Aug. 9, 1949. E. A. ARP 2,478,447

HYDRAULICALLY OPERATED EXPANDING MANDREL

Filed July 1, 1948 3 Sheets-Sheet 1

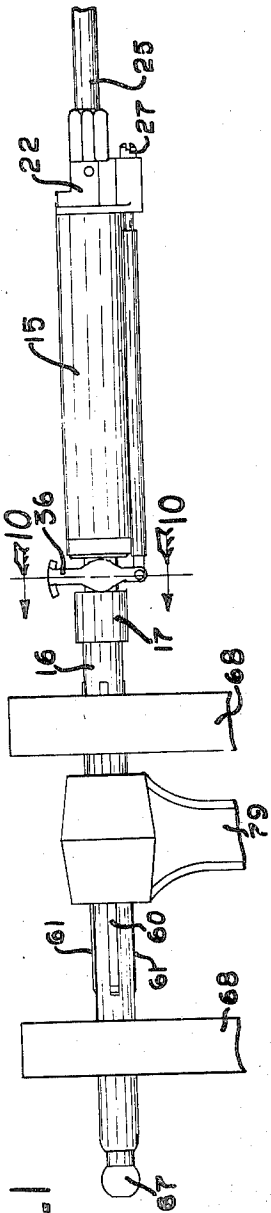


FIG. 1

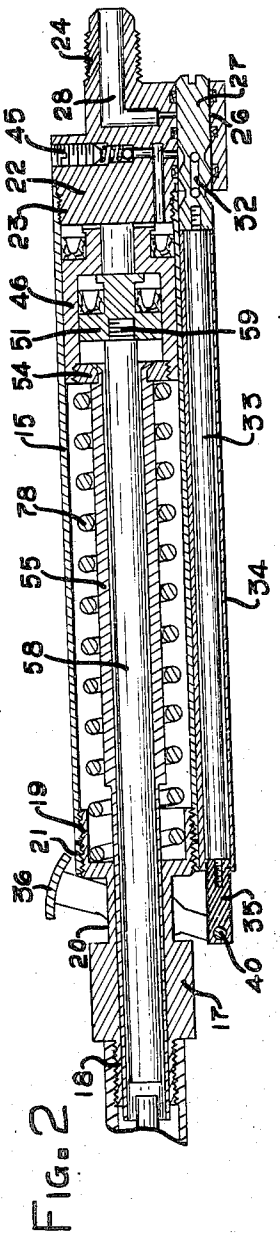


FIG. 2

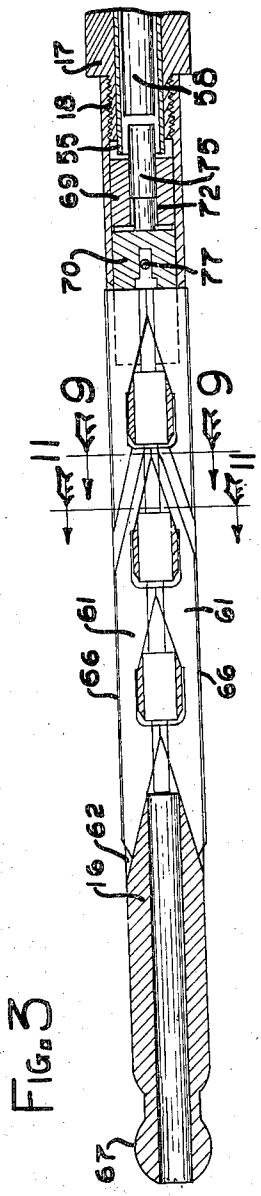


FIG. 3

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HYDRAULICALLY OPERATED EXPANDING MANDREL

Filed July 1, 1948 3 Sheets-Sheet 2

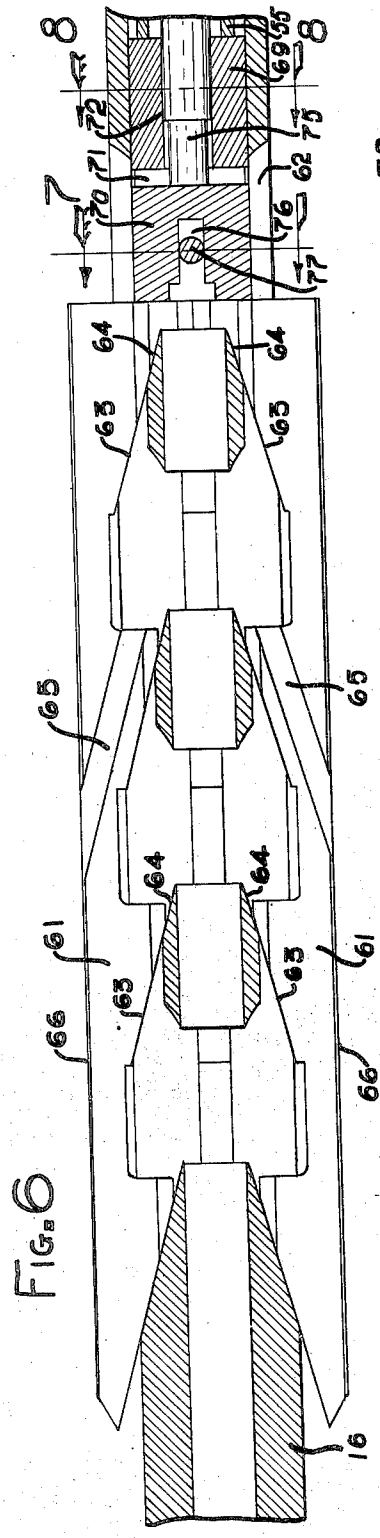


FIG. 6

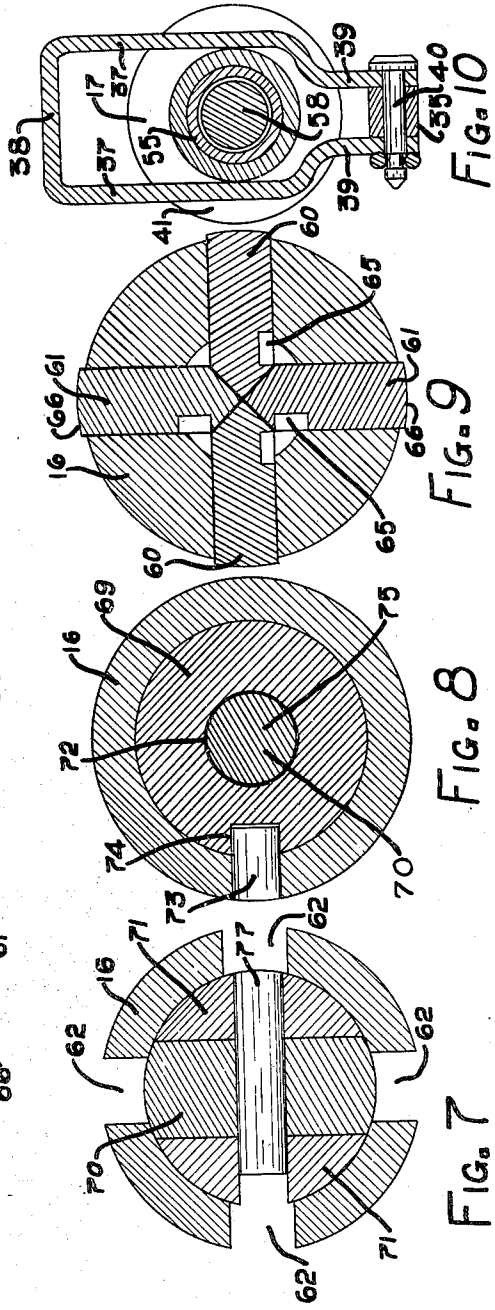


FIG. 10

FIG. 9

FIG. 8

FIG. 7

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HYDRAULICALLY OPERATED EXPANDING MANDREL

Filed July 1, 1948 3 Sheets-Sheet 3

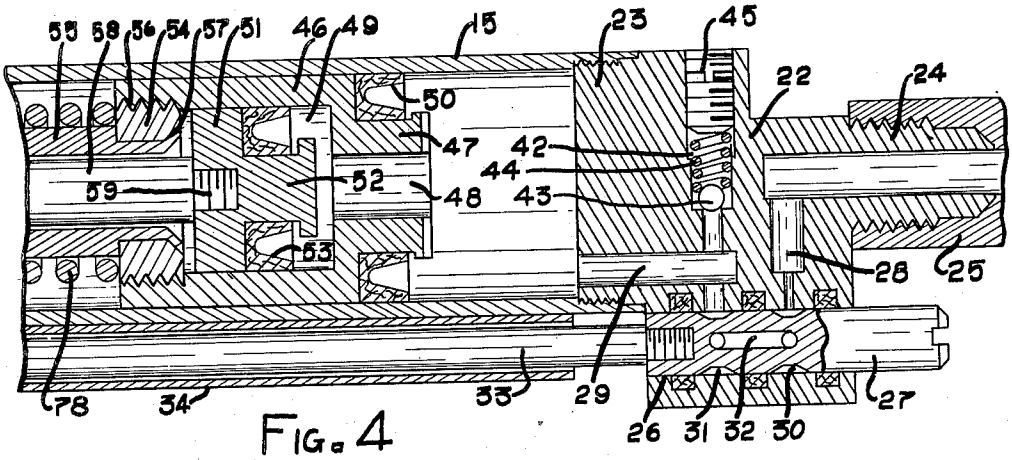
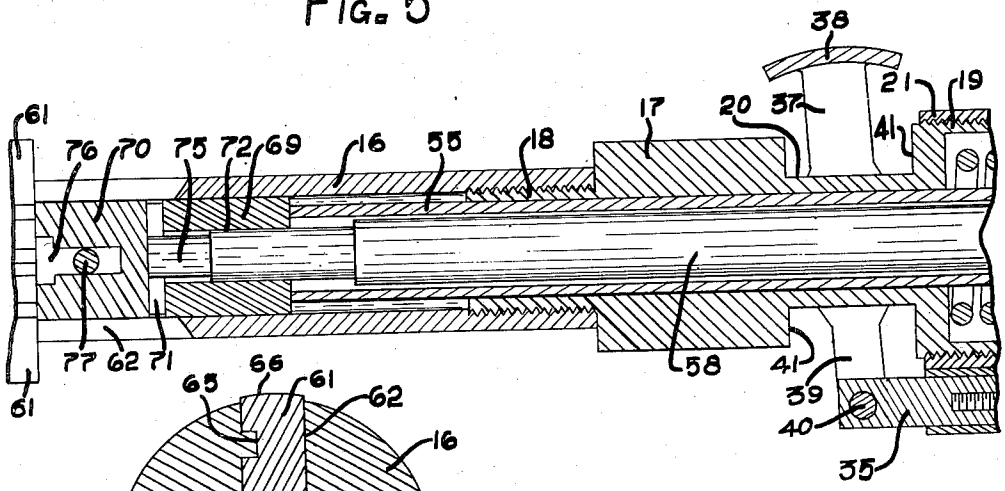


FIG. 4

FIG. 5



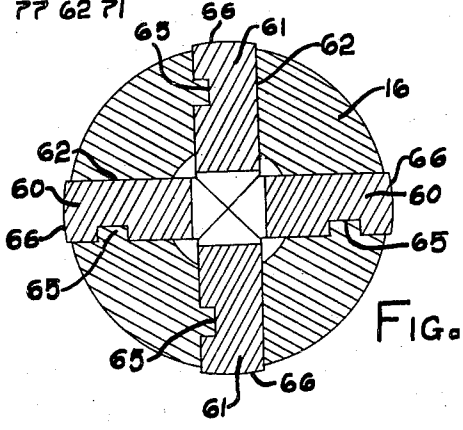


FIG. 11

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UNITED STATES PATENT OFFICE

2,478,447

HYDRAULICALLY OPERATED EXPANDING MANDREL

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Application July 1, 1948, Serial No. 36,527

18 Claims. (Cl. 279—2)

1

This invention has relation to an hydraulically operated expanding mandrel.

An object of the invention is to provide an expanding mandrel, devised to be more especially useful to position a member, such for example, as a connecting rod, to be bored or rebored, which will be of new and improved construction.

A further object is to provide an expanding mandrel wherein will be incorporated various desirable and improved features and characteristics of construction novel both as individual entities of the expanding mandrel and in combination with each other.

And a further object is to provide an expanding mandrel which will be operative in a novel and improved manner to the accomplishment of its intended service or function.

With the above objects in view, as well as others which will appear as the specification proceeds, the invention comprises the construction, arrangement and combination of parts as now to be fully described and as hereinafter to be specifically claimed, it being understood that the disclosure herein is merely illustrative and intended in no way in a limiting sense, changes in details of construction and arrangement of parts being permissible as long as within the spirit of the invention and the scope of the claims which follow.

In the accompanying drawings forming a part of this specification,

Fig. 1 is a side elevational view of an expanding mandrel made according to the invention;

Fig. 2 is an enlarged fragmentary longitudinal sectional view disclosing the right end portion of the expanding mandrel of Fig. 1;

Fig. 3 is a fragmentary longitudinal sectional view, on the scale of Fig. 2, disclosing the left end portion of the expanding mandrel of Fig. 1;

Fig. 4 is a further enlarged fragmentary longitudinal sectional view disclosing the right end portion of the part of the expanding mandrel shown in Fig. 2;

Fig. 5 is a fragmentary longitudinal sectional view, on the scale of Fig. 4, disclosing the left end portion of the part of the expanding mandrel shown in Fig. 2 and the right end portion of the part of said expanding mandrel shown in Fig. 3;

Fig. 6 is a fragmentary longitudinal sectional view, on the scale of Figs. 4 and 5, disclosing an intermediate portion of the part of the expanding mandrel shown in Fig. 3;

Fig. 7 is an enlarged transverse sectional view, taken as on line 7—7 in Fig. 6;

2

Fig. 8 is an enlarged transverse sectional view, taken as on line 8—8 in Fig. 6;

Fig. 9 is an enlarged transverse sectional view, taken as on line 9—9 in Fig. 3;

Fig. 10 is an enlarged transverse sectional view, taken on line 10—10 in Fig. 1; and

Fig. 11 is an enlarged transverse sectional view, taken as on line 11—11 in Fig. 3.

With respect to the drawings and the numerals of reference thereon, 15 denotes an elongated cylinder of the expanding mandrel which the invention presents, and 16 indicates an elongated hollow member in alined relation to and concentric relation with said elongated cylinder 15.

The elongated cylinder 15 and the elongated hollow member 16 are rigidly connected to each other through the instrumentality of a hollow fitting 17 between and alined with said elongated cylinder and hollow member. A reduced threaded end portion 18 of the hollow fitting 17 engages an internal thread provided by the inner, adjacent end portion of the hollow member 16, an enlarged threaded end portion 19 of said hollow fitting engages an internal thread provided by the inner, adjacent end portion of the cylinder 15, and an intermediate portion of the hollow fitting 17 is cut away, as at 20. The reduced threaded end portion 18 is turned into the hollow member 16 to extent causing the inner, adjacent end of said hollow member to be engaged against the body of said hollow fitting, and a locking ring 21, upon the enlarged threaded end portion 19 and against the inner, adjacent end of the cylinder 15, retains the hollow fitting and said cylinder in fixed relation to each other. The hollow fitting 17 provides a cylindrical passageway between the cylinder 15 and the hollow member 16 contiguous at its opposite ends with interior spaces of said cylinder and hollow member, respectively.

The outer end of the elongated cylinder 15, opposite the elongated hollow member 16, is closed by a head constituted as a valve casing 22. An enlarged threaded end portion 23 of said closure head or valve casing 22 engages an internal thread provided by the outer, adjacent end portion of the cylinder 15, and a reduced threaded end portion 24 of the closure head or valve casing is for receiving a tubular connection 25 leading from a source (not shown) of fluid, such as air, under pressure. The enlarged threaded end portion 23 is turned into the cylinder 15 to extent causing the outer, adjacent end of said cylinder to be engaged against the body of the closure head or valve casing, and the re-

duced threaded end portion 24 is turned into the tubular connection 25 to extent causing the inner, adjacent end of said tubular connection to be engaged against the body of said closure head or valve casing.

A longitudinally extending passageway 26 through the closure head or valve casing 22, situated at a side of the cylinder 15, snugly receives a slide valve 27, a port 28 leads from the tubular connection 25 through said closure head or valve casing to an outer part of the passageway 26, and a port 29 leads from an inner part of said passageway 26 through the closure head or valve casing to the interior of the adjacent end portion of the cylinder 15. The slide valve 27 includes an outer circumferential groove 30 adapted selectively to be alined with and situated inwardly of the port 28, an inner circumferential groove 31 adapted selectively to be alined with and situated inwardly of the port 29, and a chamber 32 disposed interiorly of said slide valve and contiguous at its outer and inner ends with said outer and inner circumferential grooves 30 and 31, respectively. The construction and arrangement are such that the slide valve 27 can be situated outwardly of the closure head or valve casing 22 to cause the port 28 and the circumferential groove 30, and the circumferential groove 31 and the port 29, to be in alinement, thus to cause the interior of the tubular connection 25 to be contiguous with the interior of the cylinder 15, or inwardly of said closure head or valve casing to cause said port 28 to be situated inwardly of and out of alinement with said circumferential groove 30, and said port 29 to be situated inwardly of and out of alinement with said circumferential groove 31, thus to cause the interior of said tubular connection to be shut off from the interior of said cylinder.

A valve stem 33, rigid with the inner end of the slide valve 27, is slidably situated in a longitudinally extending guide member 34 itself suitably and conveniently supported upon the elongated cylinder 15, and an attachment piece 35, rigid with the end of said valve stem 33 opposite said slide valve 27, projects to position beyond the inner end of said guide member 34.

A control lever 36 for the valve stem 33 is constituted as a U-member having spaced apart arms 37, 37 thereof arranged in the cut-away portion 20 of the hollow fitting 17 at opposite sides of said hollow fitting, a base 38 thereof disposed in spaced relation to the hollow fitting, and parallel extension portions 39, 39 thereof, upon the spaced apart arms 37, 37, disposed at opposite sides of and pivotally connected, as at 40, to the inner end of the attachment piece 35. Intermediate portions of opposite side edge margins of the spaced apart arms 37, 37 are of curvilinear configuration and of width to span the distance between surfaces 41, 41 of the hollow fitting 17 at opposite sides or ends of the cut-away portion 20, and the construction and arrangement are such that the spaced apart arms 37, 37 can be rocked on the surfaces 41, 41 between their positions as in Figs. 1 and 5, where the control lever 36 is disclosed situated to cause the interior of the tubular connection 25 to be contiguous with the interior of the cylinder 15, and as in Fig. 2, where said control lever is disclosed situated to cause the interiors of said tubular connection and said cylinder to be disconnected.

The port 29, between the longitudinally extending passageway 26 and the interior of the elongated cylinder 15, is contiguous with a con-

cavity 42 in the closure head or valve casing 22 and itself open to atmosphere. A ball valve 43 in said concavity 42 normally is held in closing relation to said port 29 by a compression coil spring 44 itself retained in said concavity by a nut 45, and said nut 45 is adjustable for relief of pressure of fluid in the cylinder 15 should pressure of fluid in said cylinder rise above a predetermined pressure. Stated otherwise, the closure head or valve casing 22 incorporates a safety valve constituted as the nut 45, the compression coil spring 44 and the ball valve 43.

An exterior piston 46 of the expanding mandrel, snugly, slidably situated in the outer end portion of the elongated cylinder 15 adjacent the closure head or valve casing 22, is constituted as a hollow cylindrical body integrally or rigidly supporting a neck 47 upon its outer end, adjacent said closure head or valve casing. An opening 48 through the neck 47 renders the interior space 49 of the hollow cylindrical body of the exterior piston 46 contiguous with the portion of the interior space of the elongated cylinder 15 at the closure head or valve casing end of said exterior piston. Packing surrounding the neck 47 and engaged against the hollow cylindrical body of the exterior piston, as well as against the interior wall of the elongated cylinder 15, is represented 50.

An interior piston 51 of said expanding mandrel, snugly, slidably situated in the interior space 49 of the hollow cylindrical body of the exterior piston 46, is constituted as a solid cylindrical body integrally or rigidly supporting a neck 52 upon its outer end, adjacent the neck 47 upon said exterior piston 46. Packing surrounding the neck 52 and engaged against the solid cylindrical body of the interior piston, as well as against the interior wall of the hollow cylindrical body of the exterior piston 46, is indicated 53.

The construction and arrangement will be such that the overall area of the outer surface of the exterior piston 46, including the packing 50, to be engaged by fluid under pressure in the outer end portion of the interior space of the elongated cylinder 15 and the overall area of the outer surface of the interior piston 51, including the packing 53, to be engaged by fluid under pressure conveyed to said interior piston by way of the opening 48 will be substantially equal, thus to insure that said exterior and interior pistons will be urged in direction away from the closure head or valve casing 22, toward the left in Figs. 2 and 4, under substantially the same force in response to pressure of fluid conveyed to said elongated cylinder by way of said closure head or valve casing. Stated otherwise, the opening 48, through the neck 47 of the exterior piston 46 will be of size to insure that the force exerted by pressure against said exterior piston to urge it away from the closure head or valve casing 22 will be substantially equal to the force exerted by pressure against the interior piston 51 to urge it away from said closure head or valve casing.

The exterior piston 46 rigidly supports, through the instrumentality of a connector 54, a first longitudinally extending actuator constituted as a hollow tube 55 having its inner end portion, spaced from the connector 54, slidably arranged in the cylindrical passageway of the hollow fitting 17 and projecting into the inner, adjacent end portion of the elongated hollow member 16. The connector 54 is constituted as a hollow nut

threaded, as at 56, in the hollow cylindrical body of said exterior piston at the side of the interior piston 51 opposite the closure head or valve casing 22, and the outer end portion of the first longitudinally extending actuator or hollow tube 55 is rigidly secured, as at 57, in the hollow portion of said connector or nut 54.

The interior piston 51 rigidly supports a second longitudinally extending actuator constituted as a rod 58 slidably arranged in the first longitudinally extending actuator or hollow tube 55 and terminating in adjacent relation to the inner end of said first actuator or hollow tube. The end portion of the second longitudinally extending actuator or rod 58 adjacent the interior piston 51 is secured to said interior piston through the instrumentality of an external thread 59 on said second actuator or rod fitted in an internally threaded opening in the solid cylindrical body of the interior piston.

The elongated hollow member 16 supports elongated blades, designated 60, 60 and 61, 61, respectively, which extend longitudinally of said elongated hollow member and are mounted thereon for sliding movement toward and away from the elongated cylinder 15. As disclosed, there are four elongated blades upon the elongated hollow member disposed at 90 degrees apart. The elongated blades 60, 60 are disposed in a single plane passed longitudinally and diametrically through said eongated hollow member 16, as are also the elongated blades 61, 61.

The elongated hollow member 16 includes longitudinally extending slots 62 disposed at 90 degrees apart, and there is an elongated blade in each of said longitudinal slots. The elongated blades are of duplicate construction. Each includes spaced apart camming surfaces 63 upon its interior edge engaged against spaced apart, complemental camming surfaces 64 provided by said elongated hollow member 16, and said elongated blades are keyed, as at 65, to the elongated hollow member. The construction and arrangement will be such that the elongated blades will each be moved exteriorly, all to equal extent, in response to sliding movement of said elongated blades in outward direction, or direction away from the elongated cylinder 15, and interiorly in response to sliding movement of the elongated blades in inward direction, or direction toward said elongated cylinder. Each elongated blade includes a straight exterior edge 66, and the construction and arrangement will be such that the straight exterior edges of all of the elongated blades constantly will be maintained in parallel relation regardless of the set positions of said elongated blades relative to the elongated hollow member 16. Said elongated hollow member is of general cylindrical configuration and its outer end portion 67 is curvilinear to the end that it can be readily inserted into bearings (not shown) provided, for instance, by spaced apart support members 68, 68 disclosed in Fig. 1 and by a connecting rod 79.

Movement of the exterior piston 46 in direction away from the closure head or valve casing 22, toward the left in Figs. 2 and 4, is adapted to actuate the elongated blades 60, 60 in corresponding direction, and movement of the interior piston 51 in direction away from said closure head or valve casing, toward the left in said Figs. 2 and 4, is adapted to actuate the elongated blades 61, 61 in corresponding direction.

The elongated hollow member 16 slidably supports a first actuator element 69 adapted to be operated by the first longitudinally extending actuator or hollow tube 55 to cause the elongated blades 60, 60 to be moved outwardly, in direction away from the elongated cylinder 15, and said elongated hollow member also slidably supports a second actuator element 70 adapted to be operated by the second longitudinally extending actuator or rod 58 to cause the elongated blades 61, 61 to be moved outwardly.

The first actuator element 69 is constituted as a hollow cylindrical body having thereon spaced apart finger pieces 71 extending outwardly from said hollow cylindrical body and having therethrough a central passageway 72 extending longitudinally of the elongated hollow member 16. The hollow cylindrical body of said first actuator element is situated adjacent the outer end of the first longitudinally extending actuator or hollow tube 55 and is fixed against turning movement in the elongated hollow member 16 through the instrumentality of a lug 73 in said elongated hollow member disposed in a longitudinal slot 74 in the hollow cylindrical body of said first actuator element.

The second actuator element 70 is constituted as a plug of rectilinear configuration having its opposite side edges rounded and a plunger 75 upon and extending inwardly from said plug and slidably disposed in the central passageway 72. A portion of said plunger 75 projects beyond the inner end of the first actuator element 69 and lies in adjacent relation to the second actuator or rod 58. The plug of said second actuator element 70 is disposed between the finger pieces 71 of the first actuator element 69, and an elongated slot 76 across said plug slidably receives a cross pin 77 the opposite ends of which are mounted in the first actuator element 69, or in its finger pieces 71.

The construction and arrangement will be such that the first longitudinally extending actuator or hollow tube 55 can be operated to cause the elongated blades 60, 60 to be slid outwardly, through the medium of the first actuator element 69, independently of actuation of the second longitudinally extending actuator, the second actuator element 70 and the elongated blades 61, 61, and also such that the second longitudinally extending actuator or rod 58 can be operated to cause said elongated blades 61, 61 to be slid outwardly, through the medium of the second actuator element 70, independently of actuation of said first longitudinally extending actuator, said first actuator element 69 and said elongated blades 60, 60. The first longitudinally extending actuator or hollow tube 55 when forced outwardly engages the hollow cylindrical body of the first actuator element 69 and forces this outwardly, and the finger pieces 71 of said first actuator element engage interior portions of the adjacent ends of the elongated blades 60, 60 and force these outwardly. The second longitudinally extending actuator or rod 58 when forced outwardly engages the plunger 75 of the second actuator element 70 and forces this outwardly, and the plug of said second actuator element engages interior portions of the adjacent ends of the elongated blades 61, 61 and forces these outwardly.

The new and improved expanding mandrel can be advantageously employed to accurately position a member having a bearing to be bored or rebored. The four elongated blades, disposed at 90 degrees apart, will engage and support the bearing at two different sets of diametrically oppositely disposed locations of the bearing under

pressure at the location where each elongated blade engages the bearing which is the same for all of the elongated blades, and the locations where the elongated blades 60, 60 engage and support a bearing to be positioned will be spaced 90 degrees from the locations where the elongated blades 61, 61 engage and support the bearing. Supposing the exterior piston 46 to be actuated to cause the elongated blades 60, 60 to be first engaged against a bearing in which the expanding mandrel is situated, the interior piston 51 will be later actuated to cause the elongated blades 61, 61 to be engaged against the bearing, and both said exterior and interior pistons will in cooperation eventually cause all of the elongated blades to engage the bearing under substantially the same pressure. Supposing the interior piston 51 to be actuated to cause the elongated blades 61, 61 to be first engaged against a bearing, the exterior piston 46 will be later actuated to cause the elongated blades 60, 60 to be engaged against the bearing, and the exterior and interior pistons will, in cooperation, cause all of the elongated blades to engage the bearing with equal pressure.

In the illustrated embodiment of the invention, the fluid under pressure employed is air. When the control lever 36 is situated, as in Fig. 2, to cause the port 28 to be shut off from the port 29, the outer circumferential groove 30 is contiguous with said port 29 and the inner circumferential groove 31 is in clearing relation to the closure head or valve casing 22. Thus the interior space of the elongated cylinder 15 and the interior space 49 of the hollow cylindrical body of the exterior piston 46 are open to atmosphere. A compression coil spring 78, within said elongated cylinder 15 and between the connector or nut 54 and the hollow fitting 17, is for urging the exterior piston 46 inwardly, toward the closure head or valve casing 22, upon relief of pressure in the elongated cylinder.

What is claimed is:

1. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof in opposite directions, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades in one direction longitudinally of the supporting member and interiorly of said supporting member in response to movement of said first and second blades in an opposite direction longitudinally of the supporting member, first means for causing said first blade to be moved in direction longitudinally of said supporting member, independently of said second blade, adapted to cause the first blade to be moved exteriorly of the supporting member, and second means for causing the second blade to be moved in direction longitudinally of said supporting member, independently of said first blade, adapted to cause said second blade to be moved exteriorly of the supporting member.

2. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member in opposite directions, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades in one direction longitudinally of said supporting member and interiorly of said supporting member in response to movement of the blades in an opposite direction longitudinally of the supporting member, first means for causing the oppositely disposed blades of said first set to be moved in direction longitudinally of the supporting member, independently of the oppositely disposed blades of said second set, adapted to cause said oppositely disposed blades of the first set to be moved exteriorly of said supporting member, and second means for causing said oppositely disposed blades of the second set to be moved in direction longitudinally of the supporting member, independently of the oppositely disposed blades of said first set, adapted to cause the oppositely disposed blades of said second set to be moved exteriorly of said supporting member.

3. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, first means for moving said first blade longitudinally of said supporting member independently of said second blade thus to cause the first blade to be moved exteriorly of the supporting member, and second means for moving the second blade longitudinally of said supporting member independently of said first blade thus to cause said second blade to be moved exteriorly of the supporting member.

4. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, first means for moving the oppositely disposed blades of said first set longitudinally of the supporting member independently of the oppositely disposed blades of said second set thus to cause said oppositely disposed blades of the first set to be moved exteriorly of said supporting member, and second means for moving said oppositely disposed blades of the second set longitudinally of the supporting member independently of the oppositely disposed blades of said first set thus to cause the oppositely disposed blades of said second set to be moved exteriorly of said supporting member.

5. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, first means for moving said first blade in direction longitudinally of said supporting member independently of said second blade thus to cause the first blade to be moved exteriorly of the supporting member, second means for moving the second blade longitudinally of said supporting member independently of said first blade thus to cause said second blade to be moved exteriorly of the supporting member, and means for forcibly actuating said first and second means to equal extent.

6. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing

the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, a first device for moving the oppositely disposed blades of said first set longitudinally of the supporting member independently of the oppositely disposed blades of said second set thus to cause said oppositely disposed blades of the first set to be moved exteriorly of said supporting member, a second device for moving said oppositely disposed blades of the second set longitudinally of the supporting member independently of the oppositely disposed blades of said first set thus to cause the oppositely disposed blades of said second set to be moved exteriorly of said supporting member, and means for forcibly actuating said first and second devices to equal extent.

7. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, a cylinder rigid with said supporting member, first and second pistons in said cylinder adapted to be independently moved toward said supporting member in response to fluid under pressure, a first element adapted to be actuated in response to movement of said first piston toward the supporting member to cause said first blade to be moved longitudinally and exteriorly of said supporting member, and a second element adapted to be actuated in response to movement of said second piston toward the supporting member to cause said second blade to be moved longitudinally and exteriorly of said supporting member.

8. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, a cylinder rigid with said supporting member, first and second pistons in said cylinder adapted to be independently moved toward said supporting member in response to fluid under pressure, a first element adapted to be actuated in response to movement of said first piston toward the supporting member to cause said first blade to be moved longitudinally and exteriorly of said supporting member, and a second element adapted to be actuated in response to movement of said second piston toward the supporting member to cause the oppositely disposed blades of said second set to be moved longitudinally and exteriorly of said supporting member.

9. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, a cylinder rigid with said supporting member, first and second pistons in said cylinder adapted to be independently moved toward said supporting member in response to fluid under pressure, a first element adapted to be actuated in response to movement of said first piston toward the supporting member to cause said first blade to be moved longitudinally and exteriorly of said supporting member, a second element adapted to be actuated in response to movement of said second piston toward the supporting member to cause said second blade to be moved longitudinally and exteriorly of said supporting member, and means for causing pressure applied against said first and second pistons to move them toward said supporting member to be exerted in equal amount against the first and second pistons.

10. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, a cylinder rigid with said supporting member, first and second pistons in said cylinder adapted to be independently moved toward said supporting member in response to fluid under pressure, a first element adapted to be actuated in response to movement of said first piston toward the supporting member to cause the oppositely disposed blades of said first set to be moved longitudinally and exteriorly of the supporting member, a second element adapted to be actuated in response to movement of said second piston toward the supporting member to cause the oppositely disposed blades of said second set to be moved longitudinally and exteriorly of said supporting member, and means for causing pressure applied against said first and second pistons to move them toward said supporting member to be exerted in equal amount against the first and second pistons.

11. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, a cylinder rigid with said supporting member, first and second pistons in said cylinder adapted to be independently moved under substantially equal pressure toward said supporting member in response to fluid under pressure, a first element adapted to be actuated in response to movement of said first piston toward the supporting member to cause said first blade to be moved longitudinally and exteriorly of said supporting member, and a second element adapted to be actuated in response to movement of said second piston toward the supporting member to cause said second blade to be moved longitudinally and exteriorly of said supporting member.

12. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, a cylinder rigid with said supporting member, first and second pistons in said cylinder adapted to be independently moved under substantially equal pressure toward said supporting member in response to fluid under pressure, a first element adapted to be actuated in response to movement of said first piston to-

ward the supporting member to cause the oppositely disposed blades of said first set to be moved longitudinally and exteriorly of the supporting member, and a second element adapted to be actuated in response to movement of said second piston toward the supporting member to cause the oppositely disposed blades of said second set to be moved longitudinally and exteriorly of said supporting member.

13. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, a cylinder rigid with said supporting member, external and internal pistons in said cylinder adapted to be independently moved toward said supporting member in response to fluid under pressure, a hollow tube adapted to be actuated in response to movement of said external piston toward the supporting member to cause said first blade to be moved longitudinally and exteriorly of said supporting member, and a rod within said hollow tube adapted to be actuated in response to movement of said interior piston toward the supporting member to cause said second blade to be moved longitudinally and exteriorly of said supporting member.

14. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, a cylinder rigid with said supporting member, exterior and interior pistons in said cylinder adapted to be independently moved toward said supporting member in response to fluid under pressure, a hollow tube adapted to be actuated in response to movement of said first piston toward the supporting member to cause the oppositely disposed blades of said first set to be moved longitudinally and exteriorly of the supporting member, and a rod within said hollow tube adapted to be actuated in response to movement of said interior piston toward the supporting member to cause the oppositely disposed blades of said second set to be moved longitudinally and exteriorly of said supporting member.

15. In an expanding mandrel, in combination, first and second blades, a member supporting said first and second blades for movement longitudinally thereof, means for causing said first and second blades to be moved exteriorly of said supporting member in response to movement of the first and second blades longitudinally of the supporting member, a cylinder rigid with said supporting member, external and internal pistons in said cylinder adapted to be independently moved under substantially equal pressure toward said supporting member in response to fluid under pressure, a hollow tube adapted to be actuated in response to movement of said external piston toward the supporting member to cause said first blade to be moved longitudinally and exteriorly of said supporting member, and a rod within said hollow tube adapted to be actuated in response to movement of said interior piston toward the supporting member to cause said second blade to be moved longitudinally and exteriorly of said supporting member.

16. In an expanding mandrel, in combination, first and second sets of oppositely disposed blades, a member supporting the blades of said first and second sets for movement longitudinally of said supporting member, means for causing the blades of said first and second sets to be moved exteriorly of the supporting member in response to movement of said blades longitudinally of said supporting member, a cylinder rigid with said supporting member, exterior and interior pistons in said cylinder adapted to be independently moved under substantially equal pressure toward said supporting member in response to fluid under pressure, a hollow tube adapted to be actuated in response to movement of said first piston toward the supporting member to cause the oppositely disposed blades of said first set to be moved longitudinally and exteriorly of the supporting member, and a rod within said hollow tube adapted to be actuated in response to movement of said interior piston toward the supporting member to cause the oppositely disposed blades of said second set to be moved longitudinally and exteriorly of said supporting member.

17. The combination as specified in claim 13, a first actuator element between said hollow tube and said first blade, and a second actuator element between said rod and said second blade.

18. The combination as specified in claim 14, a first actuator element between said hollow tube and the oppositely disposed blades of said first set, and a second actuator element between said rod and the oppositely disposed blades of said second set.

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