establish a driving connection between the annular member 32 and member 58. In this lower position the upper ring 61 engages the upper face of the workpiece 29, the two magnetic circuit elements 28 and 62 forming in effect closely adjacent end extensions of the workpiece whereby to eliminate end effects during the inducing of the heating currents in the workpiece, as taught in my Reissue Patent No. 22,064, dated April 7, 1942.

During the next stage of operation fluid under pressure is admitted to the cylinders 56 through the ports 71 which raises the carriage 5 to position the workpiece 29 around the inducing coil 23 as shown in Figure 4.

The motor 19 is then started to rotate the workpiece 29 about the inducing coil 23, the conical faces 34 and 75 affording an efficient driving connection whereby to obviate any relative movement between the rings 27 and 61 which might otherwise disturb the predetermined axially aligned position of the workpiece 29 relative to the inducing head 24. The collar 63 and sleeve 60 are held against relative rotation by one or more interlocking keys 79.

After the workpiece is rotating at the proper speed, the inducing coil 23 is energized from the source of high frequency current (not shown) whereby heating currents are induced in the inner surface of the workpiece to quickly raise the same to hardening temperature. The magnetic circuit elements 28 and 62 cooperate with the inducing coil to direct the lines of flux into the end faces of the workpiece whereby to eliminate end effects and provide for heating to uniform depth across the entire width of the workpiece.

In the next stage of operation, as soon as the workpiece reaches hardening temperature, the coil is deenergized and the carriage starts to lower, during which movement the quenching medium is turned on. This, in cooperation with the piston 40, raises the quench head 41 to the position shown in Figure 5. The quenching medium, as soon as the lower end of the tubular member 38 clears the member 47, flows upwardly through the mem-

ber 47 which results in the projection of a solid conical stream of quenching medium toward the heated inner surface of the rotating workpiece. The stream of quenching medium impinges against this surface at its extreme upper edge as indicated at 77 in Figure 5 and then flows downwardly over the same. As a result the workpiece is provided with an inner hardened surface zone 78 (Figure 5). The quenching medium drains through the perforate plate 35 and thence downwardly around the cylinder 38.

After the termination of the quenching period, the rotation ceases and the upper work clamping mechanism is raised, whereupon the workpiece is removed from the gripping fingers 31.

The clamping arrangement described provides an effective means for rotating the upper magnetic circuit with the lower element and to insure against possible misalignment of the workpiece incident to relative rotation of the rings 27 and 61.

In Figure 6 there is shown an arrangement wherein the outer face of the workpiece may be heat treated. In this case the mechanism supported on the flange 25 is removed and replaced by an annular portion 80 to which an annular conical workpiece supporting element 81 is secured, the workpiece 29 telescoping with this element as shown.

Also, the heating head is removed from the arbor 22 and replaced by the apparatus shown in Figure 6 wherein an annular ring element 82 is supported from the arbor 22, the element 82 providing the support for an inducing coil 83. An annular quench head 84 having an annular quench conducting passage 85 and an inwardly and downwardly directed circumferential discharge orifice 86 therein, is carried by the ring element 82. In this case the carriage 5 is moved to position the workpiece concentrically within the coil 83 and after the heating operation is lowered to position the workpiece 29 sufficiently below the quench discharge orifice 85 so that the quench medium will impinge against the same.

Various changes may be made in the detailed arrangement and construction of the parts described without departing from the spirit and substance of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. Work holding apparatus adapted to be used for centering and holding an annular workpiece along a longitudinal axis of movement, as for heat treating operations in which the workpiece and a heating head have axial movement relative to each other, and the like, comprising a pair of rotatable members relatively axially movable into and out of cooperative position with respect to the workpiece, means for rotating one of said members, said members including annular means operative in said cooperative position to engage the opposite ends of the workpiece, one of said members having an annular skirt portion extending toward the other member and a sleeve surrounding said skirt portion and guided thereby for axial movement only relative thereto, the other of said members having an annular ring element facing said sleeve, operative in said cooperative position to frictionally engage said sleeve and effect rotation of said one member from said other member, spring means urging said sleeve toward said annular ring element, and means for effecting the relative movement of said members.

2. Work holding apparatus adapted to be used

for centering and holding an annular workpiece along a longitudinal axis of movement, as for heat treating operations in which the workpiece and a heating head have axial movement relative to each other, and the like, comprising a support, annular means rotatably mounted in said support for engaging one end of the workpiece, a clutch element fixed to said annular means for rotation therewith, means on said support for rotating said annular means, a second support spaced from said first support, extensible means connecting said supports for relative movement toward and away from each other, an annular means rotatably mounted in said second support, a resiliently mounted axially movable clutch element secured on said last-mentioned annular means for rotation therewith, means for actuating said extensible means to relatively move said supports, said last-mentioned annular means being engageable with the other end of the workpiece and said clutch elements being engageable with each other upon movement of said supports toward each other to effect rotation of said last-mentioned annular means with said first-mentioned annular means, gripping means for engaging one circumferential surface of said workpiece, and means for actuating said gripping means to cause it to grip the workpiece when the two supports are brought together.

3. Work holding apparatus adapted to be used for centering and holding an annular workpiece along a longitudinal axis of movement, as for heat treating operations in which the workpiece and a heating head have axial movement relative to each other, and the like, comprising a pair of spaced rotatable members relatively axially movable into and out of cooperative position, means for rotating one of said members, said members including annular face portions operative in said cooperative position to engage the opposite ends of the workpiece, one of said members having an annular skirt and a flange extending radially from the end of said skirt most remote from the other member, a sleeve surrounding said skirt, guide means on said sleeve and extending through said flange to guide said sleeve for axial movement on said skirt, compression spring means urging said sleeve in a direction away from said flange, said other member having an annular element arranged in said cooperative position to frictionally engage said sleeve and rotate said other member from said one member, and means to effect said relative movement of said members.

HOWARD E. SOMES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
385,347	Folsom	July 3, 1888
1,214,949	Perry	Feb. 6, 1917
1,772,576	Slade	Aug. 12, 1930
2,010,703	Slade et al.	Aug. 6, 1935
2,068,913	Gregg	Jan. 26, 1937
2,166,731	Schlicht	July 18, 1939
2,262,765	Ilg	Nov. 18, 1941
2,281,297	Somes	Apr. 28, 1942
2,288,034	Somes	June 30, 1942
2,355,184	Somes	Aug. 8, 1944