

Jan 6, 1931.

R. M. GALLOWAY

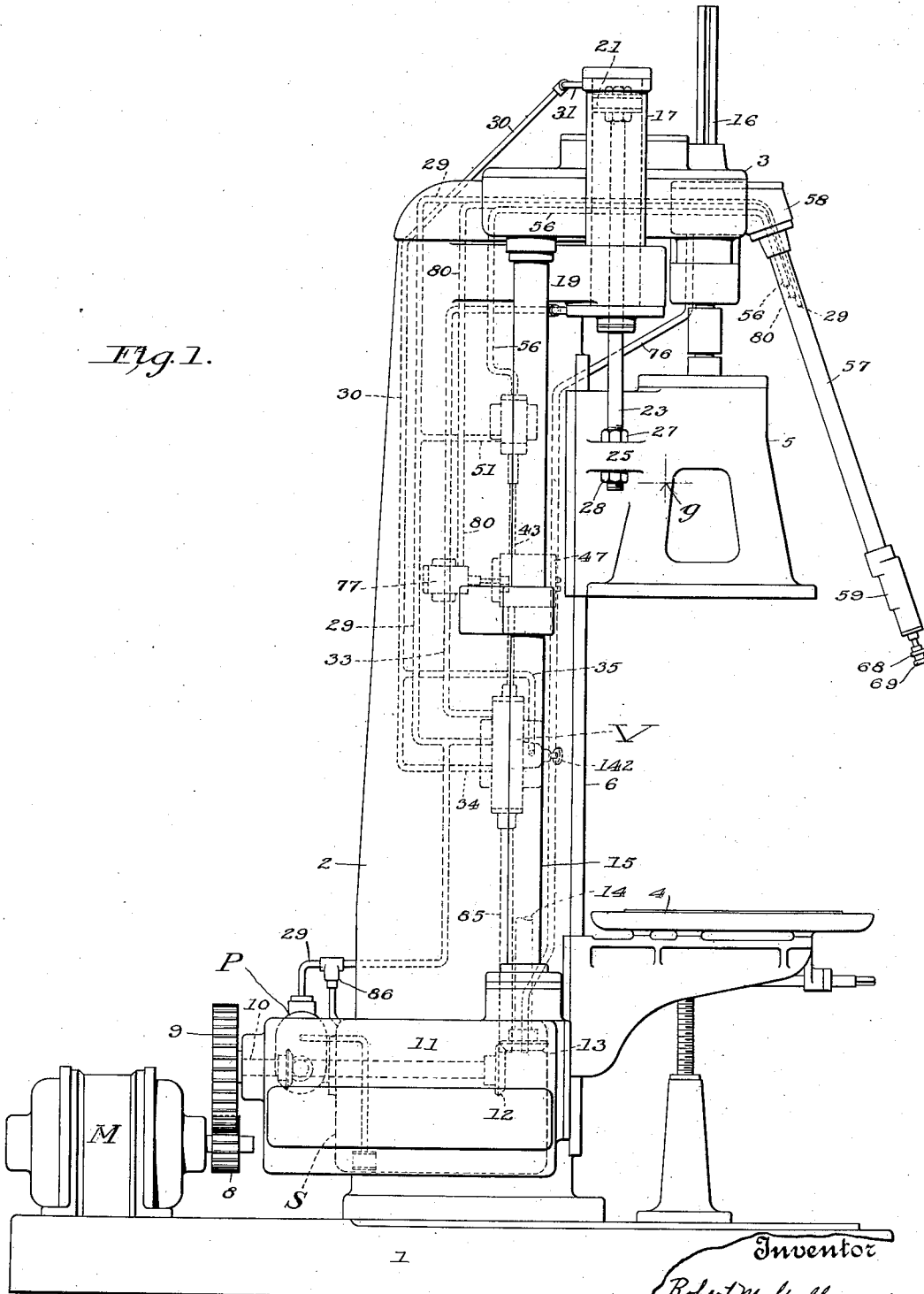
1,787,782

HYDRAULICALLY OPERATED VERTICAL DRILL

Filed April 2, 1927

5 Sheets-Sheet 1

Fig. 1.



By

Attorney

Nathan & Bowman

Inventor

Robert M. Galloway

Jan 6, 1931.

R. M. GALLOWAY

1,787,782

HYDRAULICALLY OPERATED VERTICAL DRILL

Filed April 2, 1927

5 Sheets-Sheet 2

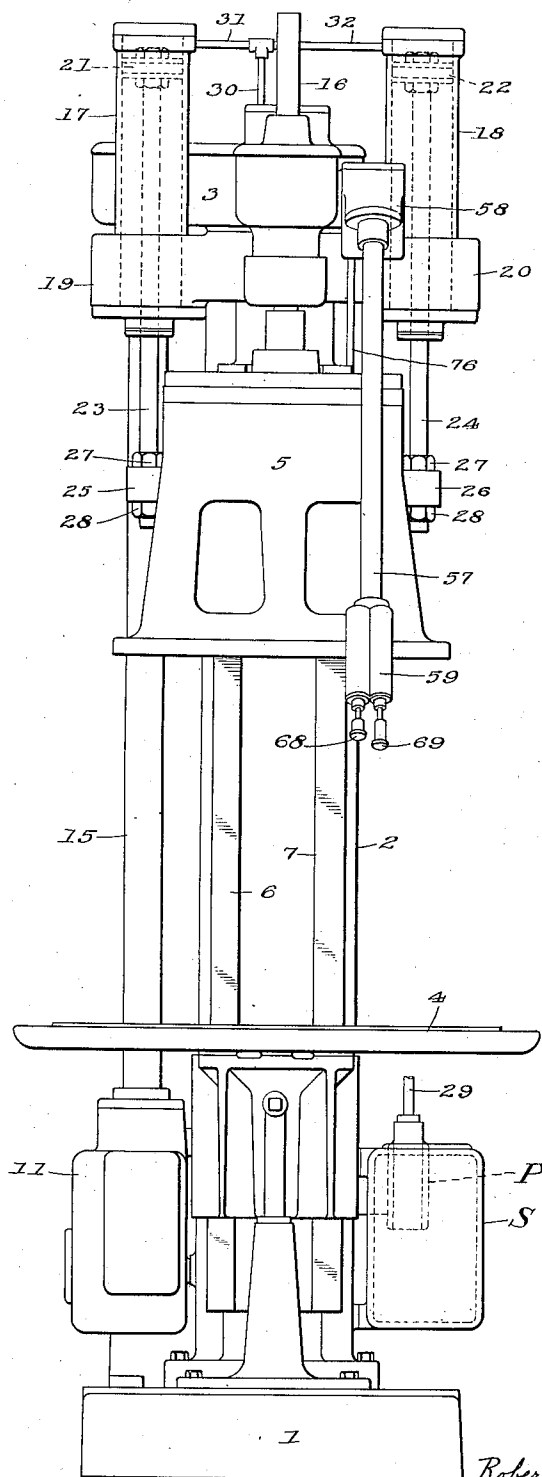


Fig. 2.

Inventor

Robert M. Galloway

By

Attorney

Nathan & Bowman

Jan 6, 1931.

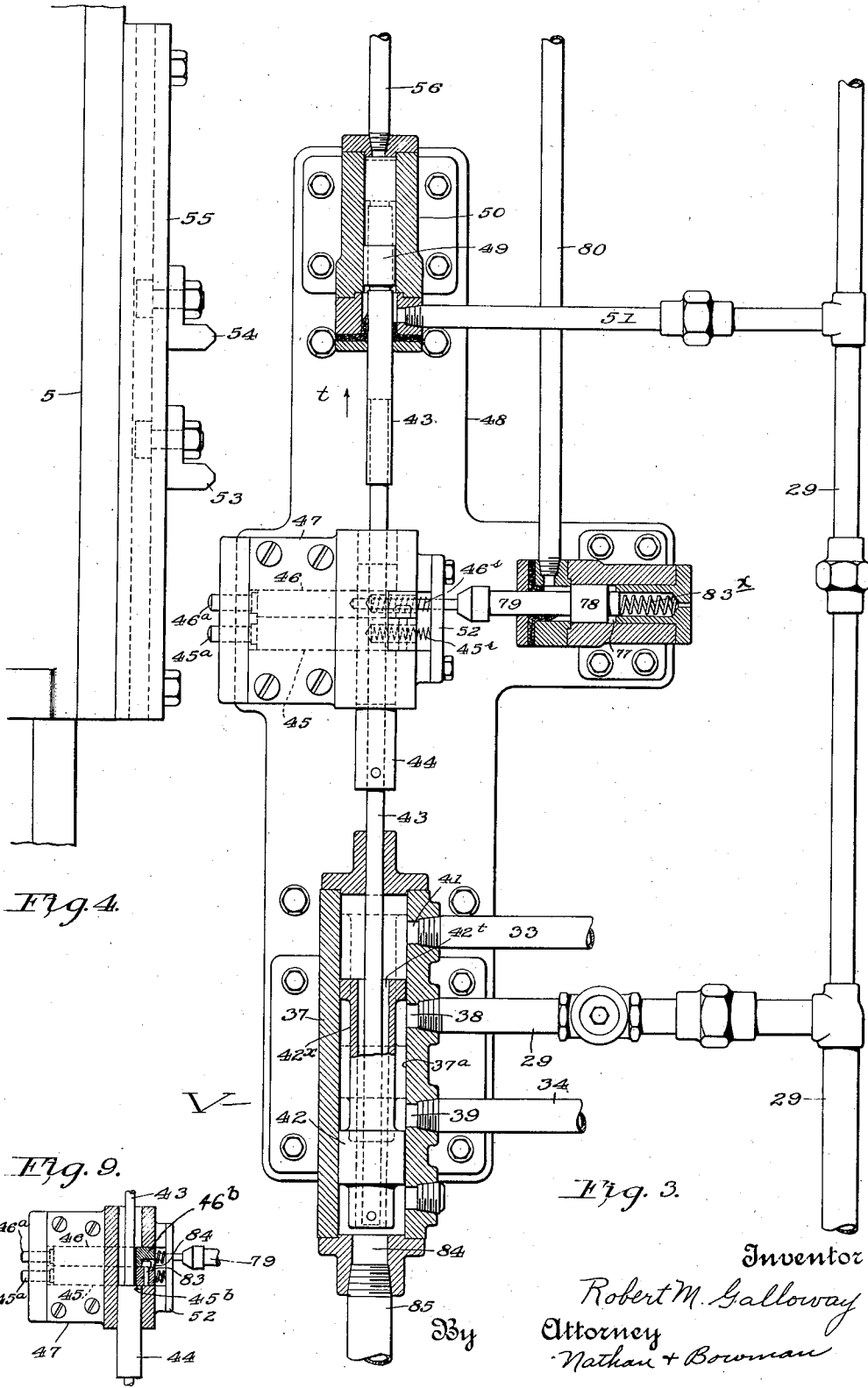
R. M. GALLOWAY

1,787,782

HYDRAULICALLY OPERATED VERTICAL DRILL

Filed April 2, 1927

5 Sheets-Sheet 3



Inventor
Robert M. Galloway
Attorney
Nathan + Bowman

Jan 6, 1931.

R. M. GALLOWAY

1,787,782

HYDRAULICALLY OPERATED VERTICAL DRILL

Filed April 2, 1927

5 Sheets-Sheet 4

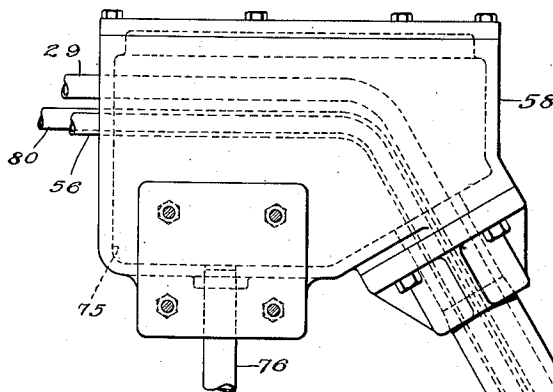


Fig. 5.

Fig. 7.

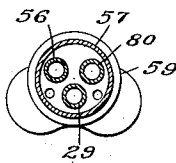


Fig. 6.

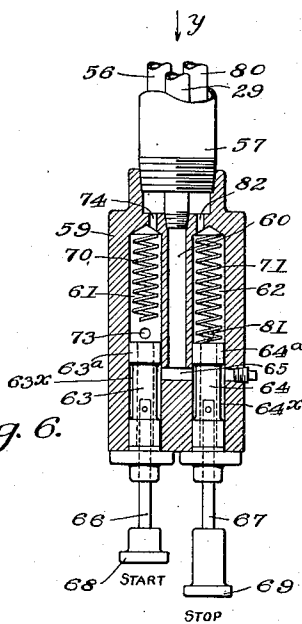
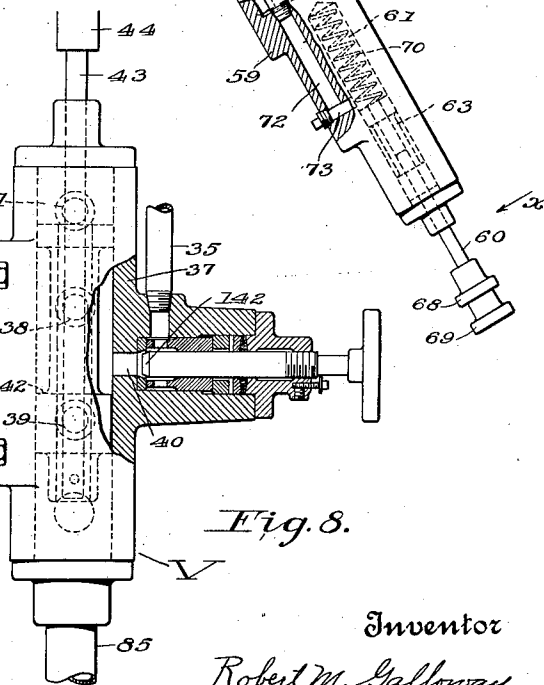


Fig. 8.



By

Attorney

Nathan + Bowman

Inventor

Robert M. Galloway

Jan 6, 1931.

R. M. GALLOWAY

1,787,782

HYDRAULICALLY OPERATED VERTICAL DRILL

Filed April 2, 1927

5 Sheets-Sheet 5

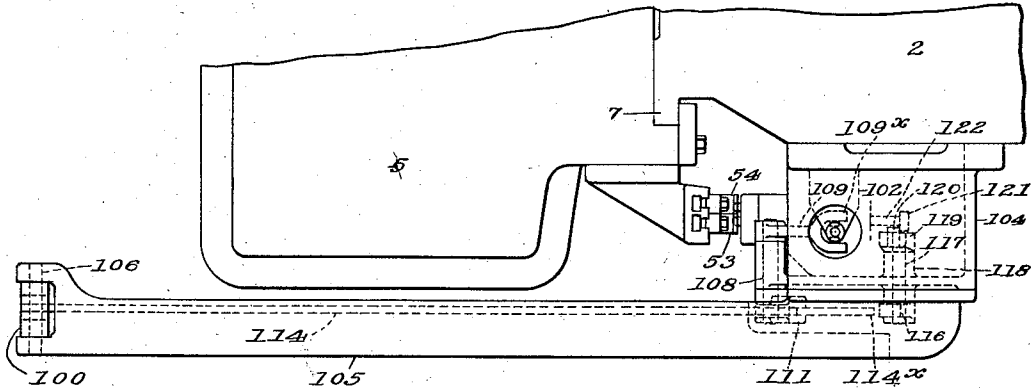


Fig. 11.

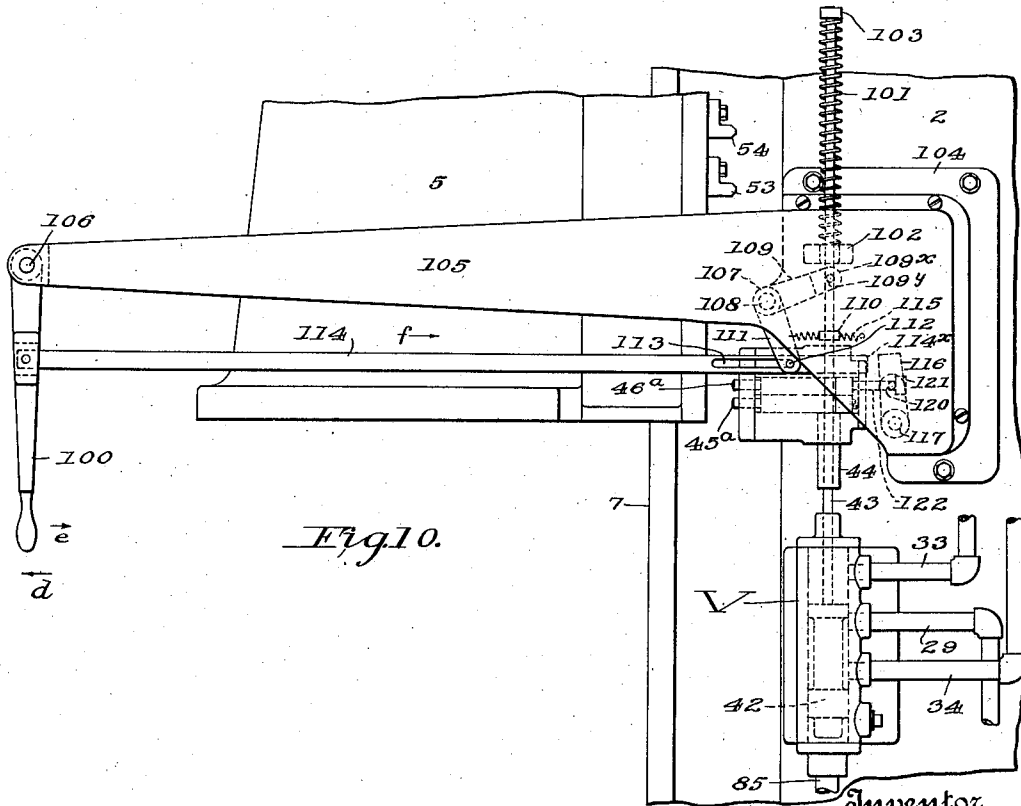


Fig. 10.

Inventor

Robert M. Galloway

By

Attorney

Nathan & Bowman

UNITED STATES PATENT OFFICE

ROBERT M. GALLOWAY, OF RICHMOND, INDIANA, ASSIGNOR TO THE NATIONAL AUTOMATIC TOOL COMPANY, OF RICHMOND, INDIANA, A CORPORATION OF INDIANA

HYDRAULICALLY-OPERATED VERTICAL DRILL

Application filed April 2, 1927. Serial No. 180,574.

This invention deals with machinery of that type in which an element is adapted to be reciprocated during the operation of the machine and it relates more particularly to means for effecting translation of such element. A metal drilling machine is a typical example of a machine of that nature and therefore, for convenience, this invention will be shown and described in connection with that type of machine tool. It is to be understood however, that this invention is neither limited to drilling machines specifically, nor even to machine tools generally.

An object of this invention is to provide an improved form of hydraulic transmission capable of more efficiently translating a movable member, such for example as the tool-head of a multiple spindle drilling machine, than have prior constructions. This object has been attained by the provision of duplicate hydraulic power transmitting devices acting upon opposite sides of the tool-head in the direction of the length of the guideways therefor. An important feature of this invention resides in the particular location of the hydraulic transmitting devices and the points at which the power is applied to the tool-head to effect its translation. In certain prior machine tools power to translate the tool-heads has been applied in line with the geometric centers of the heads. In others it has been applied back of the geometric center at a point between the guideways. I have found, however, by careful observation and experiment that better results are obtained by applying the translating power to the head at opposite sides thereof and approximately midway between the geometric center and the back of the head where it engages the guideways.

Another object of this invention is to provide an improved control mechanism for the hydraulic transmission, whereby movement of the tool-head may be initiated and thereafter it will continue through a predetermined cycle and finally come to rest after having completed an operation on the work. This improved control includes an automatically actuated master valve adapted to control the rate and direction of movement of

the tool-head. In prior machines it has been customary to provide a valve of this nature and manually to set the valve initially (in opposition to a valve-shifting spring) through the action of a suitable lever. Then during the cycle of the machine the valve was, at certain times, released and permitted to move, under the influence of the spring, to various positions in each of which it effected a different rate or direction of movement of the tool-head. This invention proposes to effect the initial setting of the valve, and also its subsequent movement, by fluid pressure, whereby the use of levers and springs for this purpose is obviated. In accordance with the preferred embodiment of this invention, to effect initial setting of the master valve and thereafter a complete cycle of the machine, it is only necessary that the operator press a push button which is so mounted as to be readily within his reach when stationed before his work.

Another object of this invention is to provide an improved safety control for the machine whereby in any emergency, such for example as the breaking of a tool, the operator readily may cause the machine immediately to discontinue its cycle of operation and to return the head to its initial inoperative position. This object has been attained by the provision of a fluid controlled emergency release for withdrawing certain valve retaining members, later to be described, which causes the valve to be moved to a position wherein it effects withdrawal of the tool-head. A push button (controlling the release) is supported adjacent the starter button and is more readily accessible than the latter whereby, in case of emergency, the operator quickly may press the emergency stop button without danger of confusion. This relative accessibility of the starter button and the emergency stop button is one of the features of this invention.

Still another object of this invention is to provide an improved hydraulic transmission and a hydraulic control therefor and to provide a single fluid pressure system embodied in the machine to provide fluid pressure for

operating both the transmission and the control.

Under certain conditions and for certain machines it may be preferable to provide manual means to set the master valve to initiate a cycle, and also to provide manual means to actuate the emergency release. This invention therefore has a further object to provide an improved lever mechanism adapted selectively to effect either operation or inoperation of the machine. This object has been attained through the provision of an improved construction including a manually actuable lever accessible to the operator (and suitable cooperating mechanism) which, when moved in one direction, will shift the master valve to start hydraulic translation of the head and which when shifted in another direction will actuate the emergency release, thereby to cause the head to be retracted from the work and brought to rest.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Figure 1 is a side elevation of an upright multiple spindle drilling machine embodying the present invention, the drill spindles being omitted. Fig. 2 is a front elevation of the machine illustrated in Fig. 1. Fig. 3 is a detail view, partly in section showing the master valve for controlling the rate and direction of movement of the tool-head, the hydraulically actuated means for setting the master valve, the fluid pressure means normally tending to shift the master valve to a predetermined position; the interference mechanism for controlling the movement of the master valve; and the emergency release for the interference mechanism. Fig. 4 is a detail view showing more particularly the adjustable dogs carried by the tool-head which, at predetermined times act upon the interference members to effect release of the master valve whereupon the valve is moved to vary the rate or direction of movement of the drill-head. Fig. 5 is a detail view of a supporting element for the "start" and "emergency stop" push buttons and the valves controlled thereby, together with certain fluid pressure and delivery pipes later to be referred to. Fig. 6 is a detail sectional view looking in the direction of the arrows α in Fig. 5 and showing, in elevation, the start and emergency stop valves. Fig. 7 is a cross sectional view looking in the direction of the

arrow γ in Fig. 6. Fig. 8 is an elevation, partly in section of the master valve casing, and showing more particularly the adjustable valve which controls the rate of feed of the tool-head during a drilling operation. Fig. 9 is a detail sectional view of the interference members for controlling the shifting of the master valve. Fig. 10 is a side elevation of a manually controlled mechanical shifting means for the master valve and the manual emergency release for the interference members. Fig. 11 is a plan of Fig. 10.

Referring more particularly to the drawings the invention is disclosed as embodied in a multiple drilling machine comprising a base 1, upright frame or column 2, over-arm 3, work-support 4, and a tool-head 5 translatable mounted on vertically disposed ways 6 and 7 provided by the column 2. Power to rotate the drill spindles (not shown) and also to actuate a gear-pump P, which later serves to supply fluid pressure to effect translation of the tool-head, is preferably provided by a motor M mounted on the base 1. Inasmuch as the means for effecting rotation of the drill spindles forms no part of the present invention detailed illustration and description thereof is deemed unnecessary. It will suffice to say that the armature shaft of the motor carries a small gear 8 which drives a gear 9, fixed upon a shaft 10, journaled horizontally in a drive box 11, secured to the column 2. The shaft 10 is connected, through bevel gears 12 and 13, with an upright shaft 14 journaled at its lower end in the drive box and at its upper end in the over-arm 3. This shaft extends through a protecting tube 15 and is connected at its upper end, through suitable gearing, with a spindle drive-shaft 16 extending into the drill-head and connected to rotate the drill spindles, not shown.

As hereinbefore stated this invention provides an improved hydraulic transmission for effecting translation of the tool-head on its ways. This improved transmission comprises hydraulic cylinders 17 and 18 supported by arms 19 and 20, respectively, projecting forwardly and outwardly from the upper end of the column 2. Pistons 21 and 22 are fitted within the cylinders 17 and 18, respectively, and these pistons are connected with the tool-head 5 by means of piston rods 23 and 24 passing through lugs 25 and 26 projecting laterally from the sides of the tool-head. Nuts 27 and 28, threaded upon the rods 23 and 24 above and below the lugs, normally serve to hold the rods and head against relative movement but permit of relative adjustment between the head and the rods.

An important feature of this invention resides in the particular location of the cylinders and the points of engagement between the piston rods and the tool-head. Referring particularly to Figs. 1 and 2 it will be seen

that the cylinders are so located that their piston rods engage the tool-head outwardly beyond the guideways 6 and 7 and intermediate the geometric center (represented by *g*) and the back of the head 5 where it engages the ways 6 and 7. Many experiments and tests have proven that this particular location of the cylinders and the points of contact between the piston rods and the tool-head maintain the head more freely translatable on the column, better precludes canting of the head on the ways, and permits the guideways to be located closer together than does any other location of those parts.

In the operation of machine tools of this nature it is desirable that the tool-head first be translated toward the work at a relatively rapid rate thereby to move the tools from their retracted and inoperative positions into engagement with the work without any appreciable loss of time. A relatively slow feeding movement is then given to the head, the rate of which is determined by the nature of the tooling operation and the material being operated on. On completion of the tooling operation the head and the tools carried thereby are withdrawn from the work and inasmuch as this is an idle movement it also may be effected at a relatively rapid rate.

The rate and direction of movement of the tool-head is controlled by the action of an automatically actuated master valve *V* (see Figs. 1, 3 and 8) which serves to direct fluid under pressure from the pressure line 29, extending from the exhaust port of the pump, either to the upper end of the cylinders through a main conduit 30 having branch lines 31 and 32 connected with the cylinders 17 and 18 respectively, or to the lower ends of the cylinders through a conduit 33 and suitable branch lines, not shown. To effect the movement of the head toward the work at materially different rates to wit:—At the rapid traverse and the slow feeding rates, the master valve is designed and actuated first to transmit to the conduit 30, through a branch 34, a relatively large volume of fluid and then, through a branch 35, a relatively small volume of fluid. Thus it will be perceived, the pump *P* draws fluid, preferably oil, from a sump *S*, supported upon the column at the foot thereof, through an intake pipe 36 and exhausts it under pressure through a pressure line 29 connected with the master valve *V* and also with certain valve controlling mechanism later to be described. The master valve *V* is shifted automatically during the operation of the machine to vary the rate and direction of movement of the tool-head in accordance with the nature of the operation being performed.

Referring now to Figs. 3 and 8 it will be seen that the master valve *V* comprises a casing 37 provided with an intake port 38 with which the pressure line 29 is connected.

This casing also provides ports 39, 40 and 41 connected respectively with the "rapid traverse down" conduit 34, the "slow feed" conduit 35 and the "rapid traverse up" conduit 33. Fluid under pressure entering the valve casing 37 through the port 38 is intermittently admitted to the ports 38, 39 and 40 by movement of a piston valve 42 slidingly fitted within a cylindrical bore 37^a formed in the casing 37 and provided intermediate its ends with a reduced portion 42^x which affords a passageway for the fluid.

The rate of flow of fluid through the port 40 into the slow feed conduit 35 is controlled by a needle valve 142 (see Fig. 8) which may be adjusted to produce any desired rate of feed commensurate with a machining operation.

In accordance with the preferred embodiment of this invention the valve piston 42 is shifted within the casing 37 by fluid pressure and is controlled in its movements by interference members as now will be described. The valve piston 42 is secured to a slide rod 43 which carries a collar 44 affording an abutment shoulder adapted alternately to engage laterally projecting portions of spring pressed interference members 45 and 46, slidingly fitted in a housing 47, fixed to a bracket 48, secured to the side of the column 2. The upper end of the rod 43 (as shown in Fig. 3) is provided with a differential piston 49 slidingly fitted within a cylinder 50 supported by the bracket 48. Fluid pressure is transmitted to the cylinder 50 at that end of the piston having the lesser area, by a pipe 51 connected with the pressure line 29, thereby permanently maintaining fluid pressure on the piston 49 and normally tending to move the rod 43 and valve 42 in the direction indicated by the arrow *t*. This movement, however, is prevented at certain times by the interference members 45 and 46 normally maintained in the path of movement of the collar 44 by expansile springs 45^a and 46^a each having one end acting on its respective member and its opposite end on a plate 52 supported by the housing 47. The interference members 45 and 46 are formed with projecting ends 45^a and 46^a, respectively, arranged within the paths of dogs 53 and 54 adjustably mounted on a slotted plate 55 secured to the side of the tool-head 5. Thus, during reciprocation of the tool-head, the dogs 53 and 54 act upon the ends 45^a and 46^a respectively, to depress the interference members 45 and 46. This causes the interference members to release the collar 44 and permit the rod 43 and valve piston 42 to be moved in the direction of the arrow *t*, under the influence of the fluid pressure entering the cylinder 50 through the pipe 51, thereby to vary the rate and direction of movement of the tool-head. At the completion of a cycle the tool-head is in its uppermost position.

tion, the rod 43 and the valve piston 42 are in the positions shown in dotted lines in Fig. 3 and the intake port 38 is connected with the port 41. To start a subsequent cycle it is necessary that the rod 43 and valve 42 be depressed to the full line position shown in Fig. 3 in which the valve 42 connects the intake port 38 with the port 39 to effect a rapid downward traverse of the tool-head.

This invention provides improved fluid pressure actuated means for resetting the valve 42 in opposition to the fluid pressure constantly beneath the piston 49. To that end, a pipe 56 is connected with the cylinder 50 to admit fluid pressure into the cylinder against the end of the piston 49 having the greater area. The pipe 56 receives fluid under pressure from the pressure line 29 as will now be explained. The pressure line 29 extends upwardly along the column 2, horizontally along over-arm 3 and downwardly through a tubular casing 57 supported by a housing 58 secured to the side of the over-arm. At its lower end the casing 57 has secured to it a housing 59 provided with a central chamber 60, with which the pipe 29 connects, and cylindrical bores 61 and 62. Within these bores are slidingly fitted valve pistons 63 and 64 having reduced intermediate portions 63^a and 64^a, respectively, forming fluid passage ways. Intermediate the enlarged ends of these valve pistons the housing 59 is provided with a transverse port 65 which connects the pressure chamber 60 with the cylinders 61 and 62. The valve pistons 63 and 64 are secured upon push rods 66 and 67, fitted with push buttons 68 and 69, respectively, and are normally maintained in the positions shown in Fig. 6 by the coil springs 70 and 71.

The pipe 56 extends from the master valve resetting cylinder 50 upwardly along the column 2, horizontally along the over-arm and downwardly through the casing 57 and, as shown in Fig. 5, connects with a chamber 72 formed in the housing 59. A port 73 connects the chamber 72 with the cylindrical bore 61. From the foregoing it will be perceived that fluid pressure is constantly maintained in the chamber 60, port 65 and about the reduced portion of the valve piston 63. This pressure is, however, normally prevented from entering the port 73 by the enlarged end 63^a of the valve piston 63. When it is desired to start an operative cycle this fluid under pressure is permitted to flow through ports 73 and 72, pipe 56 into the upper end of cylinder 50 where it acts upon the end of the piston 49 having the greater area in opposition to the pressure on the lesser piston area thereby depressing the rod 43 and master valve piston 42 to the positions shown in full lines in Fig. 3 where it is retained by the interference member 45 positioned in the path of movement of the collar 44. This is effected

by pushing inwardly on the push button 68 which causes the end 63^a of the valve piston 63 to pass beyond the port 73 and thereby establish communication from the port 65 to the port 73 by means of the reduced central portion of the valve piston. Immediately upon release of the push button 68 the spring 70 returns the valve piston to the position shown in Fig. 6 thereby discontinuing the flow of fluid to the pipe 56 and establishing a drain therefrom through the ports 72, 73, cylinder bore 61, and an exhaust port 74 formed in the housing 59. Thus, as the interference bars 45 and 46 are subsequently tripped by the dogs 53 and 54 and the rod 43 and the valve piston 42 are moved by the fluid pressure entering the cylinder 50 through pipe 51, the fluid is exhausted from the upper end of the cylinder 50 through pipe 56, through ports 72, 73, bore 61 and port 74 into the tubular casing 57 through which the pipes 29 and 56 extend. At its upper end the casing 57 communicates with a chamber 75 formed in the housing 58 and therefore the fluid exhausted through the port 74 will fill the casing 57 and overflow into the chamber 75 from which it is returned to the sump S through a drain pipe 76 (see Figs. 1 and 5).

The cycle of operation of the machine herein described is as follows:—At the completion of one cycle the machine comes to rest with the tool-head in its uppermost position and with the valve in the position shown in dotted line in Fig. 3. Now to effect a succeeding cycle the operator presses the push button 68 which admits fluid under pressure from the pressure line 29, through pipe 56 into the cylinder 50 above the differential piston 49. This pressure overcomes the pressure on the opposite end of the piston and forces the rod 43 and valve piston 42 to the position shown in full lines in Fig. 3. As the collar 44, on the rod 43, is depressed the interference members 45 and 46 are moved outwardly by the springs 45^a and 46^a to place the laterally projecting portions 45^b and 46^b in the path of movement of the collar 44 and the ends 45^a and 46^a in the paths of the dogs 53 and 54 respectively. The rod 43 having been shifted the operator releases the push button 68 which then moves under the action of the spring 70 thereby discontinuing the pressure through the pipe 56 and permitting it to exhaust through port 74, casing 57, and drain pipe 76 back to the sump. With the master valve piston 42 depressed, fluid, under pressure from the pump P, flows through pipe 29 and port 38 into the cylinder bore 37^a intermediate the enlarged ends of the valve piston 42 and then outwardly through ports 39 and 40 and rapid traverse and slow feed pipes 34 and 35, respectively, to the pipe 30 leading to the upper ends of the cylinders 17 and 18. This effects a rapid depression of the pistons 21 and 22 and the tool-head connected there-

with. The dog 53 is so adjusted on the head that just prior to contact of the tools with the work the dog engages the end 45^a of the interference member 45 thereby depressing it and moving the portion 45^b of the member 45 out the path of movement of the collar 44. When the collar is thus released the fluid pressure in the pipe 51 which continuously maintains pressure beneath the piston 49 moves the rod 43 and valve piston 42 axially in the direction of the arrow *t* until the end of the collar 44 engages the interference member 46, which places the piston 42 in an intermediate position not shown. This movement of the valve piston 42 causes its lower enlarged end to close the port 39 thereby discontinuing the rapid traverse of the tool-head whereupon pressure from the pipe 29 may escape only through the port 40 into the feed pipe 35. As hereinbefore explained the rate of flow through the port 40 is controlled by the needle valve 142, thus the head will then be caused to descend at a relatively slow feeding rate.

When the head has descended sufficiently to complete the tooling operation the dog 54 will engage the end 46^a of the interference member 46 and depress it to cause it to release the collar 44 whereupon the rod 43 and valve pistons 42 again move in the direction of the arrow *t* to the dotted line position in Fig. 3. This movement of the valve wholly disconnects the feed port 40 from the pressure intake port 38 and connects the latter with the port 41 whereupon the fluid under pressure entering the valve casing through the pipe 29 passes into pipe 33 which conducts it to the cylinders 17 and 18 beneath the pistons 21 and 22. This causes the tool-head to be retracted at a rapid rate and it comes to rest in its uppermost position with the valve 42 and the valve controlling piston 49 in the positions shown in dotted lines (Fig. 3). From the foregoing it will be perceived that after the rod 43 has been depressed to initiate a cycle, pressure is maintained thereon tending to shift the valve piston 42 to the positions in which it effects a rapid upward movement of the tool-head and that such instantaneous movement is prevented by the interference members which are rendered ineffective at predetermined times to permit shifting of the valve.

Sometimes in the operation of machine tools of this nature (such as for example upon breaking of a tool) it is essential that the machine be not permitted to complete its normal cycle but that the operation be discontinued and the tool-head returned to its retracted position and brought to rest. An object of this invention is to provide improved means whereby this readily may be effected. To that end I have provided fluid actuated means for withdrawing the interference members 45 and 46 out of the path of the collar 44. Upon the bracket 48 I have secured a cylin-

der 77 having slidably fitted therein a piston 78 to which is connected a rod 79. This rod is also connected with the interference member 46 and therefore movement of the piston 78 will likewise effect movement of the interference member. Connected with the cylinder 77 intermediate the piston 78 and the interference member 46 is a pressure pipe 80 which, like the pipes 29 and 56 extend upwardly along the column 2, horizontally along the over-arm and downwardly through the casing 57 to the housing 59 where it connects through a port 81 with the cylindrical bore 62. Under normal conditions the port 81 is isolated from the fluid pressure entering the bore 62 through port 65 by the enlarged end 64^a of the valve piston 64, but when, in case of emergency, it is desired to discontinue the cycle of operation and return the head to its uppermost position the operator may, by pressing the push button 69, shift the valve 64 inwardly against the action of the spring 71 thereby permitting fluid under pressure to flow through port 65, about the reduced intermediate portion of the valve 64 and outwardly through port 81, and pipe 80 into the emergency release cylinder 77. This will move the piston 78 and rod 79 to the right as viewed in Fig. 3, against the action of a spring 83^x and will carry with it the interference member 46. As shown in Fig. 9 the interference members 45 and 46 are so connected together by a pin and slot connection 83—84 that this retraction of the member 46 also effects retraction of the member 45 whereby both interference members are moved out of the path of the collar 44 and the valve 42 is permitted rapidly to move to the dotted line position in Fig. 3 thereby effecting a rapid upward movement of the tool-head as hereinbefore explained. The pin and slot connection between the interference members is so arranged that retraction of the member 45 during normal operation of the machine does not affect the member 46.

Upon release of the push button 69 the spring 71 returns the valve piston 64 to the position shown in Fig. 6 thereby connecting the port 81 with an exhaust port 82 which leads into the casing 57 thereby permitting exhaust from the cylinder 77 when the piston 78 is subsequently moved to the left, (as viewed in Fig. 3) by the spring 83^x.

A feature of this invention resides in the location of the "start" and "stop" push buttons whereby they are both readily accessible to the operator when in his normal working position and also in the relative degree of accessibility of the two buttons. It is to be observed that I have so arranged the emergency stop button 69 that it projects beyond the starter button 68 whereby the former is more readily accessible than the latter. By means of this relative positioning of the buttons the operator may, in case of emergency, hur-

riedly depress the emergency stop button without confusion and without looking up from his work.

When the master valve piston 42 is in its uppermost position, as shown in dotted lines in Fig. 3, where it effects rapid upward movement of the pistons 21 and 22 (and thereby the tool-head 5) the port 39 is in communication with an exhaust port 84 in one end of the valve casing 37 and therefore the fluid in the upper ends of the cylinders 17 and 18 may be exhausted through the pipes 34, ports 39 and 84 and returned to the sump through a pipe 85 connected with the last named port. Likewise when the valve 42 is in its lowermost position wherein it effects rapid downward movement of the pistons and tool-head, the lower ends of the cylinders may exhaust through the pipes 33 port 41, through a central bore 42¹ in the valve piston 42 and then through port 84 and pipe 85 back to the sump.

To prevent the building up of excessive pressure in the pressure line 29 any suitable or preferred pressure relief line may be provided, such for example as that shown at 86 in Fig. 1.

In the modified form of the invention illustrated in Figs. 10 and 11 the valve piston 42 is adapted to be shifted to its lowermost position, (in which it effects a rapid downward traverse of the tool-head) by means of a hand lever 100. The return movement of the valve is effected by means of a coil spring 101 surrounding the valve rod 43 and interposed between a stationary lug 102 and a collar 103 secured upon the rod 43. In these views the parts which correspond to the parts hereinbefore described have been similarly numbered and they will be described only in so far as is necessary for an understanding of the modified valve shifting mechanism and emergency release. Bolted to the side of the column 2 is a supporting casting 104 which sustains the housing 47 for the interference members 45 and 46 and other mechanism later to be described. To this casting is secured one end of a forwardly projecting bracket 105 which has fulcrumed to it, at its free end by means of pivot pin 106, the lever 100. Journaled in a bearing 107 provided by the support 104, is a rock shaft 108 to which is secured at one end an arm 109 having a bifurcated end 109^x carrying pins 109^y which overlie a collar 110 fixed upon the rod 43. The opposite end of the rock shaft 108 carries a second arm 111 carrying a pin 112 projecting into a slot 113 formed in a link 114 pivoted at its forward end to the lever 100. The arms 111 and 109 form in effect a bell-crank lever, and a spring 115 attached to the former normally maintain the arms in the positions shown in Fig. 10 i. e. with the pin 112 in the innermost end of the slot 113. To set the valve piston 42 to its lowermost position thereby to initiate a cycle the

operator grasps the lever 100 and pulls it in the direction of the arrow *d*. This pulls forwardly on the link 114 and due to the engagement of the pin 112 with the end of the slot 113 swings the bellcrank lever 109-111 clockwise, as viewed in Fig. 10. This movement of the bell-crank causes the pins 109^y to engage the collar 110 on the rod 43 (which then is in its uppermost position), thereby depressing the rod 43 and valve 42 in opposition to the spring 101. As the collar 44 passes beyond the interference members 46 and 45, they snap into place in the path of the collar 44 thereby preventing its return under the action of the spring 101. During the descent of the tool-head the dogs 53 and 54 depress the interference members 45 and 46 as hereinbefore described and permit automatic shifting of the valve piston 42 thereby to effect slow down feed of the tool-head and then a rapid upward traverse thereof.

As hereinbefore explained it is sometimes desirable to interrupt the normal cycle of operation of the machine and quickly to retract the tool-head from the work and bring it to rest. With this modified construction this readily may be effected by manipulation of the starting lever 100 in a direction opposite to that in which it was moved to start the machine, or in the direction indicated by the arrow *e*. This movement of the lever 100 pushes the link 114 in the direction indicated by the arrow *f* and causes its rearward end 114^x to engage and rock an arm 116 fixed upon one end a short rock-shaft 117, journaled in a bearing 118 provided by the support 104. To the other end of the shaft 117 there is secured an arm 119 which carries a stud 120 engaging a head 121 formed on a rod 122 attached to the interference member 46. The interference members are connected together by a pin and slot connection as hereinbefore described and therefore retraction of the member 46 by the swinging of the lever 100 in the direction of the arrow *e* will likewise retract the interference member 45, thereby permitting the collar 44, rod 43 and valve piston to move under the influence of the spring 101 to a position wherein rapid upward traverse is effected.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equiva-

lents thereof, by Letters Patent of United States:—

1. In a machine of the character described, in combination, a frame; a member translat-
ably mounted thereon; hydraulic means to
translate said member on said frame in op-
posite directions and at a plurality of rates
in one direction; a valve adapted to control
the action of said hydraulic means; normally
inactive fluid pressure means adapted at cer-
tain times to act upon said valve to set it in
one position to effect translation of said mem-
ber in one direction; pressure means con-
stantly acting upon said valve tending to
move it to other positions in which it effects
translation of said member in another direc-
tion and at various rates; interference means
normally acting to prevent movement of said
valve under the influence of the last men-
tioned pressure means; and means, actuated
by the movement of said translatable mem-
ber successively, to render said interference
means ineffective thereby to effect a prede-
termined cycle of movement of said translat-
able member.

2. In a machine of the character described, in combination, a movable member; hydrau-
lic means to move said member in oppo-
site directions and at a plurality of rates in
one direction; a controlling valve for said hy-
draulic means, said valve including a shift-
able member having a plurality of operative
positions in each of which it effects a differ-
ent translation of said member; means act-
ing constantly on said shiftable valve mem-
ber tending to move it to one of its extreme
positions; and fluid pressure means acting in
opposition to said constantly acting means to
overcome the latter thereby to move said
shiftable valve member to its other extreme
position.

3. In a machine of the character described, in combination, a movable member; a hydrau-
lic transmission including a constant de-
livery pump and a hydraulic motor adapted
to translate said member; a valve to control
the action of said hydraulic transmission;
fluid pressure means, controlled by the move-
ment of said member, successively to move
said valve step-by-step to a plurality of po-
sitions in each of which it effects a different
rate or direction of translation of said mem-
ber in a predetermined cycle; and fluid pres-
sure means to reset said valve to initiate a
succeeding cycle.

4. In a machine of the character described; in combination, a frame; a member movable
thereon; hydraulic means to move said mem-
ber, said hydraulic means including a cylin-
der; a piston movable in said cylinder; an
operative connection between said piston and
said member; a fluid pressure line; conduits
connected with opposite ends of said cylinder;
a shiftable valve adapted in extreme positions
to connect said conduits with said pressure

line; a rod connected with said shiftable
valve; a differential piston on said rod; a
second cylinder within which the differen-
tial piston is slidingly mounted; a connection
from said fluid pressure line to said second
cylinder constantly maintaining fluid pres-
sure on that side of said differential piston
having the lesser area thereby tending to
shift said valve; automatically actuated in-
terference members controlling the move-
ment of said valve under the influence of the
fluid pressure on the differential piston; and
manually controlled means to admit fluid
pressure from said pressure line into said sec-
ond cylinder at the end of said differential
piston having the greater area thereby to
shift said piston and valve in opposition to
the pressure on the other end of said piston.

5. In a machine of the character described, in combination, a movable member; hydrau-
lic means to move said member; a shiftable
valve adapted to control the action of said
hydraulic means; means tending to shift said
valve through a plurality of operative posi-
tions; interference members acting to pre-
vent shifting of said valve; means, controlled
by the movement of said movable member,
successively to render said interference mem-
bers ineffective to prevent shifting of said
valve; and an emergency release for said
valve comprising fluid pressure means for
simultaneously rendering all of said inter-
ference members ineffective.

6. In a machine of the character described, in combination, a movable member; hydrau-
lic means to move said member; a shiftable
valve adapted in various positions to vary
the action of said hydraulic means; a rod
connected to said valve; fluid pressure means
acting on said rod to shift said valve; an
abutment shoulder on said rod; interference
members arranged in the path of said shoul-
der and preventing movement of said rod
and valve; means, controlled by the move-
ment of said head, successively and periodi-
cally to render said interference members in-
effective to prevent movement of said rod
and valve; and manually controlled fluid
pressure emergency means, operable during
a working cycle, simultaneously to move all
of said interference members out of the path
of said abutment, thereby to permit said
valve instantly to receive its complete move-
ment under the influence of the fluid pres-
sure means acting thereon.

7. In a machine of the character described, in combination, a movable member; hydrau-
lic means to move said member; a shiftable
valve adapted to control the action of said
hydraulic means; fluid pressure means tend-
ing to shift valve through a plurality of op-
erative positions; interference members act-
ing to prevent shifting of said valve; means
controlled by the movement of said movable
member successively to render said interfer-

ence members ineffective to prevent shifting of said valve; and an emergency release for said valve comprising a manually controlled fluid pressure means for simultaneously rendering all of said interference members ineffective.

8. In a machine of the character described, in combination, a movable member; a hydraulic transmission to translate said member; a valve to control the action of said hydraulic transmission; fluid pressure means, controlled by the movement of said member, successively to move said valve step-by-step to a plurality of positions in each of which it effects a different rate or direction of translation of said member in a predetermined cycle; fluid pressure means to reset said valve to initiate a succeeding cycle; a valve for controlling the last mentioned means; and a push button control for said last named valve.

9. In a machine of the character described, in combination, a translatable member; hydraulic means to move said member; a shiftable valve adapted to control the actions of said hydraulic means; means tending to shift said valve through a plurality of operative positions; interference members adapted to hold said valve in certain ones of its operative positions; means actuated by the movement of said translatable member successively to render said interference members ineffective, thereby to permit said valve to move to its next operative position; an emergency release for said valve comprising a cylinder; a piston movable in said cylinder; an operative connection between said piston and said interference members; a fluid conduit connected with said cylinder; a fluid pressure line; and a manually controlled valve adapted to admit fluid pressure from said line into said conduit, and thereby into said cylinder, to retract said piston and said interference members.

10. The combination set forth in claim 9 in which the emergency control valve is adapted to be actuated by a push button supported accessible to the operator when in his normal working position.

11. A machine tool combining a frame; a member translatable mounted thereon; hydraulic means to translate said member; a valve for controlling said hydraulic means; fluid pressure means to move said valve in one direction to initiate an operative cycle; means tending to shift said valve in the opposite direction to cause it to vary the action of said hydraulic means; a plurality of interference members adapted successively to arrest said valve in various operative positions; means operative upon movement of said member to cause interference members to release said valve; emergency means for simultaneously rendering all of said interference members ineffective to restrain said valve against movement; and independent

manually actuable means located readily accessible to the operator for controlling said fluid actuated means and for actuating said emergency means.

12. A machine tool combining a frame; a member translatable mounted on the frame; hydraulic means to translate said member; a valve connected with said hydraulic means and adapted to control the action thereof, said valve having two positions which effect oppositely directed movements of said member; means tending to move said valve to one of its positions; an interference member for preventing movement of said valve; means actuated by the movement of said member to render said interference member ineffective thereby to permit said valve to move to its other position; fluid-actuated valve resetting means; a fluid-actuated emergency release mechanism for said interference member; a fluid pressure line; fluid conduits extending to said resetting means and to said emergency release mechanism; and means selectively to connect said fluid pressure line with either said resetting means or said emergency release mechanism.

13. A machine tool combining a frame; a member translatable mounted thereon; hydraulic means to translate said member; a master valve adapted to control the action of said hydraulic means; a piston connected with said valve; a valve resetting cylinder within which the piston is located; means normally tending to move said valve; interference means to prevent movement of said valve; a fluid actuated piston adapted to render said interference means ineffective; a cylinder enclosing said last named piston; a tubular casing supported from said frame; a fluid pressure line located within said casing; two fluid delivery conduits located within said casing and extending to said valve resetting cylinder and to the cylinder containing said interference-means controlling piston respectively; a valve housing carried by said casing; a pair of valves in said housing; means to actuate one of said pair of valves to connect said pressure line with the conduit leading to the master valve resetting cylinder; and means to actuate the other of said pair of valves to connect said pressure line with the interference member retracting cylinder.

14. The combination set forth in claim 13 characterized by this that the pair of valves are normally kept closed and push buttons are connected with said valves to enable the operator to open them at will.

15. The combination set forth in claim 13 characterized by this that the pair of valves are normally kept closed; that push buttons are connected with the valves to enable the operator to open them at will, and that one of said buttons is more readily accessible than the other.

16. A machine tool combining a frame; a member translatable mounted thereon; fluid pressure means for translating said member, said fluid pressure means including a cylinder, supported by said frame a piston in said cylinder and operatively connected with said translatable member; a fluid pressure line connected with opposite ends of said cylinder; a master control valve for said fluid pressure means; fluid actuated means to shift said valve; a closed casing supported from said frame and having one portion extending to a position accessible to an operator when in his normal position; a fluid pressure line within said casing; a conduit within said casing and extending to the shifting means for said master control valve; a valve supported by the accessible end of said casing and adapted upon manipulation to admit fluid pressure from the pressure line in said casing into said conduit and to said master valve shifting means.

17. The combination set forth in claim 13, in which the actuating means for the pair of valves comprise push buttons connected with the valves and in which the push button connected with the valve which controls the flow of fluid to the means for rendering the interference means ineffective is more readily accessible to the operator than the button which controls the master valve resetting mechanism.

18. A machine tool combining a frame; a member translatable mounted thereon; a closed casing supported by said frame; fluid pressure means to translate said member; said means including a cylinder and a piston therein, one of which is connected with the frame, and the other of which is connected with the member; fluid pressure conduits connected with opposite ends of said cylinder; a source of fluid pressure; a master control valve interposed between said source of fluid pressure and said conduits and adapted by movement to control the flow of fluid from the former to the latter; fluid pressure means for shifting said valve; said means comprising a fluid pressure line in said closed casing; a conduit connected with said valve shifting means and extending into said casing; a valve supported by said casing and adapted to connect the pressure line in the casing with the conduit connected with the valve shifting means; and push button means to actuate the last named valve.

19. A machine tool combining a frame; a member translatable mounted on the frame; hydraulic means to translate said member; a master control valve for said hydraulic means; means normally tending to move said valve from one operative position to another; an interference member adapted to prevent movement of said valve; fluid pressure means to cause said interference member to release said valve thereby to permit

it to be moved from its initial position; fluid pressure means to reset said valve; a casing member depending from the upper end of said frame; a fluid pressure line within said casing; a valve housing supported by said casing; a fluid pressure chamber in said housing said chamber being connected with said fluid pressure line; fluid delivery conduits within said casing and connected with said valve resetting means and said releasing means; ports connecting said fluid pressure chamber with said conduits; auxiliary valves normally closing said ports; exhaust ports normally connecting said conduits with the interior of said casing; manual means to shift said valves to connect said pressure chamber with said conduits; means to return said auxiliary valves to their initial position to connect said conduits with said exhaust ports thereby to permit the fluid used to effect resetting of the master valve and to actuate said release to be exhausted into said casing.

20. The combination set forth in claim 19, in which the fluid pressure to actuate the head translating means, the valve resetting means and the means to move the interference member, thereby to permit movement of the master valve, is provided by a pressure pump which draws liquid from a suitable sump and in which the casing member which supports the auxiliary valves is connected with the sump by a suitable drain, thereby to return to the sump the fluid exhausted into the casing.

In witness whereof, I have hereunto subscribed my name.

ROBERT M. GALLOWAY.