Jan. 20, 1953 E. A. ARP 2,625,843

MACHINE FOR BORING ARTICLES

Filed Nov. 12, 1948 4 Sheets-Sheet 1

FIG. 1

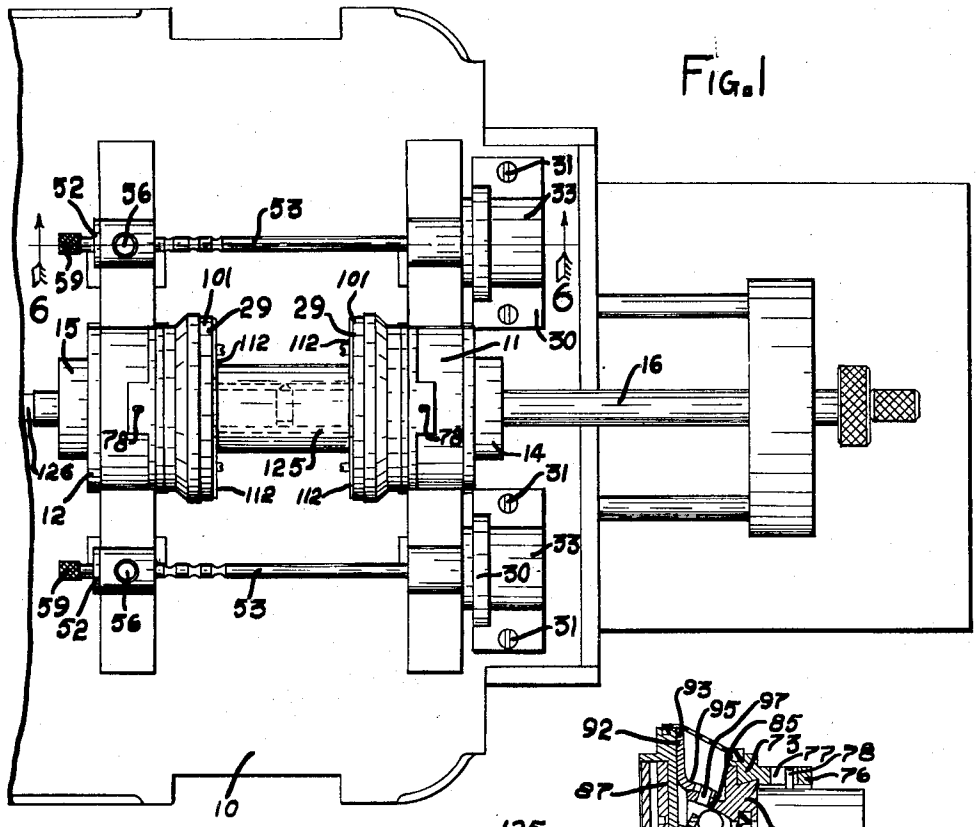
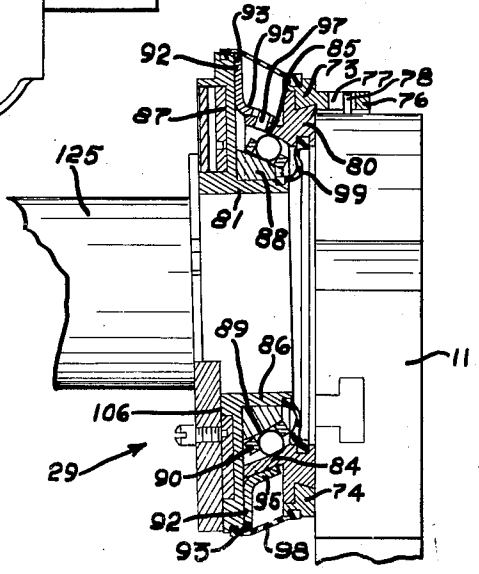


FIG. 5



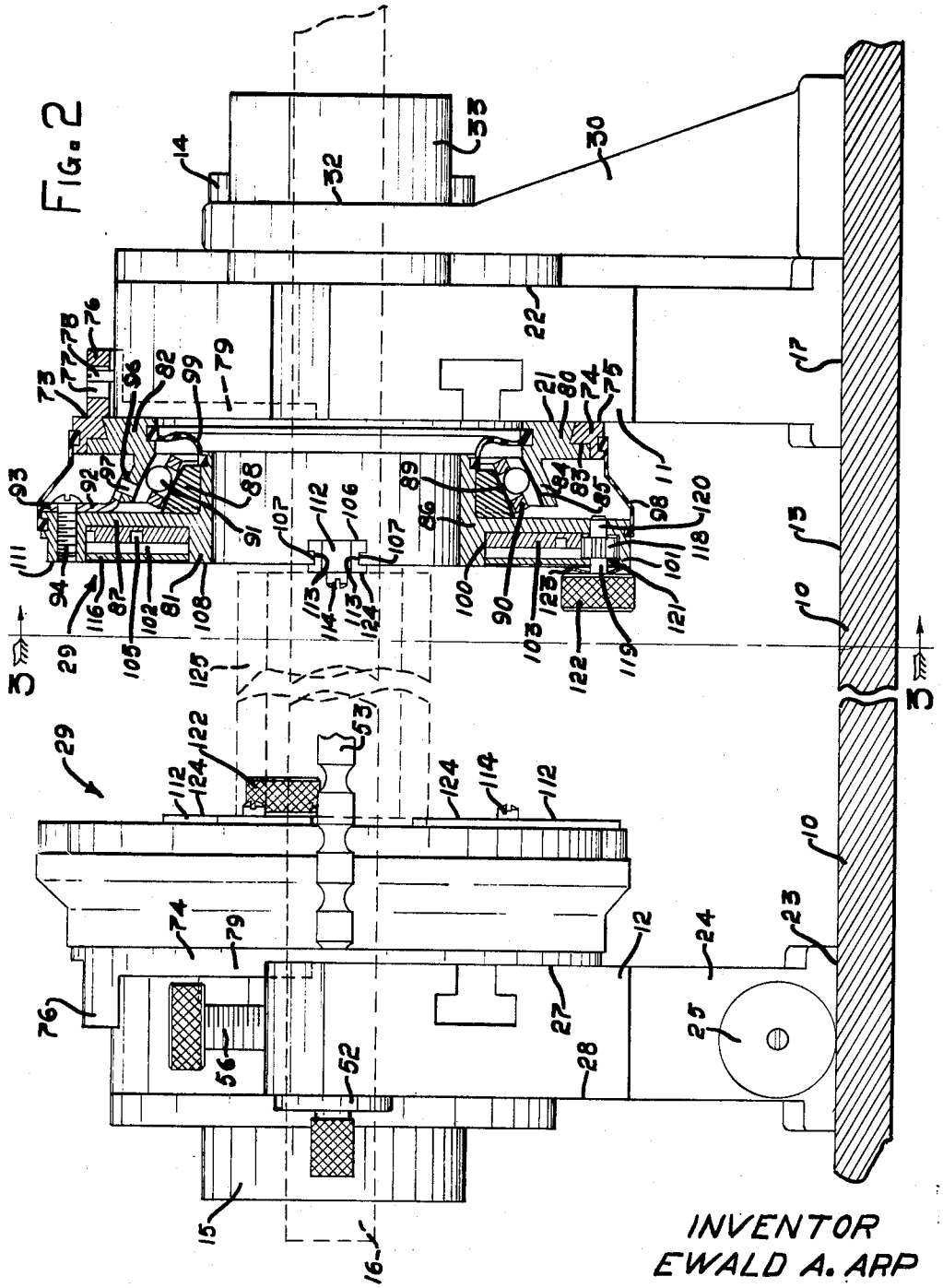
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MACHINE FOR BORING ARTICLES

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FIG. 2



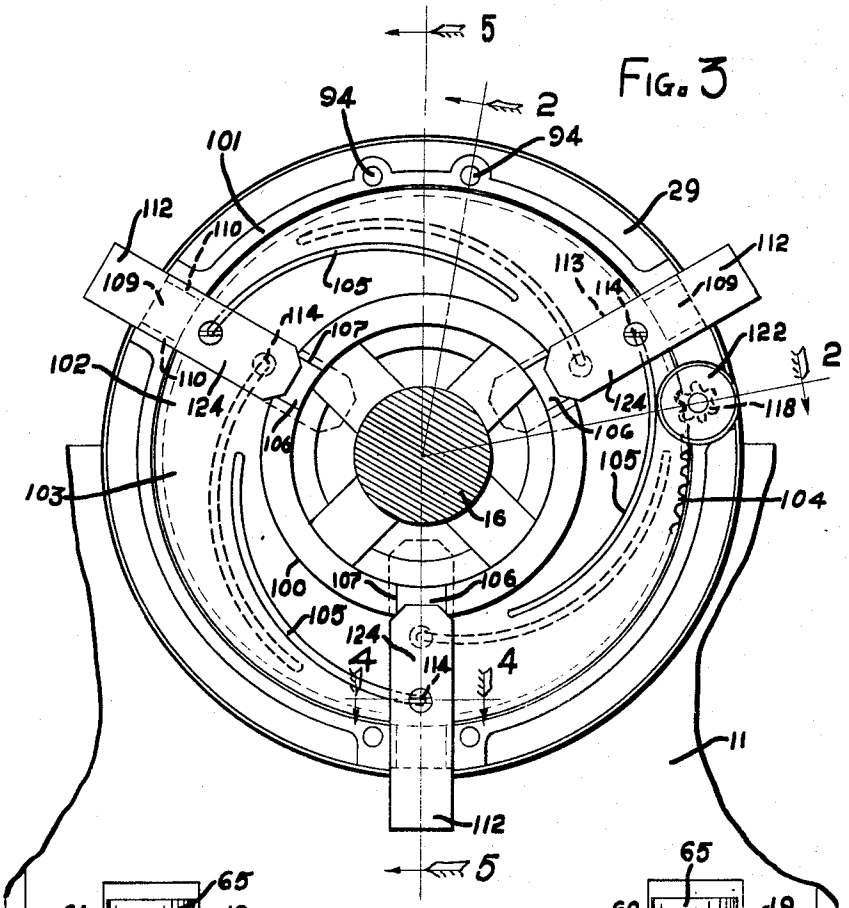
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MACHINE FOR BORING ARTICLES

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FIG. 3



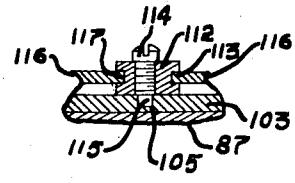


FIG. 4

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MACHINE FOR BORING ARTICLES

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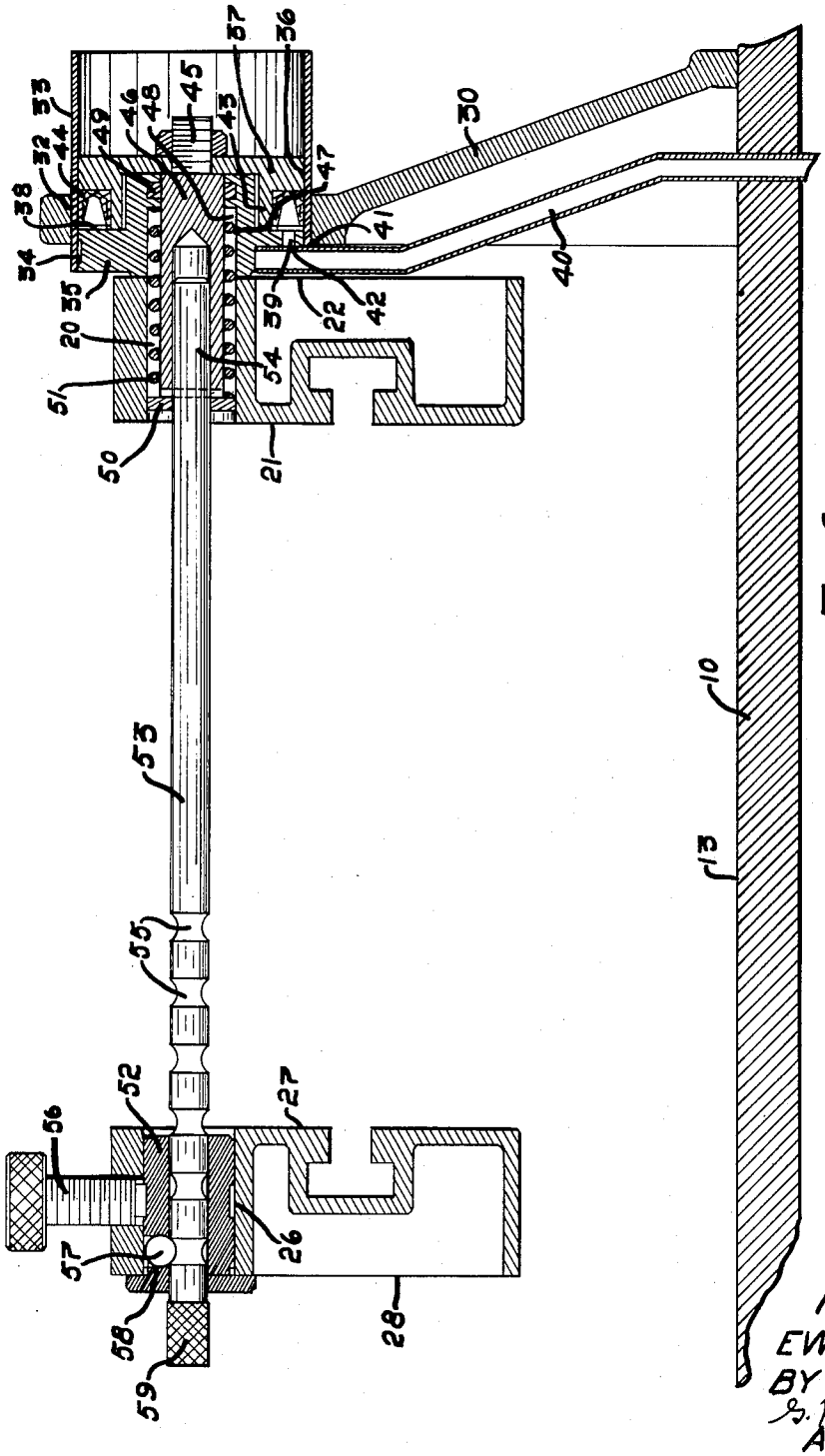


FIG. 6

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UNITED STATES PATENT OFFICE

2,625,843

MACHINE FOR BORING ARTICLES

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Application November 12, 1948, Serial No. 59,727

6 Claims. (Cl. 77—3)

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This invention has relation to a machine which has been devised to be especially useful for boring the bearings of articles such, for example, as the bearings of connecting rods for wrist pins, etc.

An object of the invention is to provide a machine for boring bearings which will be of novel and improved construction and designed to perform its intended service in new and improved manner.

A further object is to provide a bearing boring machine wherein will be incorporated various desirable features and characteristics novel both as individual entities of the machine and in combination with each other.

A further object is to provide a machine of the present character which will incorporate a novel and improved construction and arrangement for centering and alining with respect to each other bearings of articles to be bored and a boring bar with appropriate tool for operating on said bearings.

And a further object is to provide in the machine adjustable clamping units for supporting articles bearings of which are to be bored which will be of simple, practical, efficient, new and improved construction.

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 top plan view of a machine made according to the invention, a part of the frame of the machine being broken away;

Fig. 2 is an enlarged fragmentary elevational view disclosing parts of the machine as they would appear from the bottom of the sheet in Fig. 1, the frame of said machine in section and an adjustable clamping unit of the machine in section, taken substantially on line 2—2 in Fig. 3;

Fig. 3 is a vertical sectional view, taken as on line 3—3 in Fig. 2, with parts omitted;

Fig. 4 is a detail sectional view, taken on line 4—4 in Fig. 3;

Fig. 5 is a sectional view, taken substantially

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on line 5—5 in Fig. 3 and on a reduced scale, detailing features of an adjustable clamping unit of the machine, the view also showing a supporting unit of said machine in side elevation; and

Fig. 6 is an enlarged sectional view, taken on line 6—6 in Fig. 1.

A frame 10 of the machine is constituted as a rectilinear slab of rigid material, and can be supported in any suitable and convenient manner, as, for example, as a part of a table, desirably so that the rectilinear slab will be in a horizontal plane.

Spaced apart, parallel boring bar supporting units, indicated 11 and 12, respectively, are situated upon the flat upper surface 13 of the frame 10 for slidably adjustable movement in direction toward and away from each other, and said supporting units 11 and 12 include self-alining bearings, represented 14 and 15, respectively, which can be of construction as disclosed in my pending application Serial No. 44,442, for Self-Alining Bearing, filed August 16, 1948, adapted to be situated in alined relation in a single, desirably horizontal, plane to be capable of selectively receiving a boring bar with cutting tool (not shown), or a locating rod or mandrel 16, as in Fig. 1. The supporting units 11 and 12 are keyed to the frame 10, as at 126, for slight rocking movement in a horizontal plane.

The boring bar supporting unit 11 is constituted as an elongated rectilinear member disposed in perpendicular relation to the frame 10, as well as in perpendicular relation to a boring bar with cutting tool, or to a locating rod or mandrel, such as 16, when situated in the self-alining bearings 14 and 15. A flat lower surface 17 of said boring bar supporting unit 11 rests upon the flat upper surface 13 of said frame 10 for slidable movement thereover toward and away from the boring bar supporting unit 12, and lower portions of the boring bar supporting unit 11 are cut away to provide spaced apart, elongated slots 18, contiguous with the flat lower surface 17 and parallel to a locating rod or mandrel or to a boring bar when in said self-alining bearings 14 and 15, including upwardly facing shoulders 19 for a purpose to be made plain. Additionally, upper portions of the boring bar supporting unit 11 include spaced apart, horizontally disposed, transversely extending guideways 20, at the opposite sides of the self-alining bearing 14 in spaced relation thereto, contiguous at their inner and outer ends with flat interior and exterior surfaces, indicated 21 and 22, respectively, of said boring bar supporting unit 11 and parallel with a locating

rod or mandrel or a boring bar when in the self-alining bearings 14 and 15, as well as parallel with the frame 10. The flat interior and exterior surfaces 21 and 22 are perpendicular to a locating rod or mandrel or a boring bar when in said self-alining bearings 14 and 15 and to said frame 10.

The boring bar supporting unit 12 is constituted as an elongated rectilinear member disposed in perpendicular relation to the frame 10, as well as in perpendicular relation to a locating rod or mandrel, or to a boring bar, when situated in the self-alining bearings 14 and 15. A flat lower surface 23 of said boring bar supporting unit 12 is in adjacent or contiguous relation to the flat upper surface of said frame 10, and lower portions of the boring bar supporting unit 12 are cut away to provide spaced apart slots 24, contiguous with said flat lower surface 23 and parallel to a locating rod or mandrel, or to a boring bar, when in said self-alining bearings 14 and 15, which house supporting rollers 25 resting upon said flat upper surface 13 for rolling or sliding movement of the boring bar supporting unit 12 toward and away from the boring bar supporting unit 11. Also upper portions of the boring bar supporting unit 12 include spaced apart, horizontally disposed, transversely extending guideways 26, at the opposite sides of the self-alining bearing 15 in spaced relation thereto, contiguous at their inner and outer ends with flat interior and exterior surfaces, indicated 27 and 28, respectively, of said boring bar support 12 and parallel with a locating rod or mandrel or a boring bar when in the self-alining bearings 14 and 15, as well as parallel with the frame 10. The flat interior and exterior surfaces 27 and 28 are disposed in parallel relation to the flat interior and exterior surfaces 21 and 22.

The guideways 20, 20 and 26, 26 are in a single horizontal plane, and guideways 20, 26 and 20, 26 of the different supporting units 11 and 12 are in alinement.

The machine includes a pair of duplicate self-adjusting clamping units, each represented 29, one of which is mounted upon the supporting unit 11 and the other of which is mounted upon the supporting unit 12. The clamping units 29 are situated between the supporting units 11 and 12. Their construction and the manner of their detachable association and assembly with said supporting units will be hereinafter described.

Spaced apart supporting brackets, each designated 30, situated at opposite sides of the self-alining bearing 14 in spaced relation thereto and at the side of the supporting unit 11 opposite the supporting unit 12, are rigidly secured, as at 31, upon the frame 10, and each supporting bracket 30 rigidly carries, as at 32, a horizontal cylinder 33 adjacent the outer end of and with which the guideway 20 at the corresponding side of said self-alining bearing 14 is concentrically alined.

Each horizontal cylinder 33 fixedly supports, as at 34, a hollow head 35 adjacent the supporting unit 11, and slidably supports, as at 36, a piston 37, at the side of the hollow head 35 opposite said supporting unit 11. A space within each cylinder 33, between the corresponding hollow head 35 and piston 37, is denoted 38, and a port 39 through said corresponding hollow head 35 is contiguous at its inner end with a flexible hose 40 and at its outer end with the space 38. Each flexible hose 40 passes through and is secured in an opening 41 through its corresponding horizontal cylinder 33. The inner end of each flexible hose is sealed shut by the corresponding hollow head 35, and a port 42 in each flexible hose is contiguous with the port 39 through said corresponding hollow head. Each piston 37 supports a neck 43, and packing surrounding the neck and engaged against the body of the corresponding piston, as well as against the interior surface of the corresponding cylinder 33, is represented 44. Fluid under pressure within the spaces 38 of the cylinders 33 is adapted to cause the pistons 37 to be forcibly moved away from the hollow heads 35, to the right in Figs. 1 and 6 of the drawings, and said pistons 37 will be free for movement toward said hollow heads 35, to the left in said Figs. 1 to 6, upon relief of the fluid under pressure.

Each piston 37 rigidly centrally supports, as at 45, a connecting plug 46 slidably mounted, as at 47, in the hollow interior 48 of the corresponding head 35, and the inner end portion of each connecting plug 46 is disposed in the corresponding guideway 20 with the flat exterior surface 22 of the supporting unit 11 in contiguous or adjacent relation to the interior surfaces of the hollow heads 35, about as disclosed in Figs. 1 and 6. A packing between an outer end portion of each connecting plug 46 and an interior surface of the corresponding hollow head 35 is indicated 49, an annular flange rigid with the inner end of each connecting plug 46 and situated in the inner end portion of the corresponding guideway 20 is denoted 50, and a compression coil spring 51 in the hollow interior 48 of each head 35, in surrounding relation to the corresponding connecting plug 46 and having its opposite ends engaged against the corresponding hollow head 35 and annular flange 50, normally urges said corresponding connecting plug 46 and the corresponding piston 37 inwardly, in direction toward the supporting unit 11, to the left in said Figs. 1 and 6. The construction and arrangement are such that the pistons 37 will cause the connecting plugs 46 to be moved outwardly, away from the supporting unit 11, in response to application of fluid under pressure to the spaces 38 of the cylinders 33, against resilient action of the compression coil springs 51, and said compression coil springs will react upon relief of pressure in said cylinders 33 to cause said pistons 37 and connecting plugs 46 to be moved inwardly, toward said supporting unit 11.

Each of the guideways 26 through the supporting unit 12 removably supports a bushing 52, and a connecting rod 53 slidably disposed in each bushing 52 has an end portion thereof, in spaced relation to said supporting unit 12, secured, as at 54, in the inner end portion of the connecting plug 46 at the corresponding side of the self-alining bearing 14. The connecting rods 53 are adjustably assembled, through the instrumentality of the bushings 52, with the supporting unit 12 to the end that said supporting unit 12 can be initially set closer to or farther from the supporting unit 11, depending upon the size of an article the bearing of which is to be bored. Each connecting rod 53 is in alined relation with its corresponding connecting plug 46, and the outer end portion of each connecting rod includes longitudinally spaced grooves 55 extending the full circumference of the connecting rod. Fixing screws 56 in the supporting unit 12 are for detachably locking the bushings 52 in the guideways 26, and a ball 57 in a radial slot 58 in each bushing 52 is adapted to be selectively removably situated in the different grooves 55 of the corresponding connecting rod 53 thus to secure said corresponding connecting rod in fixed relation to the bushing. A manipulating knob on the free, outer end of each

connecting rod 53, adjacent the outer end of the corresponding bushing 52, is denoted 59. The supporting unit 12 will be initially set on the frame 10 at a distance from the supporting brackets 30, 30 so that the clamping units 29, 29 will become engaged with opposite surfaces of an article a boring of which is to be bored in response to actuation of the pistons 37 in direction away from the supporting unit 11 in the manner as hereinbefore set forth. It will be apparent that the supporting unit 12 will be forcibly moved toward said supporting unit 11, through the instrumentality of the connecting plugs 46 and the connecting rods 53, in response to outward movement of said pistons 37, and with relief of pressure in the spaces 38, the compression coil springs 51 will return said supporting unit 12 to the position at which initially set.

The boring bar supporting unit 11 is adapted to be locked down against the flat upper surface 13 of the frame 10 through the instrumentality of vertically disposed locking elements 60 slidably mounted, as at 61, in the frame 10. The upper end portion of each locking element 60 is disposed above the flat upper surface 13 of said frame 10 in an elongated slot 18, and a compression coil spring 62, upon each locking element 60 between a collar 63 thereon and said flat upper surface 13, normally urges the corresponding locking element 60 upwardly. A neck 64 with head 65 rigid with the upper end of each locking element 60 lies in the elongated slot 18 at the corresponding end of the supporting unit 11 with said head 65 above and said neck 64 between upwardly facing shoulders 19 of said supporting unit 11, and said compression coil springs 62 normally retain the locking elements 60 in position to permit the supporting unit 11 to be released from the frame 10.

A vertical cylinder 66, in surrounding relation to the lower end portion of each vertically disposed locking element 60 and rigid with the lower surface of the frame 10, slidably supports a piston 67 fixed, as at 68, upon said vertically disposed locking element. A space within each cylinder 66, above the corresponding piston 67, is denoted 69, and a port leading to each space 69 is represented 70. Each piston 67 has a neck 71, and packing surrounding the neck and engaged against the body of the corresponding piston, as well as against the interior surface of the corresponding cylinder 66, is represented 72. Fluid under pressure, applied through a flexible hose (not shown), within the spaces 69 of the cylinders 66 is adapted to cause the pistons 67 to be forcibly moved downwardly, and said pistons will be free for upward movement upon relief of the fluid under pressure. The construction and arrangement are such that the heads 65 will be moved downwardly with downward movement of the pistons 67, against resilient action of the compression coil springs 62, to be grasped against the shoulders 19, and said compression coil springs 62 will react upon relief of pressure in said cylinders 66 to cause the heads 65 of the locking elements to be released from said shoulders 19.

The self-adjusting clamping units 29, 29 are disposed in spaced, parallel relation, and each of said clamping units includes a retainer member 73 to be detachably assembled with one of the supporting units, 11 or 12, as the case may be. Each retainer member 73 is constituted as an annular element 74 having a flat exterior surface 75, adapted to be engaged against the flat

interior surface, 21 or 27, as the case may be, of the corresponding supporting unit, and an attaching element 76, integral or rigid with and extending exteriorly from said annular element in perpendicular relation thereto. A slot 77 through each attaching element 76 is for removably receiving a post 78 extending upwardly from an upper surface of the corresponding supporting unit, and the construction and arrangement will be such that when the attaching elements 76 are upon the posts 78, the flat exterior surfaces of the annular elements of the retainer members and the flat interior surfaces of the supporting units will be in engagement. An annular flange 79 upon each annular element 74, adjacent the corresponding attaching element 76, is adapted to retain the corresponding retainer member 73 against movement in a horizontal plane relative to the corresponding supporting unit.

An exterior bearing race supporting frame of each self-adjusting clamping unit 29 is designated 80, and an interior bearing race supporting frame of each clamping unit is represented 81.

Each exterior bearing race supporting frame 80 is constituted as an annular body 82, rigidly fitted and secured, as at 83, within and to the corresponding retainer member 73, and a part-spherical annular bearing 84 situated at the side of the corresponding annular body 82 adjacent the corresponding interior bearing race supporting frame 81. Each annular bearing 84 is disposed in parallel relation to the flat exterior surface 75 of the corresponding retainer member 73 and provides an annular, interiorly facing bearing surface 85 which is of part-spherical configuration.

Each interior bearing race supporting frame 81 is constituted as an annular body 86 and an annular flange 87 in surrounding, perpendicular relation to an intermediate portion of said annular body 86. An annular bearing 88 rigidly secured upon and about the portion of each annular body 86 at the side of the corresponding annular flange 87 adjacent the corresponding exterior bearing race supporting frame 80, against said corresponding annular flange 87, provides an exteriorly facing bearing surface 89 which is of part-spherical configuration and is disposed interiorly of and in spaced relation to the interiorly facing bearing surface 85 of the corresponding annular bearing 84. Each annular bearing 88 is in concentric relation to the corresponding annular bearing 84 and each exteriorly facing bearing surface 89 is in concentric relation to the corresponding interiorly facing bearing surface 85.

A conical retainer fixedly secured about and against the exteriorly facing bearing surface 89 of each annular bearing 88 is denoted 90, and balls within openings through each conical retainer 90 and engaged with the corresponding interiorly and exteriorly facing bearings surfaces 85 and 89 are indicated 91.

The ball bearing construction and arrangement as illustrated and described permits rocking movement of the interior bearing race supporting frame 81 upon the exterior bearing race supporting frame 80 in the instance of each adjustable clamping unit 29, and each interior bearing race supporting frame 81 is supported upon its corresponding exterior bearing race supporting frame 80 by clips 92 in such manner as to offer no interference to relative rocking movement of said interior and exterior bearing race supporting frames. Each clip 92 includes a verti-

cal body portion 93 rigidly secured, as at 94, to the annular flange 87 of the interior bearing race supporting frame 81 of the corresponding adjustable clamping unit and a part-spherical wing portion 95 upon the corresponding part-spherical annular bearing 84. The wing portion of one of the clips 92 includes an elongated slot 96 in its outer end in which a pivot pin 97, supported upon and extending outwardly from the annular bearing 84 of the exterior bearing race supporting frame 80 of the corresponding adjustable clamping unit, is situated. The construction and arrangement are such that each clip 92 is supported upon the corresponding annular bearing 84 to be free to have both rocking and bodily movement toward and away from said corresponding annular bearing.

An exterior flexible sheath suitably and conveniently connected between the retaining member 73 and the annular flange 87 of each adjustable clamping unit 29 is represented 98, and an interior flexible sheath suitably and conveniently connected between the annular body 82 and the annular body 86 of each adjustable clamping unit is indicated 99.

A portion of the annular body 86 of the interior bearing race supporting frame 81 at the side of the annular flange 87 opposite the annular bearing 88 provides, in the instance of each self-adjusting clamping unit 29, an externally facing cylindrical bearing surface 100 in concentric relation to said annular body 86, and an annular element 101, integral or rigid with each annular flange 87 at the side thereof opposite the corresponding exterior bearing race supporting frame 80 and in spaced, surrounding, concentric relation to the corresponding externally facing cylindrical bearing surface 100, defines, together with said annular flange 87 and bearing surface 100, an annular concavity 102.

An annular disc 103 in each concavity 102 adjacent the corresponding annular flange 87, supported upon the corresponding externally facing bearing surface 100 for rotative movement, constitutes a combination gear and actuator of each clamping unit 29. Stated otherwise, each annular disc, or combination gear and actuator, 103 integrally includes equally spaced gear teeth 104 upon its periphery and equally spaced camming slots 105 in its surface opposite the corresponding annular flange 87. In the disclosure as made, there are three camming slots 105 spaced at 120 degrees apart, each camming slot curves smoothly from an outer toward an inner portion of the corresponding annular disc, and the camming slots in each annular disc bear precisely the same relation to its true center.

The end of the annular body 86 of each interior bearing race supporting frame 81 adjacent the corresponding externally facing bearing surface 100, opposite the corresponding annular bearing 88, is cut away to provide spaced apart, radially extending T-slots 106 each defining spaced apart, oppositely disposed, parallel, radially extending ribs 107, 107 situated in contiguous relation with a flat interior surface 108 of said annular body 86, as well as in parallel relation to the corresponding annular flange 87. In the disclosure as made, there are three sets of spaced apart, oppositely disposed, parallel, radially extending ribs 107, 107 spaced at 120 degrees apart.

The free end of each annular element 101, spaced interiorly from the corresponding annular flange 87, is cut away to provide spaced apart, radially extending T-slots 109, in radially alined relation to the T-slots 106, each defining spaced apart, oppositely disposed, parallel, radially extending ribs 110, 110 situated in contiguous relation with a flat interior surface 111 of said annular element 101, as well as in parallel relation to the corresponding annular flange 87. As shown, there are three sets of spaced apart, oppositely disposed, parallel, radially extending ribs 110, 110, and the spaced apart, oppositely disposed ribs of each set upon each annular element 101 are in radial alinement with the spaced apart, oppositely disposed ribs of a set upon the corresponding annular body 86. Also, the flat interior surfaces 108 and 111 of the annular body 86 and the annular element 101, respectively, of each clamping unit 29 lie in a single plane parallel to the annular flange 87 of the corresponding interior bearing surface supporting frame 81.

Each clamping unit incorporates three different sets of radially alined, inner and outer T-slots, and each set of T-slots 106, 109 slidably supports a radially adjustable clamping member or block 112. Each clamping member or block 112 includes longitudinally extending slots 113, 113 in its opposite side edges in which the corresponding spaced apart ribs 107, 107 and 110, 110 are snugly fitted thus to render the clamping members or blocks slidably adjustable radially of the corresponding interior bearing race supporting frame 81. Said clamping members or blocks are adapted to be adjusted radially of the corresponding clamping unit, selectively inwardly or outwardly, in response to rotative movement of the corresponding annular disc 103, and to this end a camming element 114 rigidly fixed in an outer end portion of each clamping member or block 112 includes an extension 115 snugly, slidably situated in a corresponding camming slot 105.

A cover for each of the annular concavities 102 is constituted as segmental plates 116, between adjacent clamping members or blocks 112. As shown, each segmental plate 116 has its opposite side edges snugly, slidably fitted, as at 117, in the longitudinally extending slots 113 of the next adjacent clamping members or blocks, the outer and inner circumferential surfaces of each segmental plate are, respectively, contiguous with an internal cylindrical surface of the corresponding annular element 101 and the externally facing cylindrical bearing surface 100 of the corresponding annular body 86, and each segmental plate is in spaced, parallel relation to the annular disc 103 of the corresponding clamping unit.

A pinion for rotating each annular disc 103 is designated 118. Each pinion 118 is fixedly supported on an intermediate portion of a spindle 119 having one of its end portions rotatably mounted, as at 120, in the annular flange 87 of the corresponding interior bearing race supporting frame 81 and its other end portion rotatably mounted, as at 121, in an adjacent segmental plate 116. There is a pinion 118 in mesh with gear teeth 104 of each annular disc 103, and an end of each spindle 119 projects beyond the segmental plate 116 in which mounted and fixedly supports a knurled hand piece 122 for accomplishing manual rotation of the corresponding pinion. A tension washer upon each spindle 119 between the corresponding hand piece 122 and segmental plate 116 is denoted 123. Each knurled hand piece 122 can be rotatably manipulated to cause the corresponding annular disc 103 to be rotated, through the instrumentality of the corresponding pinion 118 and gear teeth 104, thus

to cause the correspoding clamping members or blocks 112 to be simultaneously adjusted inwardly and outwardly, and the construction and arrangement are such that all of the clamping members or blocks 112 of each clamping unit will be moved to equal extent or degree in response to rotatable adjustment of the corresponding annular disc 103.

When the self-adjusting clamping units 29, 29 are assembled with the bearing bar supporting units 11 and 12, the clamping members or blocks 112 of the different self-adjusting clamping units are in opposed relation, and flat interior surfaces 124 of the clamping members or blocks of each clamping unit lie in a single plane parallel with the plane of the annular flange 87 of the corresponding clamping unit.

In the accomplishment of practical operation of the machine, the boring bar supporting units 11 and 12 will be set up on the frame 10 in spaced relation to each other a distance sufficient to permit the self-adjusting clamping units 29, 29 to be supported in spaced relation upon and between said supporting units, in the manner as set forth, an article, such as 125, a bearing of which is to be rebored will be placed between the clamping units, and a locating rod or mandrel will be inserted in and through the self-alining bearing 14, the clamping unit upon the supporting unit 11, said article, the clamping unit upon the supporting unit 12 and the self-alining bearing 15, as the locating rod or mandrel 16 is disclosed situated in Fig. 1 of the drawings. Thereafter, the supporting units will be actuated in the manner as hereinbefore described to cause the clamping units 29 to grasp oppositely disposed surfaces of the article.

Supposing the article a bearing of which is to be bored to be of about the construction as in the disclosure, said article will be situated so that its longitudinal axis is disposed in a plane parallel to the frame 10 with its open ends adjacent the clamping units 29, 29, and the clamping members or blocks 112 of the different clamping units will be adjusted to be in longitudinally alined relation to said article and clear of its bearing to be rebored. With said article and clamping members or blocks so relatively situated, fluid under pressure will be applied to the spaces 69 of the vertical cylinders 66 and to the spaces 38 of the horizontal cylinders 33. Fluid under pressure applied to said spaces 69 will cause the supporting unit 11 to be secured down against the frame 10 in the manner as set forth, and in response to fluid under pressure applied to said spaces 38 the supporting unit 12 will be forcibly moved toward said supporting unit 11, also in the manner as described. The flat interior surfaces 124 of the clamping members or blocks 112 will engage the opposite ends of the article a bearing of which is to be bored, in spaced relation to the bearing. Upon application of force to the clamping members or blocks causing them to be pressed against the article, the interior bearing race supporting frame 81 of each clamping unit will be capable of rocking in universal direction relative to its corresponding exterior bearing race supporting frame 80 with the result that said clamping members or blocks will exert retaining pressure against opposed surfaces of articles having bearings to be rebored in direction longitudinally of the articles and apply no force tending to impart rocking movement to the articles. The construction and arrangement will be such that the part-spherical bearing surfaces 85 and 89, which are concentric to each other, also are concentric, in the instance of each clamping unit 29, to an axis of rotation for the corresponding interior bearing race supporting frame 81 in the longitudinal axis of a locating rod or mandrel when supported in the machine, as well as in the plane of the flat interior surfaces 124 of the clamping members or blocks 112 of the corresponding clamping unit. Thus with rocking movement of the interior bearing race supporting frames 81 relative to the exterior bearing race supporting frames 80, said clamping members or blocks 112 will rotate about fixed axes which are both in the longitudinal axis of a locating rod or mandrel and in the plane of the flat interior surfaces 124, and there will be no shifting movement of the axis of rotation for the clamping members or blocks as would be the case were said axis of rotation not so situated. Stated otherwise, the construction and arrangement will be such that the clamping members or blocks 112 will remain at unvarying distance from the axes of rotation of the interior bearing race supporting frames 81 with rocking movement of said interior bearing race supporting frames. Thus any selected location in any of the flat interior surfaces 124 will bear unchanged relation to the axis of rotation of the corresponding interior bearing race supporting frame no matter to what position it may be rocked, and the axis of rotation for the flat interior surfaces 124 of the clamping members or blocks 112 of each clamping unit fixedly remains in the plane of said flat interior surfaces, as well as at the longitudinal axis of a locating rod or mandrel when supporting an article to be bored.

Pressure of fluid in the spaces 38 of the cylinders 33 and in the spaces 69 of the cylinders 66 will be relieved when an article is to be removed from the machine, and another article the bearing of which is to be rebored can be located in the machine by repetition of the operations hereinbefore described.

It will be understood of course that the locating rod or mandrel 16 will be removed from an article having a bearing to be rebored after said article is set up in the machine, and a boring bar with cutting tool set up in the bearings of the supporting units 11 and 12 and actuated to accomplish a reboring operation upon the bearing of the article.

What is claimed is:

1. In a machine of the character described, a frame, spaced apart, parallel supporting units mounted on said frame for movement toward and away from each other, alined bearings upon said supporting units for removably receiving a boring bar locating element for insertion through an article to be bored while situated between said supporting units, spaced apart, self-adjusting clamping units upon said supporting units each comprised as an outer annular bearing support upon one of said supporting units and having a first annular, part-spherical bearing surface at its inner side and in concentric relation to said alined bearings, an inner annular bearing support having a second annular, part-sperical bearing surface at its outer side and in spaced, concentric relation to said first annular, part-spherical bearing surface, means mounting the inner annular bearing support of each of said clamping units upon the outer annular bearing support thereof and interconnecting said inner and outer annular bearing supports for relative universal rocking movement, clamping surfaces upon and disposed inwardly of each of said inner annular

bearing supports, said first and second annular, part-spherical bearing surfaces of each of said clamping units being concentric to an axis of rotation for the inner annular bearing support of the corresponding clamping unit in the longitudinal axis of a boring bar locating element when in said alined bearings and also in the plane of the clamping surfaces upon said inner annular bearing support, said clamping surfaces of the inner annular bearing supports of the different clamping units being in substantially parallel, oppositely disposed relation and said clamping units being situated between said supporting units and said article and each having an opening disposed interiorly of the corresponding first and second annular, part-spherical bearing surfaces for passage of said boring bar locating element, and means for actuating said supporting units toward each other to cause said clamping surfaces upon said inner annular bearing supports to be engaged against oppositely disposed surfaces of said article.

2. In a machine of the character described, a frame, spaced apart, parallel supporting units mounted on said frame for movement toward and away from each other, alined bearings upon said supporting units for removably receiving a boring bar locating element for insertion through an article to be bored while situated between said supporting units, spaced apart, self-adjusting clamping units upon said supporting units each comprised as an outer annular bearing support upon one of said supporting units and having a first annular, part-spherical bearing surface at its inner side and in concentric relation to said alined bearings, an inner annular bearing support having a second annular, part-spherical bearing surface at its outer side and in spaced, concentric relation to said first annular, part-spherical bearing surface, means mounting the inner annular bearing support of each of said clamping units upon the outer annular bearing support thereof and interconnecting said inner and outer annular bearing supports for relative universal rocking movement, radially adjustable clamping members upon each of said inner annular bearing supports, a clamping surface upon each of said clamping members disposed inwardly of the corresponding inner annular bearing support, said first and second annular, part-spherical bearing surfaces of each of said clamping units being concentric to an axis of rotation for the inner annular bearing support of the corresponding clamping unit in the longitudinal axis of a boring bar locating element when in said alined bearings and also in the plane of the clamping surfaces of the clamping members upon said inner annular bearing supports, said clamping surfaces being in substantially parallel, oppositely disposed relation and said clamping units being situated between said supporting units and said article and each having an opening disposed interiorly of the corresponding first and second annular, part-spherical bearing surfaces for passage of said boring bar locating element, and means for actuating said supporting units toward each other to cause said clamping surfaces upon said inner annular bearing supports to be engaged against oppositely disposed surfaces of said article.

3. The combination as specified in claim 2, and means for accomplishing radial adjustment of said clamping members.

4. In a machine of the character described, a frame, a supporting unit on said frame, a bearing upon said supporting unit for removably receiving a boring bar locating element for insertion through an article to be bored, a self-adjusting clamping unit comprised as an outer annular bearing support upon said supporting unit and having a first annular part-spherical bearing surface at its inner side and in concentric relation to said bearing, an inner annular bearing support having a second annular, part-spherical bearing surface at its outer side and in spaced, concentric relation to said first annular, part-spherical bearing surface, means mounting the inner annular bearing support upon the outer annular bearing support and interconnecting said inner and outer annular bearing supports for relative universal rocking movement, and clamping surfaces upon and disposed inwardly of said inner annular bearing support, said first and second annular, part-spherical bearing surfaces being concentric to an axis of rotation for said inner annular bearing support in the longitudinal axis of a boring bar locating element when in said bearing and also in the plane of said clamping surfaces.

5. The combination as specified in claim 4 wherein said clamping surfaces are upon clamping members assembled with said inner annular bearing support for radial adjustment.

6. The combination as specified in claim 5, and means for accomplishing radial adjustment of said clamping members.

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