Feb. 13, 1940. W. A. HART 2,190,067

BROACHING MACHINE

Filed Sept. 28, 1935 2 Sheets-Sheet 1

FIG. 1.

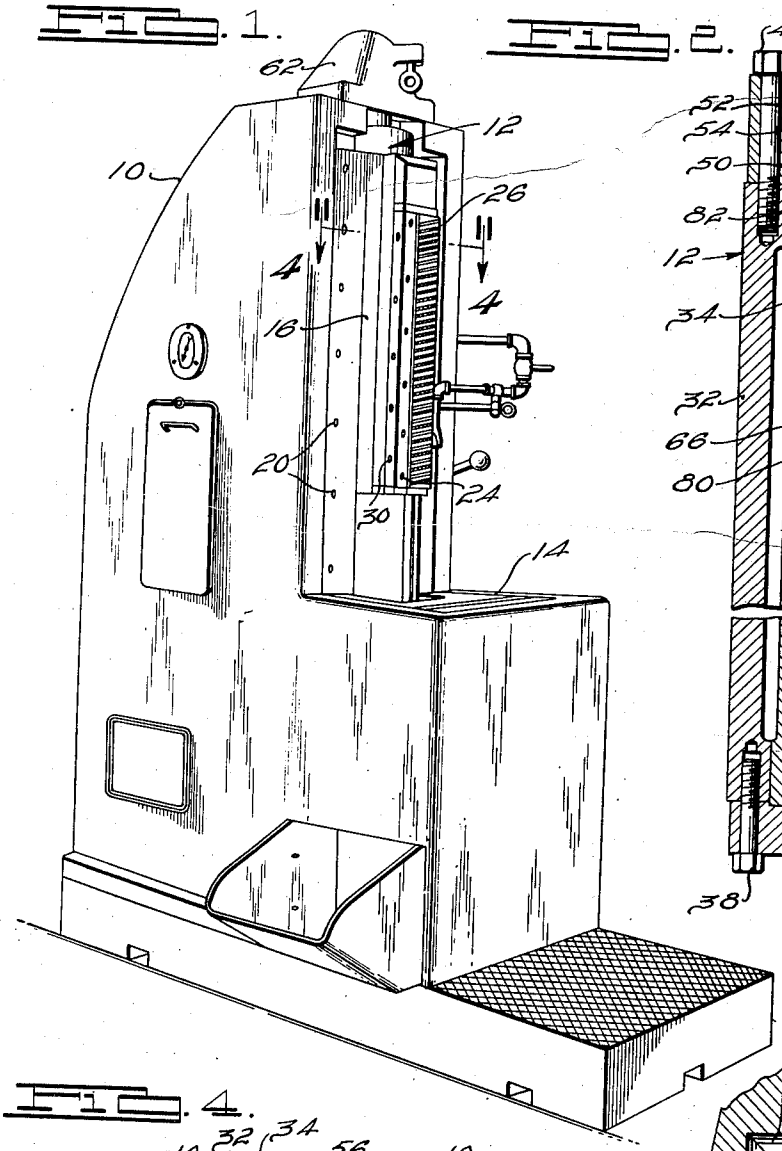


FIG. 2.

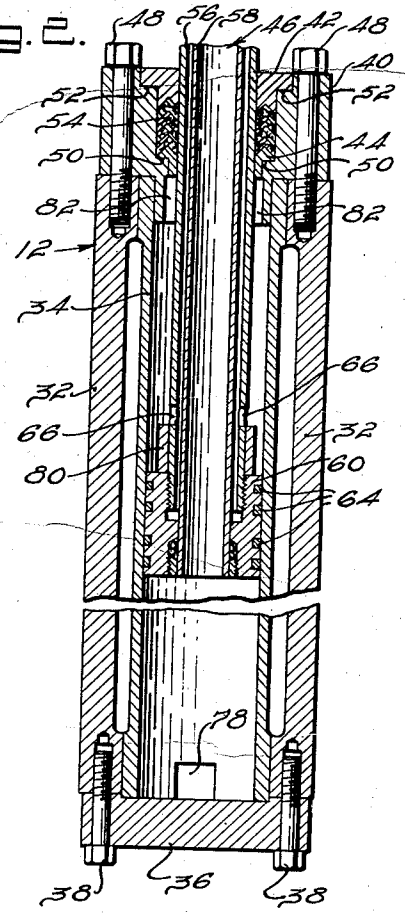


FIG. 4.

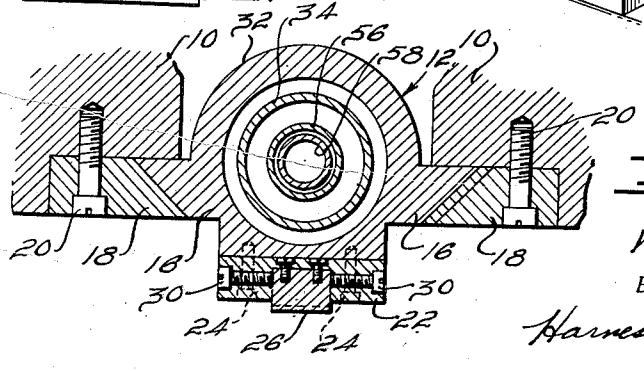
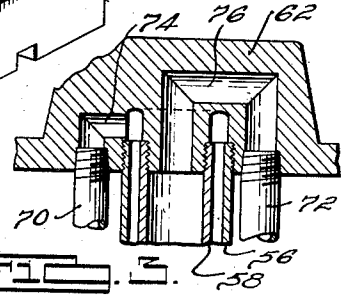


FIG. 3.



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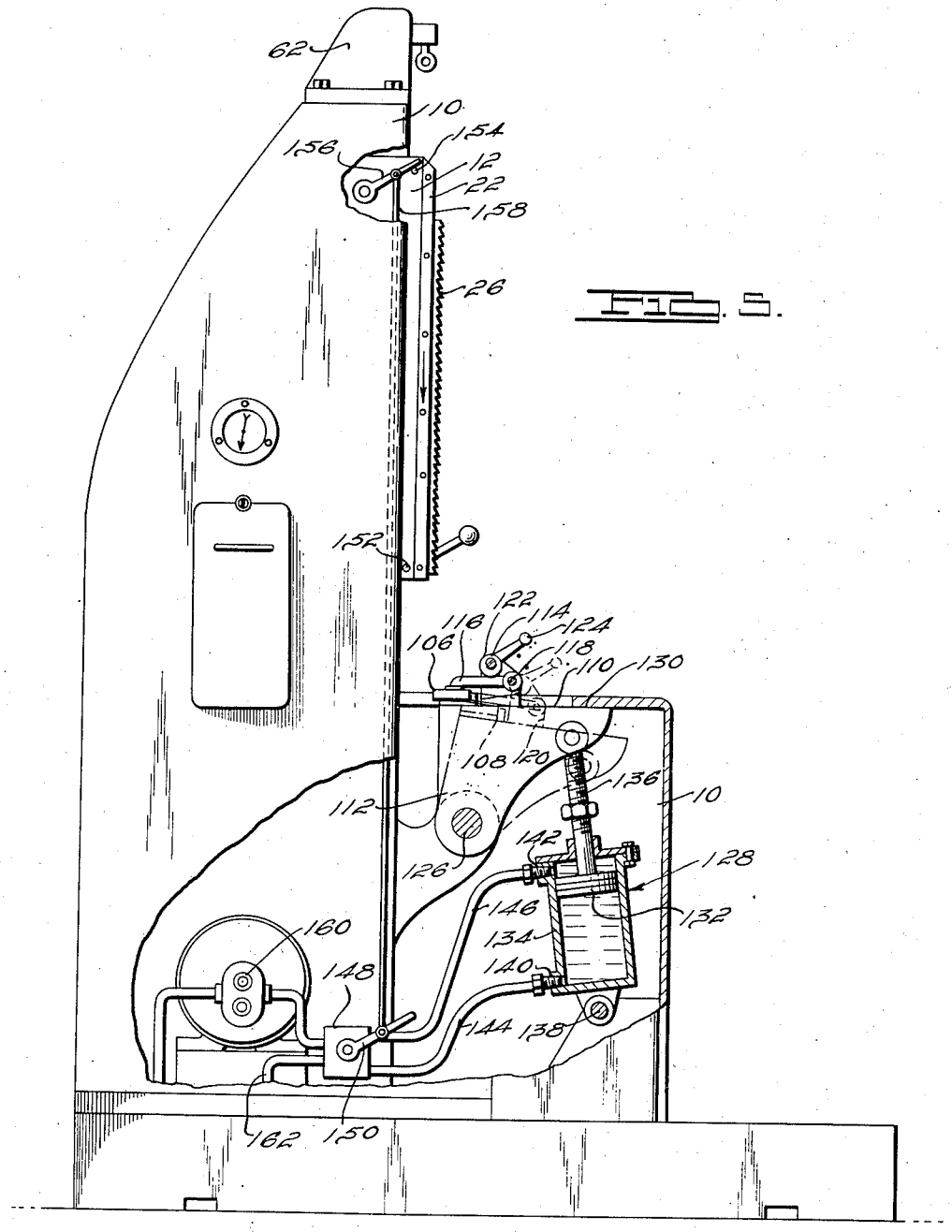


FIG. 5.

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UNITED STATES PATENT OFFICE

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BROACHING MACHINE

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Application September 28, 1935, Serial No. 42,619

1 Claim. (Cl. 90—33)

The present invention relates to metal working machines, and more particularly to improved mechanism for automatically moving the cutting and work supporting elements of such machines.

It is an object of the present invention to provide a metal working machine embodying improved means for effecting relative reciprocatory motion between a tool head and work supporting table.

It is also an object of the present invention to provide a fluid pressure operated cylinder for use in metal working machines and the like, and particularly adapted to impart a reciprocatory motion to a tool head.

It is also an object of the present invention to provide a cylinder of the last mentioned type, embodying a stationary piston and a movable casing therefor, for supporting a tool head, in which the fluid pressure intake and exhaust lines may all be connected to the piston rod.

It is also an object of the present invention to provide a cylinder of the last mentioned type, in which the movable casing is free of fluid pressure connections.

It is also an object of the present invention to provide a fluid pressure operated cylinder of the above mentioned type in which the intake and exhaust lines may both be connected at the same end of the piston structure.

It is also an object of the present invention to provide a fluid pressure operated cylinder embodying a two-passage piston rod, constructed to accommodate fluid pressure intake and exhaust lines and in which one of the passages communicate with the interior of the piston casing on one side of the piston, and the other passage communicates with the interior of the casing on the other side of the piston.

It is also an object of the present invention to provide a fluid pressure operated cylinder embodying a movable casing and a stationary piston, in which the piston is constructed to provide two concentric passages, one of which communicates with one side of the piston head and the other of which communicates with the other side of the piston head.

It is also an object of the present invention to provide a metal working machine embodying a pivotally supported work table, and automatic means to pivot the table from a cutting position to a loading position.

It is a further object of the present invention to provide a metal working machine of the last mentioned type in which the pivotal movements of the work table are controlled in accordance with the movements of the machine cutting tool.

It is a further object of the present invention to generally improve and simplify metal working machines, particularly those constructed to operate broaching tools, and to provide an automatic machine which is simple in construction, economical of manufacture, and accurate and positive in operation.

Other objects of the present invention appear in the following description and in the appended claim.

In the drawings, throughout which corresponding reference characters are used to designate corresponding parts:

Fig. 1 is a view in perspective of a broaching machine embodying a fluid pressure operated cylinder constructed in accordance with the present invention;

Fig. 2 is a view in vertical section of a fluid pressure operated cylinder embodying the present invention;

Fig. 3 is a view in vertical section of illustrative fluid pressure connections to the piston rod of the cylinder shown in Fig. 2;

Fig. 4 is a view in horizontal section taken along the line 4—4 of Fig. 1; and

Fig. 5 is a view in side elevation of a broaching machine embodying a pivoted work table in accordance with the present invention.

As will be understood, metal working machines, such for example as automatic broaching machines, compromise in general a table for supporting the work to be machined or broached, a corresponding support for a cutting tool, and means to impart relative motion to the work piece and the cutting tool. In certain instances, the work piece is stationarily supported during a cutting movement and the cutting tool is reciprocated with respect thereto. Alternatively, the cutting tool may be stationarily supported and the work piece reciprocated with respect thereto.

In the practice of both of these alternative arrangements, it has become customary to utilize fluid pressure operated mechanism to provide the relative motion between the work piece and the cutting tool, and an important feature of the present invention is the provision of an improved construction of fluid pressure operated cylinder for effecting such automatic relative movement.

In the form illustrated, the improved fluid pressure operated cylinder of the present invention, comprises generally a casing within which

a piston is slidably supported and to which a piston rod is connected. Preferably, and as illustrated, the piston rod is stationarily supported and in operation, the casing reciprocates with respect to the piston head, the cutting tool being supported on the exterior of the casing.

To effect movement of the casing in one direction, fluid is introduced into the casing on one side of the piston and is exhausted from the casing on the other side of the piston. To produce an opposite direction of casing movement, a reverse transfer of fluid is effected.

In the form illustrated, the piston rod consists of two concentrically formed conduits, corresponding ends of which are fixed in the piston head and to a stationary support respectively. The inner conduit registers with a central opening cut through the piston head, and thus communicates with the interior of the casing on one side of the piston head. The outer conduit is provided with peripheral openings adjacent the point at which it is connected to the piston head, and thus communicates with the interior of the casing on the opposite side of the piston head. The piston rod conduits may be selectively dimensioned to produce any desired relation between the rates of travel of the casing in the respective directions.

The intake and exhaust lines may be connected to the piston rod in various ways. Preferably, and as illustrated, the intake and exhaust lines lead to the stationary piston rod support, and are connected to the piston rod conduits through cross passages formed in such support.

As will be understood, the feature of connecting the intake and exhaust lines to the stationary portions of the cylinder eliminates the necessity of flexible supply lines, and thus materially simplifies the construction. It also avoids the necessity of connecting fluid lines into the casing. Since the connections to the casing portions on the two sides of the pistons are arranged within the single piston rod, such rod need extend only on one side of the piston head, and provision is required for passing such piston rod through only one end of the casing. With this arrangement, accordingly, packing mechanism is required at only one point in the unit.

In the use of the improved cylinder of the present invention, particularly in connection with automatic broaching machines, the complete travel cycle of the cylinder casing is preferably automatic; that is, after having been started in motion, it travels to one limit of travel, is automatically reversed, travels to an opposite limit of travel and is again automatically reversed. The automatic reversing mechanism may be arranged in various ways. A preferred arrangement for accomplishing this is disclosed in the co-pending application of Richard A. Thompson, Serial No. 35,693, filed August 7, 1935, and assigned to the same assignee as the present application. As disclosed in that application, suitable reversing valve mechanism is provided, and arranged for movement from a position corresponding to one direction of flow, to a position corresponding to an opposite direction of flow, as the casing approaches opposite limits of travel. A reversing movement of the valve reverses the connection of the cylinder supply line to a source of pressure and an exhaust line.

To facilitate the insertion and removal or work, and ensure that the cutting tool shall not engage the work during a return movement of the former, it has been found desirable to provide means to withdraw the work during such return movement, and a further feature of the present invention is the provision of an improved, pivotally supported work table, in combination with automatic means to swing the table between loading and cutting positions in accordance with the movements of the cutting tool. The illustrated arrangement is such that at the completion of a cutting movement, the work table is automatically swung to a loading position, at which it remains throughout the return movement of the cutting tool. At the completion of the return movement, and the beginning of a new cutting movement, the work table is automatically swung to a cutting position, in which it remains throughout the cutting movement. Preferably, and as illustrated, the actuating mechanism for the work table comprises a fluid pressure cylinder, the connections to which are reversed at the above mentioned limits of travel by a suitable reversing control valve which responds to the position of the cutting tool.

Referring to Figs. 1 through 4 of the drawings, an illustrative machine with which the improved cylinder of the present invention may be used, comprises generally the supporting frame **10**, the vertical forward face of which is recessed to accommodate the cylinder mechanism designated generally **12**, and the lower forward portion **14** of which is horizontally disposed to provide a suitable table upon which the work to be broached or machined (not shown) may be positioned. A preferred form of work table is disclosed in Fig. 5 and is described below. The cylinder mechanism **12** is provided with the laterally extending rail sections **16**, which are slidably supported against the face of the frame **10** by the guides **18**. Guides **18** are secured to frame **10** by studs **20**. The forward face of the cylinder mechanism **12** is adapted to form a support for tool carriage **22**, which is secured thereto by the countersunk studs **24**. Cutting tool **26** is fitted in a longitudinal recess formed in carriage **22** and is secured therein by the countersunk studs **30**.

As best shown in Figs. 2 and 4, cylinder mechanism **12** comprises the outer hollow cylindrical sleeve **32**, within which the hollow casing **34** is relatively tightly fitted. The lower ends of sleeve **32** and casing **34** are closed by the plate **36**, which is secured to casing **32** by studs **38**. The upper ends of sleeve **32** and casing **34** are closed by collar **40**, retaining rings **42** and **44**, and by the piston rod designated generally **46**. Collar **40** is secured to sleeve **32** by studs **48**. Retaining ring **44**, which is provided with a central aperture dimensioned to slidably receive piston rod **46**, is press fitted within collar **40** and is supported against the annular shoulder **50** formed near the lower end thereof. Retaining ring **42**, provided with a correspondingly dimensioned central aperture to receive piston rod **46**, is press fitted into the upper end of collar **40** and is supported against the annular shoulder **52** formed in the latter. A suitable packing gland **54** is interposed between rings **42** and **44** to prevent the escape of fluid to the exterior of the cylinder.

Piston **46** comprises the two concentric hollow conduits **56** and **58**. The lower end of conduit **56** is externally threaded, and is threaded into the upper end of piston head **60**. The upper end of conduit **56**, as best shown in Fig. 3, is threaded into the stationary support **62**, which may form a part of the machine frame **10**. The upper and lower ends of the inner sleeve **58** are correspondingly externally threaded, and are threaded into support **62** and piston head **60**,

respectively. As will be understood, piston head 60 is slidably supported within casing 34, and may, if desired, be provided with a plurality of piston rings 64 to prevent the transfer of fluid around it.

The inner conduit 58, as will be noted, extends through piston head 60 and connects into the lower portion of casing 34, as viewed in Fig. 2. The outer casing 56 is provided with one or more peripheral openings 66, that connect into the upper portion of casing 34, as viewed in Fig. 2. As shown in Fig. 3, the upper ends of conduit 56 and 58, respectively, communicate with the fluid supply lines 70 and 72, through the cross passages 74 and 76 formed in support 62.

The boss 78 formed on the lower end of plate 36 is of substantially the same diameter as the inner conduit 58 and is in axial alignment therewith. At the upper limit of the stroke of casing 34, boss 78 enters the lower end of conduit 58 and forms a fluid cushion for casing 34. A corresponding cushion is provided at the lower limit of travel of casing 34 by sleeve 80 which surrounds the outer conduit 56, and is disposed to enter a cooperating area 82 provided by the formation of the lower end of collar 40.

With reference to the operation of the cylinder mechanism as a whole, it will be understood that fluid introduced under pressure through intake line 70, circulates through the space between conduits 56 and 58, through the openings 66, and into the upper portion of casing 34. This action develops a pressure tending to force casing 34 upwardly. In response to this movement, the fluid which normally occupies the lower portion of casing 34 is forced therefrom through conduit 58 and out through the line 72. To effect a downward movement of cylinder mechanism 12, fluid is introduced through line 72, and circulates through conduit 58 into the lower portion of casing 34, forcing the latter downwardly. In response to this movement, the fluid previously introduced into the upper portion of casing 34 is forced outwardly through opening 66, through the space between conduits 56 and 58 and out through line 70. It will be understood that the rates of travel in the respective directions is determined by the characteristics of the fluid pressure supply source and by the sizes of the conduits 56 and 58. It will also be understood that different rates of travel in the respective directions may be effected by suitably relating the areas of conduits 56 and 58. As previously mentioned, a preferred arrangement for selectively connecting lines 70 and 72 to a source of fluid pressure and to an exhaust chamber respectively, is disclosed in the above identified co-pending application of the present applicant.

Referring now to Fig. 5, work piece 106 and a usual rest 108 therefor are removably secured to the upper surface 110 of work table 112 by the illustrative clamping mechanism 114. Clamping mechanism 114 may be of any suitable type and as illustrated comprises the clamp 116, pivotally secured by pin 118 to a support 120 which may be formed integrally with work table 112. The eccentric 122 may be rotated by arm 124 to force clamp 116 tightly into engagement with work piece 106.

Work table 112 is pivotally supported on shaft 126 to the main supporting frame 10, and is adapted to be automatically swung between the full line and dotted line positions by the fluid pressure mechanism designated generally 128. In the full line position, the upper flat surface 110 of table 112 bears against the shoulder 130 formed in frame 10. The tool 26, in passing across the work piece 106, tends to rotate table 112 in a counterclockwise direction, as viewed in Fig. 5, the shaft 126 being preferably located in offset relation to the path of movement of tool 26. The force thus applied by the tool 26 positively maintains table 112 in the cutting position. In the full line position, it will be understood, table 112 holds work piece 106 in cutting position with respect to cutting tool 26. In the dotted line or loading position of table 112, work piece 106 is swung out of the path of cutting tool 26, and is not engaged thereby during its return movement. The movement of table 112 to the loading position, in addition to avoiding engagement between the cutting tool and the work piece during the return movement of the former, also facilitates the removal of the completed work piece 106 and the insertion of a new work piece.

The fluid pressure mechanism 128 may be constructed in various ways. As illustrated, it comprises a piston 132, slidably received within the casing 134, and pivotally connected to work table 112 through the piston rod 136. Casing 134 is pivotally supported to frame 104 by shaft 138, and is provided with the side openings 140 and 142, into which the ends of the flexible supply lines 144 and 146 respectively are secured. The other ends of supply lines 144 and 146 are connected to a suitable conventional reversing valve 148, the actuating arm 150 of which is subject to control by a lower cam 152, which moves with tool 26, as well as by an upper cam 154, which also moves with tool 26, and is disposed to engage a rocker arm 156. Rocker arm 156 is connected to arm 150 through push rod 158.

It will be understood that in one position, valve 148 connects line 146 to a source of fluid pressure illustrated as pump 160, and connects line 144 to a suitable exhaust chamber (not shown) through line 162; and that in a reverse position it connects line 144 to pump 160 and connects line 146 to the exhaust chamber.

With reference to the operation of the unit as a whole, the parts are shown in the positions occupied when in readiness for a cutting movement of tool 26. In these positions, cam 154 retains the valve actuating arm 150 in the illustrated position, in which line 144 is connected to pump 160. These connections forcibly retain piston 142 in the upper illustrated position within cylinder 134, and force work table 112 to the full line or cutting position.

This positioning of the part obtains until the completion of a cutting movement of tool 26, at which time cam 152 engages valve arm 150, rotating it in a clockwise direction to a position in which the valve connections are reversed. With the reversed connections, line 146 is connected to pump 160 and piston 132 is accordingly forced to an opposite position in cylinder 134 and in the course of this movement rotates work table 112 around shaft 126 to the loading position shown in dotted lines, in which work piece 106 is out of the path of cutting tool 26. This positioning of the parts obtains until, at the completion of a return movement, cam 154 again engages arm 156 and moves valve arm 150 to the illustrated position. At this time work table 112 is again swung in a counter-clockwise direction to the cutting position.

Although specific embodiments of the present invention have been described, it will be evident that various modifications may be made in the form, number and arrangement of parts within the spirit and scope thereof, as defined in the appended claim.

What is claimed is:

In a broaching machine having a frame provided with longitudinally extending ways thereon, a cylinder closed at one end and positioned parallel to and between said ways, guiding means on said cylinder and engaging said ways so as to give guiding support to said cylinder at points adjacent the ends of the cylinder, a stationary piston in said cylinder, a pair of concentric hollow piston rods extending through the other end of said cylinder and connected to said piston for supporting the same, the inner of said hollow rods defining the fluid inlet and outlet passage for one end of the cylinder and the space between the rods defining the fluid inlet and outlet passage for the other end of the cylinder, a stationary piston rod supporting head secured to the frame adjacent one end of the ways and having a pair of separate fluid passages formed therein, the inner rod being fixedly connected to and supported by said head in fluid communication with one of said head passages, and the outer rod being fixedly connected to and supported by said head with the space between said rods in fluid communication with the other head passage, and means on said cylinder intermediate its ends for supporting a broaching tool.

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