

March 22, 1938.

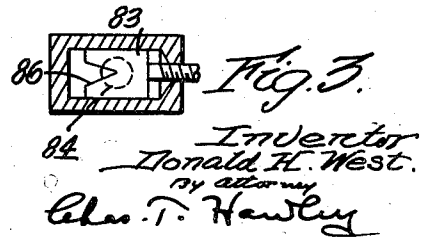
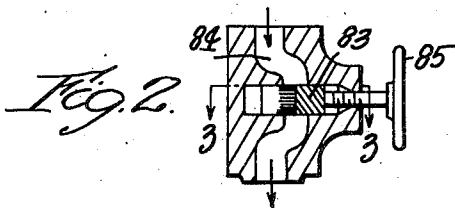
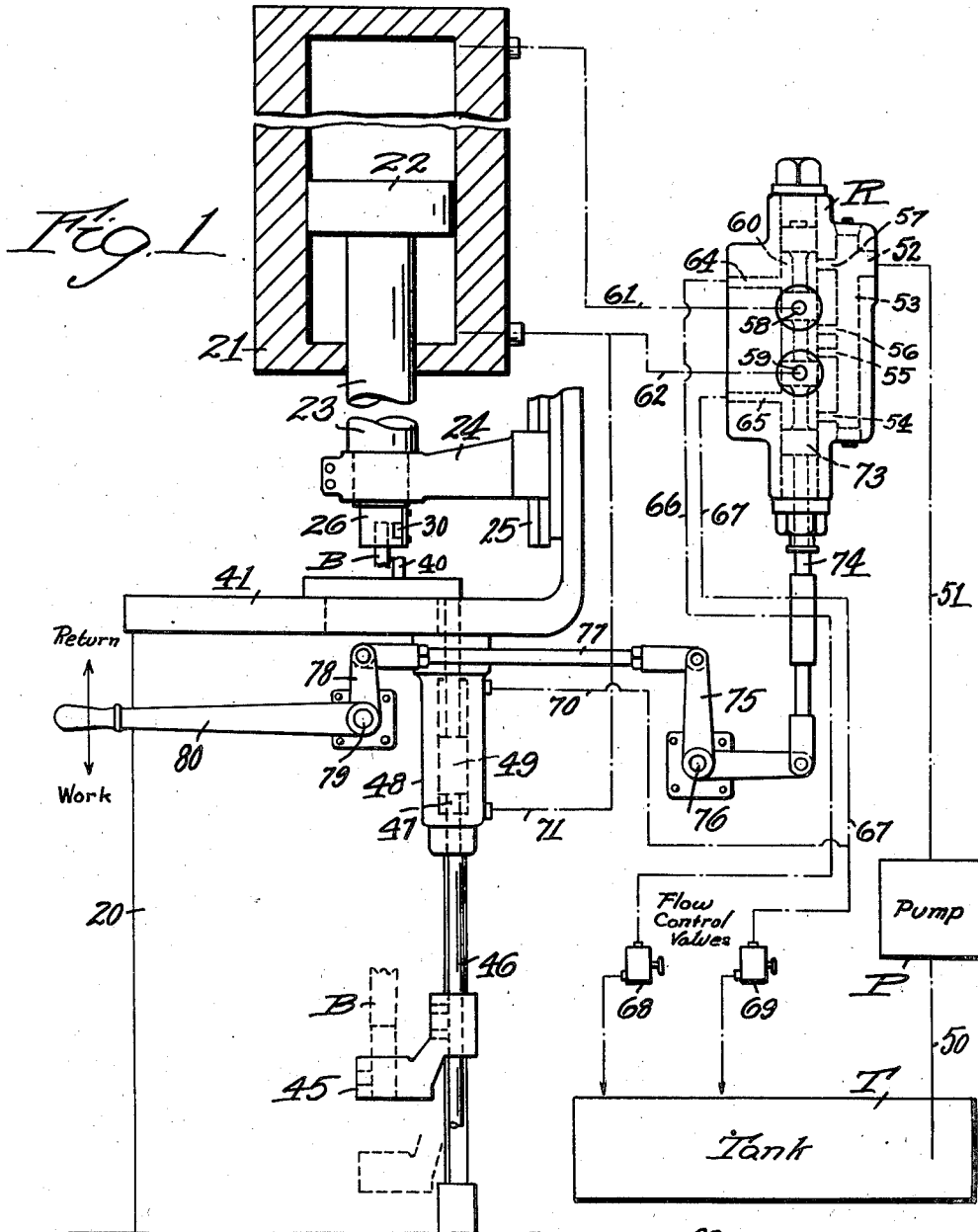
D. H. WEST

2,111,689

VERTICAL BROACHING MACHINE

Filed June 25, 1936

2 Sheets-Sheet 1



March 22, 1938.

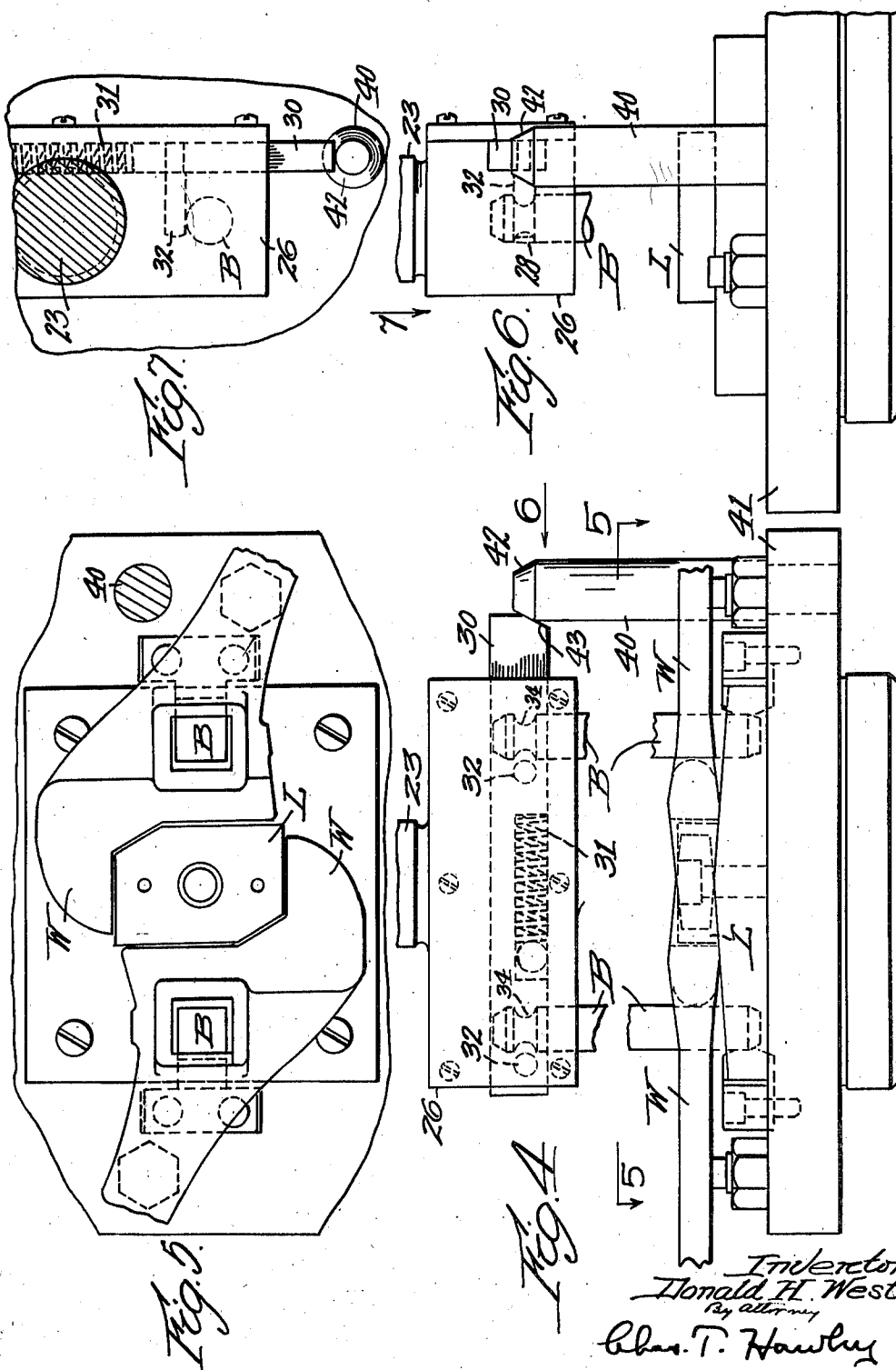
D. H. WEST

2,111,689

VERTICAL BROACHING MACHINE

Filed June 25, 1936

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,111,689

VERTICAL BROACHING MACHINE

Donald H. West, Marlboro, Mass., assignor to
The Lapointe Machine Tool Company, Hudson,
Mass., a corporation of Maine

Application June 25, 1936, Serial No. 87,268

6 Claims. (Cl. 90—33)

This invention relates to broaching machines of the vertical type and in which the broach is pushed downward through the work. In such machines it is customary to release the broach at the lower end of the working stroke, so as to permit removal of the work before the upward return movement of the broach. After the work is removed, the broach and broach holder are restored to raised position.

It is the general object of my invention to provide means for raising the broach and for reconnecting the broach to the broach holder before substantial upward travel of the broach holder has taken place.

An important feature of the invention in its preferred form relates to the provision of a single control device by which the operator may cause the broach to be lifted and reconnected to the broach holder and may also effect return movement of the broach holder and broach to raised position.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is a side elevation of the invention in full hydraulic application;

Fig. 2 is a detail sectional view of a control valve;

Fig. 3 is a sectional plan view, taken along the line 3—3 in Fig. 2;

Fig. 4 is an enlarged front elevation showing the connections between the broach and broach holder;

Fig. 5 is a plan view, taken along the line 5—5 in Fig. 4;

Fig. 6 is an end view, looking in the direction of the arrow 6 in Fig. 4; and

Fig. 7 is a partial plan view, looking in the direction of the arrow 7 in Fig. 6.

Referring to the drawings, I will now describe the details of construction of my invention.

My improved vertical broaching machine comprises a base or frame 20 supporting a main cylinder 21 in which a piston 22 is vertically slidable. The piston rod 23 for the piston 22 is guided at its lower end by an arm 24 slidable on vertical fixed guideways 25. A broach holder 26 is fixed to the lower end of the piston rod 23 and moves upward and downward therewith.

The broach holder 26 is provided with one or more recesses 28 (Fig. 6) to receive the upper ends of broaches B. A locking bar 30 is trans-

versely slidable in a guideway in the broach holder 26 and is movable to locking position by a coil spring 31.

The bar 30 is provided with a stud 32 for each broach B and these studs when in locking position enter circumferential grooves 34 in the necks of the broaches B and prevent downward displacement thereof.

The upper ends of the broaches are preferably beveled as indicated in Figs. 4 and 6, so that they will displace the locking pins 32 on insertion in the broach holder.

A release post 40 is mounted on the fixed platen 41 which supports the work, and projects upward as indicated in Fig. 4 so that its conical upper end 42 will engage a beveled surface 43 on the end of the locking bar 30 and move the bar to the left (as viewed in Fig. 4) when the broach holder 26 approaches its extreme lower position. This movement of the bar 30 unlocks the broaches B and allows them to drop through the work and rest on a broach support 45 (Fig. 1) positioned substantially below the platen 41.

As the broach holder 26 is thereafter raised, the locking bar 30 will clear the release post 40 and the studs 32 will return to locking position.

The broach support 45 is preferably slidable on one or more fixed vertical guide rods 46 and is connected to a piston rod 47 preferably extending through both ends of a broach lifting cylinder 48 and having a piston 49 connected thereto within said cylinder.

Attention is called to the fact that the oil capacity of the cylinder 48 is very much less than the oil capacity of the main or broaching cylinder 21.

Fluid under pressure may be provided by a pump P having an intake connection 50 to a reservoir or tank T. The pump P is connected by a pipe 51 to a port 52 in a control and reversing valve R.

The port 52 is connected through an intake passage 53 to inlet ports 54, 55, 56 and 57. Additional ports 58 and 59 connect the cylinder 60 of the control valve R by pipes 61 and 62 to the opposite ends of the main broaching cylinder 21.

Exhaust ports 64 and 65 connect the valve cylinder 60 through pipes 66 and 67 and back pressure control valves 68 and 69 to the tank T.

The upper end of the broach lifting cylinder 48 is connected by a pipe 70 to the exhaust line 67 and the lower end of the cylinder 48 is connected by a pipe 71 to the pipe 62 which connects the reversing and control valve R to the lower end of the main cylinder 21.

A four-part piston 73 is slidable in the valve cylinder 60 and is connected by a piston rod 74 to a bell crank 75 mounted on a fixed pivot 76. The second arm of the bell crank 75 is connected
5 by a link 77 to an arm 78 mounted on a cross shaft 79 having a handle 80 secured thereto.

The control valves 68 and 69 are manually adjustable to provide any desired back pressure for the main piston 22. The specific construction
10 of these control valves forms no part of my present invention but may be as shown in Figs. 2 and 3 in which a valve member 83 may be adjusted transversely of a passage 84 by a hand wheel 85. The valve member 83 is provided with
15 a triangular port 86. It is obvious that transverse adjustment of the member 83 will restrict to any desired extent the flow of liquid through the control valve.

Having described the details of construction
20 of the preferred form of my invention, the operation thereof is as follows:

When the handle is in the neutral or mid-position shown in Fig. 1, both connections 61 and 62 to the main cylinder 21 are closed and the
25 supply pipe 51 is connected through both pipes 66 and 67 and both control valves 68 and 69 to the tank T.

One or more pieces of work W (Figs. 4 and 5) are positioned above the platen 41 in any convenient manner, as by a locating block L, and the handle 80 is then moved downward from neutral to working position. This movement of the handle raises the four-part piston 73 in the control and reversing valve R and connects the
35 inlet port 56 through the port 58 and pipe 61 to the upper end of the main cylinder 21 and at the same time connects the lower end of the cylinder 21 through the pipe 62, ports 59 and 65, and pipe 67 to the back pressure control valve 69 and through said valve to the tank T.
40

Broaching pressure is thus applied to the upper side of the piston 22 and the liquid forced out from the lower end of the cylinder 21 is delivered to the tank T through the control valve 69 which restricts the flow of oil sufficiently to build up any desired back pressure under the piston 22.
45

At the same time, the upper end of the broach lifting cylinder 48 is connected through the pipe
50 70 to the pipe 67 and the lower end of the cylinder 48 is connected through the pipe 71 to the pipe 62.

As the pressure in both pipes 62 and 67 is the back pressure determined by the valve 69, both
55 sides of the piston 49 are exposed to equal pressures, and the piston 49, piston rod 47 and broach support 45 will move by gravity to their lowermost positions.

As the broach or broaches B and broach holder 26 approach their lower limits of travel, the broaches are released by the engagement of the post 40 (Fig. 4) with the locking bar 30 and the broaches drop to the support 45.
60

When the handle 80 is thereafter moved to its upper position, the four-part piston valve 73 will be moved downward to a position in which the inlet port 55 is connected through the port 59 and pipe 62 to the lower end of the main cylinder 21, while the upper end of the cylinder 21
70 is connected through the pipe 61, ports 58 and 64 and pipe 66 to one back pressure control valve 68 and through said valve to the tank T. The main piston 22 and associated parts are thus caused to move upward.

75 The operating pressure in the pipe 62 is also

communicated through the pipe 71 to the lower end of the broach-lifting cylinder 48, while the upper end of the cylinder is connected through the pipes 70 and 67 to the other back pressure control valve 69 and thence to the tank T.
5

Both cylinders 21 and 48 are thus connected to the same working pressure at their lower ends, but are connected to separate control valves at their upper ends. As the flow of oil from the upper end of the main cylinder 21 is many times
10 greater than the flow from the upper end of the cylinder 48, the escape of oil from the main cylinder will be substantially retarded by the control valve 68, while the escape of oil from the broach-lifting cylinder 48 will be very little
15 retarded by the control valve 69.

Consequently, the piston 49, piston rod 47 and broach-support 45 will move upward much more promptly and rapidly than the piston 22, piston rod 23 and broach holder 26. The broach or
20 broaches B will thus overtake the broach holder and be automatically locked thereto as soon as the locking bar 30 has been raised sufficiently to clear the post 40. Thereafter the broach-lifting piston 49 will be stopped in its upward travel
25 by engagement thereof with the upper end of the cylinder 48 but the piston 22 will continue to move upward and to lift the broach B above the position to be occupied by the new piece of work W.
30

By the described hydraulic apparatus and connections, I control the rate of movement of the pistons 22 and 49 so that a single movement of the handle 80 raises the broach or broaches B relatively quickly into engagement with the
35 holder 26 and thereafter more slowly returns the main piston 22 to upper position.

The handle 80 thus performs an entirely additional function in addition to the usual control of the reversing valve R and without special attention or manipulation by the operator.
40

The control valves 68 and 69 may be relatively adjusted to vary the back pressure resistance in accordance with substantial differences in weight of the broach in use. For a very heavy broach a
45 greater retardation of the main piston will be necessary, which would be obtained by further closing the back pressure valve 68.

I thus entirely avoid the direct lifting of the broach and manual connection of the same to the broach holder, which operation was quite laborious when heavy broaches were in use, and which also consumed considerable time as the broach could not be reconnected to the broach holder until the holder had moved upward far
50 enough to release the locking bar. The task was ordinarily performed after the full upward movement of the broach holder had been completed.

Having thus described my invention and the advantages thereof, I do not wish to be limited
60 to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:—

1. In a vertical push-down broaching machine, an upper broach holder, a lower broach support associated with said broach holder, the lowest
65 position of said broach support being a greater distance below the lowest position of said broach holder than the length of the broach with which said broach holder and broach support both cooperate, means to release said broach from said
70 holder at the lower end of the working stroke, and means to begin the upward return movement of the broach holder and to simultaneously raise said broach support to restore said broach to operative relation with said broach holder.
75

2. In a vertical push-down broaching machine, an upper broach holder, a lower broach support associated with said broach holder, the lowest position of said broach support being a greater distance below the lowest position of said broach holder than the length of the broach with which said broach holder and broach support both cooperate, means to move said broach holder upward, and means to move said broach support and broach upward at the beginning of the broach holder movement and at greater speed.

3. In a vertical push-down broaching machine, a broach holder, a main hydraulic cylinder and piston connected to move said broach holder, a broach support associated with said broach holder, the lowest position of said broach support being a greater distance below the lowest position of said broach holder than the length of the broach with which said broach holder and broach support both cooperate, an auxiliary hydraulic cylinder and piston connected to move said broach support, and a single device effecting simultaneous operation of said two cylinders and pistons to move said broach holder and said broach support upward.

4. In a vertical push-down broaching machine, a broach holder, a main hydraulic cylinder and piston connected to move said broach holder, a broach support associated with said broach holder, the lowest position of said broach support being a greater distance below the lowest position of said broach holder than the length of the broach with which said broach holder and broach support both cooperate, an auxiliary hydraulic cylinder and piston connected to move said broach support, exhaust connections for each end of said first cylinder, a back pressure control valve in each exhaust connection, means to connect the upper end of said auxiliary cylinder to the exhaust connection from the lower end of said main cylinder, whereby a separate back pressure valve controls the exhaust from each cylinder during the simultaneous upward move-

ments of said pistons, and means to simultaneously supply oil under equal pressure to both cylinders.

5. In a vertical push-down broaching machine, a broach holder, a main hydraulic cylinder and piston connected to move said broach holder, a broach support associated with said broach holder, the lowest position of said broach support being a greater distance below the lowest position of said broach holder than the length of the broach with which said broach holder and broach support both cooperate, an auxiliary hydraulic cylinder and piston connected to move said broach support, exhaust connections for each end of said first cylinder, a back pressure control valve in each exhaust connection, and means to connect both ends of said auxiliary cylinder to the operative exhaust connection from the main cylinder when said main piston is moving downward whereby said auxiliary piston is free to move downward by gravity on its inoperative return stroke.

6. In a vertical push-down broaching machine, a broach holder, a main hydraulic cylinder and piston connected to move said broach holder, a broach support associated with said broach holder, the lowest position of said broach support being a greater distance below the lowest position of said broach holder than the length of the broach with which said broach holder and broach support both cooperate, an auxiliary hydraulic cylinder and piston connected to move said broach support, means to supply equal pressure to the lower ends of said two cylinders to move said pistons upward, and means to simultaneously provide relatively high back pressure for said main cylinder and relatively low back pressure for said auxiliary cylinder during said upward movements, whereby said auxiliary piston responds more quickly than said main piston and said broach support is raised more quickly than said broach holder.

DONALD H. WEST.