

July 7, 1959

C. L. HODGSON ET AL

2,893,270

DRILLING MACHINE

Filed Dec. 9, 1957

6 Sheets-Sheet 1

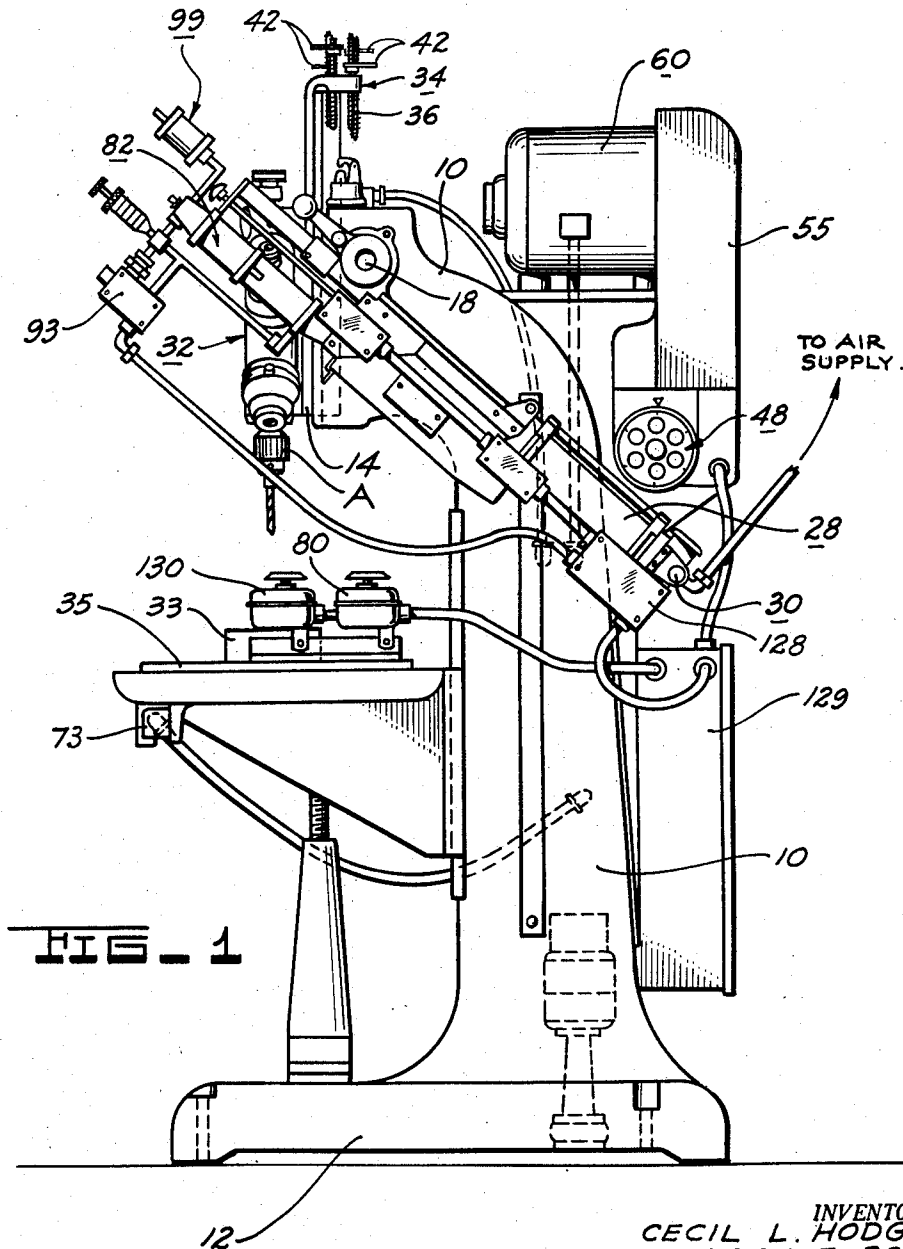


FIG. 1

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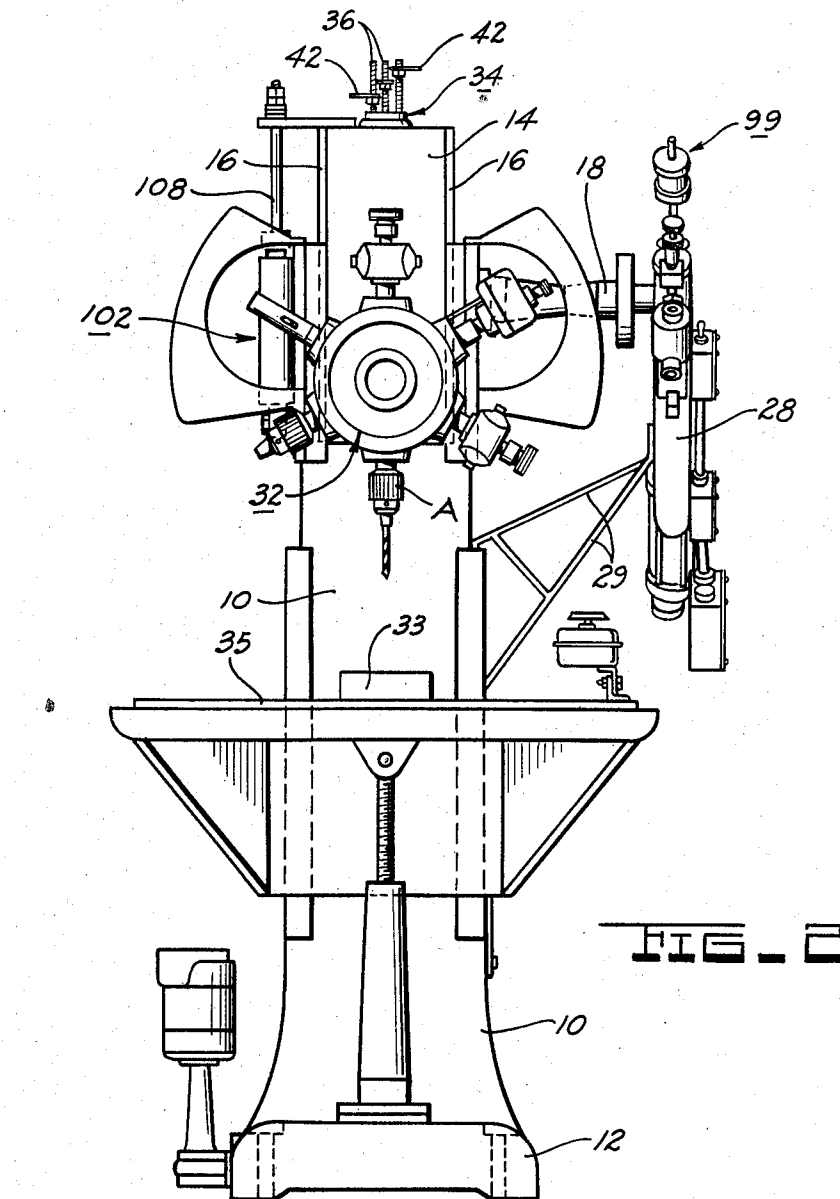
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6 Sheets-Sheet 2



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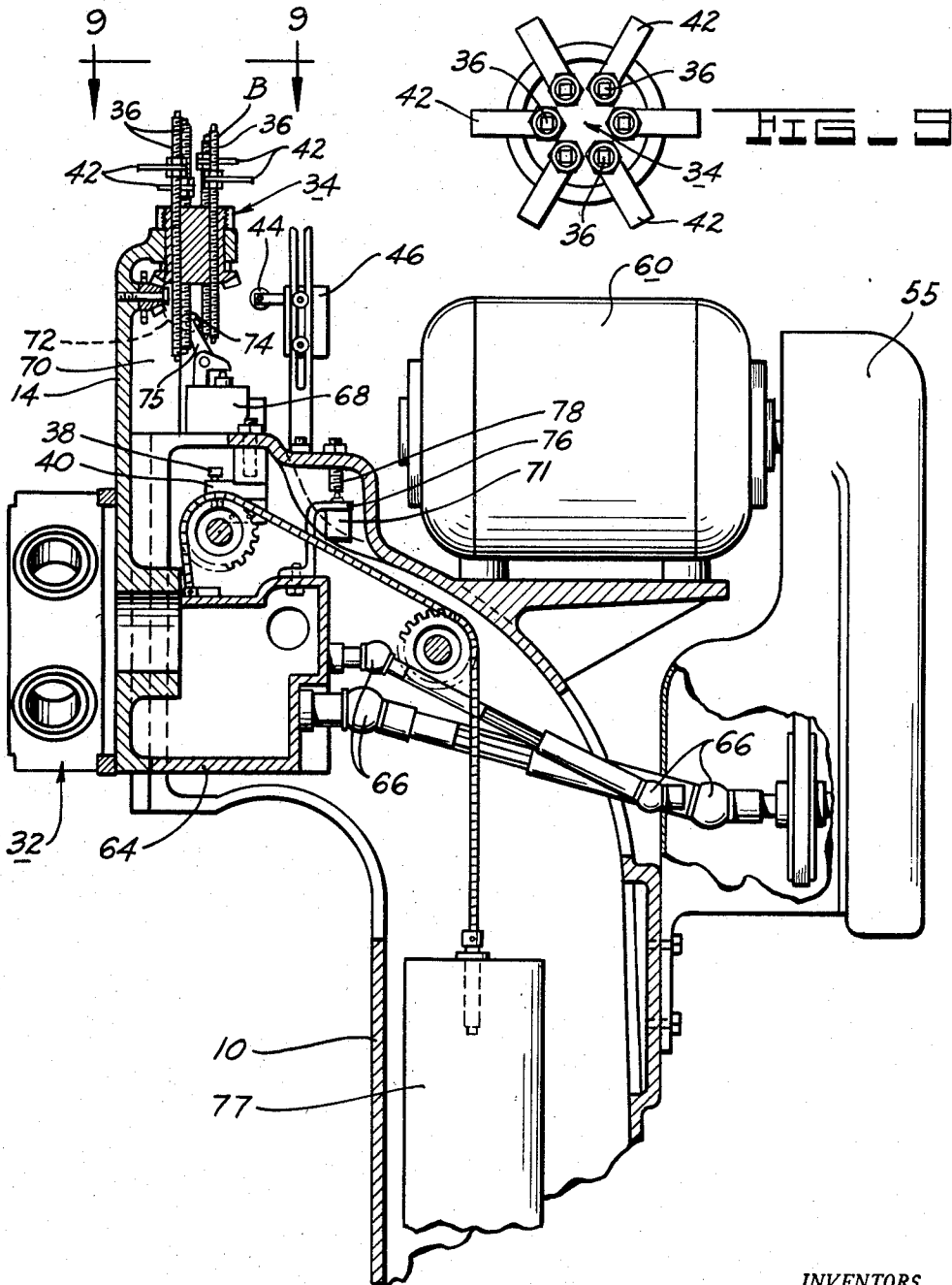
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6 Sheets-Sheet 3



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6 Sheets-Sheet 4

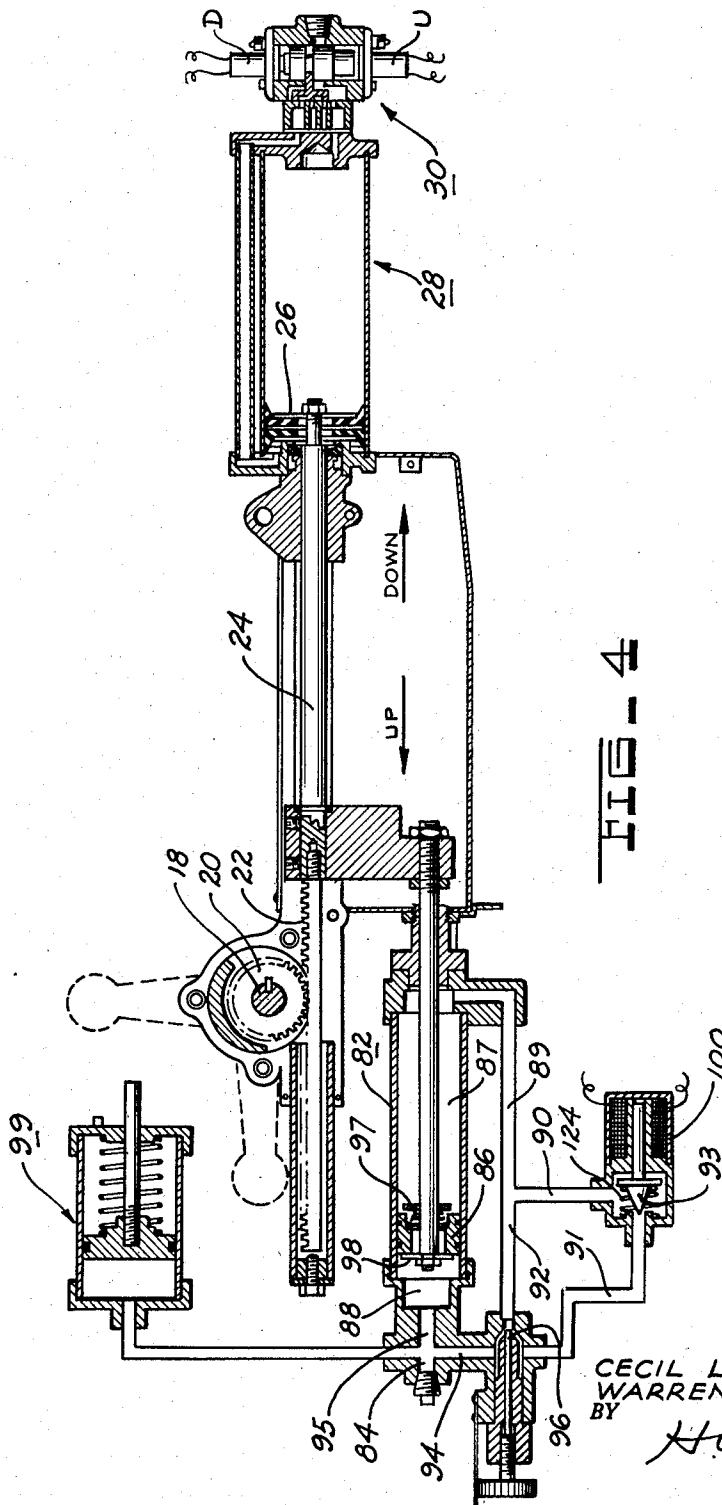


FIG. 4

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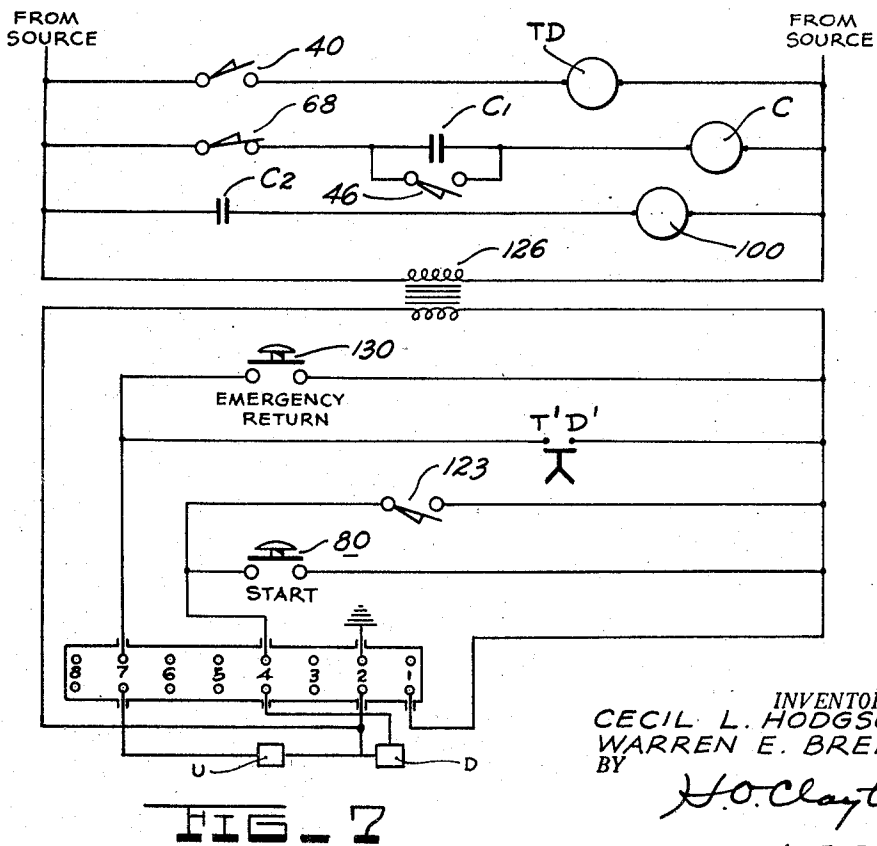
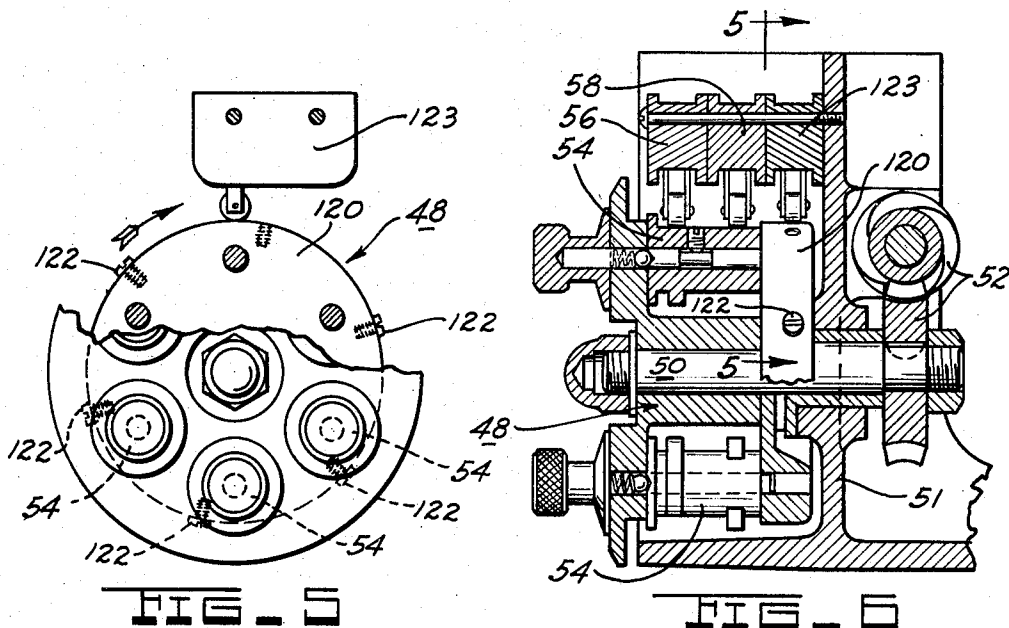
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6 Sheets-Sheet 5



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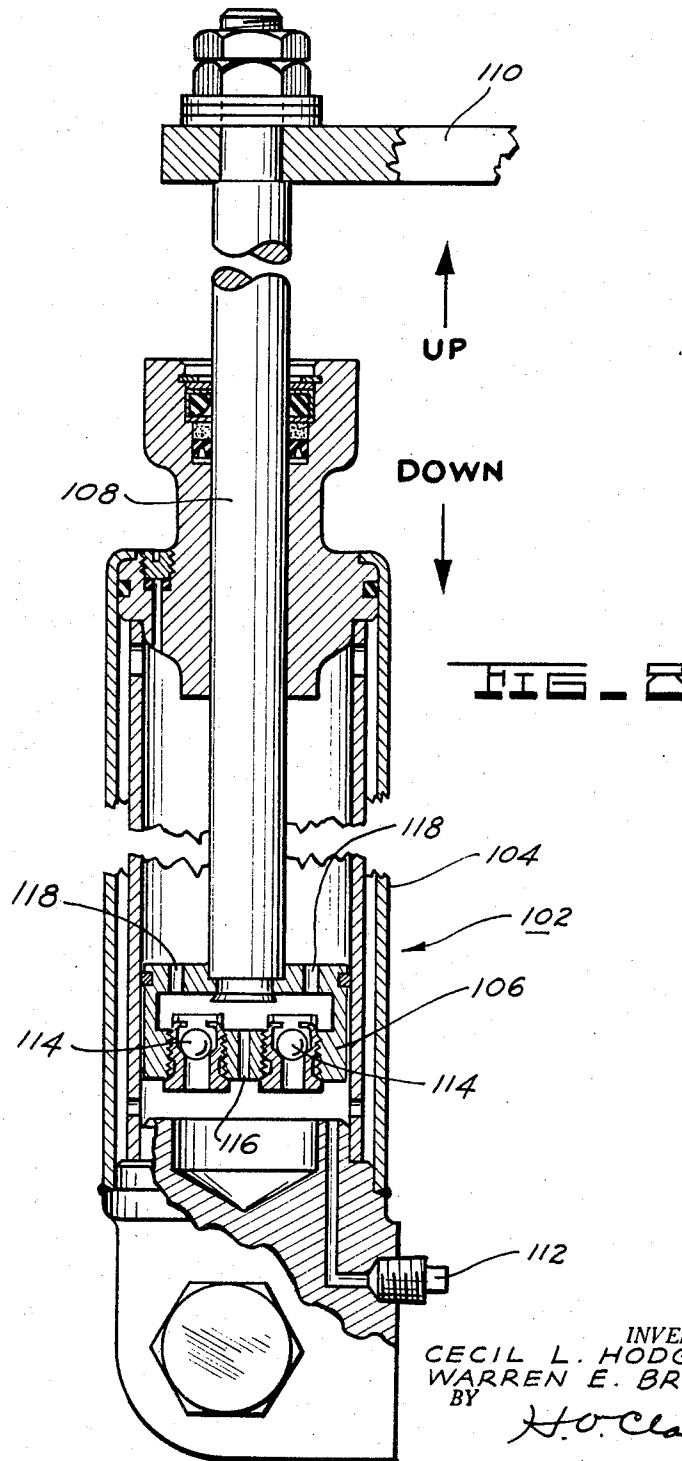
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DRILLING MACHINE

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6 Sheets-Sheet 6



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2,893,270

DRILLING MACHINE

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Application December 9, 1957, Serial No. 701,534

3 Claims. (Cl. 77—25)

This invention relates in general to a turret type drill press and more particularly to power means for automatically operating such a press.

The turret type drill press of the day, having a plurality of tool holding devices mounted on the spindles of its turret head, is usually manually operated requiring the several successive operations of manually rotating a wheel to perform the operations of the mechanism. Our invention is directed to power means for automatically performing these operations thereby eliminating a manual operation of the mechanism.

One of the principal objects of our invention is to provide automatically operable power means for operating a normally manually operated turret type drill press, no claim to which is made per se, the structure of the drill press being supplemented and only slightly modified to make this power operation possible; and it is a further object of our invention to so construct and control this power means that the same will closely simulate a manual operation of the drill press mechanism.

Yet another object of our invention is to include, in the aforementioned power means, (1) means for, at will, stopping the operation of the drill press mechanism at any station in its cycle of operation or at the end of a cycle of operations, (2) means for, at will, interrupting a down operation of the turret head of said mechanism before a cutting operation has been initiated and immediately thereafter retract said turret head to its starting position and (3) means for effecting a multi-stage down operation of the turret head with a pause at the end of said operation, followed by a relatively slow-up operation of said head.

A further object of our invention is to combine, with a turret type drill press mechanism including a turret head and power means for indexing parts of the mechanism and driving the tools mounted on said head, power means, including a fluid pressure operated motor, for effecting a four stage operation of the mechanism for each of the cutting operations, each of said stage operations including the successive steps of effecting (1) a first stage relatively fast down movement of the turret head with its cutting tool toward the work to be cut, (2) a second relatively slow stage of downward movement of said head, (3) a pause in the bodily movement of the head while the cutting tool does its so-called clean-up work, and lastly an upward cushioned movement of the head back to its starting position.

Other objects of the invention and desirable details of construction of parts will become apparent from the following detailed description of certain illustrative embodiments of the invention, taken in conjunction with the accompanying drawings illustrating said embodiments, in which:

Figure 1 is a side elevation of the automatically operable turret type drill press mechanism of our invention;

Figure 2 is a front elevation of the mechanism of Figure 1;

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Figure 3 is a view, largely in section, disclosing the slidable ram of the mechanism together with some of the controls of said mechanism;

Figure 4 is a sectional view disclosing details of the ram operating fluid pressure motor together with the check means for effecting a two-stage down operation of said motor;

Figure 5 is a front view, taken on the line 5—5 of Figure 6, of the speed control drum, parts being broken away to disclose a portion of one of the controls for effecting a down operation of the ram;

Figure 6 is a sectional view disclosing details of the speed control drum of Figure 5 and the control for, in part, effecting the down operation of the ram;

Figure 7 discloses the electrical hookup of the electrical controls of our invention;

Figure 8 is a sectional view disclosing details of the hydraulic check unit for cushioning the up movement of the ram; and

Figure 9 is a view, taken on the line 9—9 of Figure 3, disclosing details of the switch operating means, mounted on the depth stop drum, for effecting the second stage operation of the ram operating fluid pressure motor.

There is disclosed in the several figures of the drawings a preferred embodiment of our drill press mechanism. Referring to Figures 1, 2 and 3 a column 10, having a base portion 12 resting on the floor, serves as a support for a movable ram 14 having dovetail ways 16 fitting within a head portion of the column. The ram traverses this head portion, moving up and down in the operation of the drill press; and these movements are effected by a fluid pressure motor operated connecting means including a rack and pinion mechanism, not shown, located behind the face of the ram, Figure 2, said mechanism being drivably connected to a shaft 18. To this shaft there is connected a pinion 20, Figure 4, meshed with a rack 22 connected to a rod 24. This rod is connected to the piston 26 of a double acting fluid pressure motor 28 the power fluid for operating the piston being preferably compressed air. The motor 28 and its associated parts, including control means therefor, are mounted on the column 10 by a bracket 29, Figure 2. This motor is controlled by any well known type of solenoid operated four-way valve 30 which is operative to admit the compressed air to one end of the motor, the other end of the motor being at the same time vented to the atmosphere via the valve 30. Thus with an energization of the motor 28 the ram is moved by the two rack and pinion mechanisms either up or down to traverse the head of the column 10.

As is disclosed in Figures 1, 2 and 3 a turret head 32, which is indexed by mechanism not shown, is mounted on the ram 14 to be bodily movable therewith, said head serving as a mounting for rotatable spindles upon which are mounted the desired cutting tools disclosed in Figure 2. The operator threads whatever holding device he requires onto the spindle nose; for example, he may use a tapping head, Morse taper sleeve, or drill chuck. The cutting tools are, of course, mounted in the desired sequence depending upon the operations to be performed and the spindle speeds available at each station. The work to be processed is indicated by the reference numeral 33, Figure 2, and rests upon a work table 35 secured to the column 10 and adjustable as to its height above the floor.

A so-called depth stop drum 34, Figure 3, mounted on the upper end of the ram 14 houses a plurality of depth stop screws 36 of different lengths. These screws, which are adjustably mounted in the drum 34, are equal in number to the number of tools mounted on the turret head there being one stop for each tool. With a downward movement of the ram as the tool is performing its cutting operation the particular stop screw associated with

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the tool then working strikes a yieldable stop member 38, Figure 3, mounted on the column 10; and this operation serves to limit the depth of the cutting operation. The contacting of the stop member by the stop screw also serves to close a switch 40 constituting part of the electrical control means of our invention. Plate members 42, adjustably mounted on the upper ends of the screws 36, serve, with a downward movement of the ram, to strike a switch operating roller 44; and this operation serves to momentarily close a normally open switch 46 which is also a part of the electrical controls of our invention. As is disclosed in Figure 3 the switch 46 is adjustably mounted on a support secured to the column 10. The operation of the switches 40 and 46 of our invention and the remainder of the electrical controls will be referred to hereinafter.

One of these electrical controls is disclosed in Figures 1, 5 and 6 and includes a so-called speed control drum 48 drivably connected to a shaft 50, Figure 6. This shaft is driven by a worm and gear mechanism 52 drivably connected to the indexing mechanism, not shown, of the drill mechanism. The shaft 50 is rotatably mounted in a support member 51 preferably mounted on a transmission case 55. Selectively adjustable switch operating cam members 54 rotatably mounted on the drum 48 serve, one at a time and depending upon the indexed position of the drum, to close switch 56 and 58 constituting part of the electrical controls of the power means for driving the spindles of the turret head and indexing the turret head 32, the depth stop drum 34, and the speed control drum 48. The switches 56 and 58 are, as is disclosed in Figure 6, mounted on the support 51. This power means includes a motor 60, Figure 3, the transmission case 55 housing a plurality of electric clutches and other force transmitting means and further includes a gear case 64 mounted on the ram and housing both the indexing means and a plurality of gears. These gears are connected with mechanism within the case 55 by universal joints 66, and the power means also includes means connecting the indexing means with the turret head and drums 34 and 48, and means interconnecting the gears in the case 64 with the spindles to be driven.

The switches 56 and 58, depending upon the speed controlling setting of the manually adjustable cam members 54, cooperate with the other controls to determine the speed of the selected turret spindle being operated; and the electrical controls also include two spaced apart normally closed switches 68, Figure 3, only one of which is shown. These switches 68 are mounted on the column 10 on its left and right sides and are positioned opposite reinforcing ribs 70 on the edges of the rams. Only one of these ribs 70 is shown in Figure 3. When the ram is traversed to its uppermost position, a position it has reached in Figure 3, a roller 74, constituting part of a switch operating lever mechanism 75, is positioned at the base of a cam-like portion 72 of the upper end of the rib 70; and during the first part of the downward movement of the ram as the two rollers move along the cams 72, the switches 68 are closed and remain closed for the remainder of said downward movement. One of the two switches 68 controls the speed of certain electric clutches in the case 55 with the ram in its completely up position; and the other of said switches 68 controls (1) the speed of the motor 60 when the ram is in its up position, and (2) the stage operation of the fluid pressure motor 28. The latter control function will be described hereinafter.

Completing the description of the principal features of the turret drill press disclosed herein a switch 71, mounted on a bracket 76 secured to the gear case 64, is closed, by contacting a stop 78 mounted on the column 10, just before the ram reaches its uppermost position; and this operation serves to initiate an operation of the index mechanism, not shown, to index the turret head 32, depth stop drum 34 and speed control drum 48. The turret

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32 and drum 34 complete their indexing operations a fraction of a second before the drum 48 completes its operation.

As stated above our invention lies in the means for automatically operating the above described drill press mechanism, that is in the means for automatically operating the shaft 18 to simulate a manual operation thereof; and it is presumed that a better understanding of the invention may be had if such a manual operation is described here. In this manual operation after a starter switch 80, Figure 1, is closed to initiate the operation of the power operated driving and indexing mechanism, the attendant, by the operation of the usual wheel-like member, not shown, secured to the shaft 18, moves the ram 14 downwardly to effect the cutting operation of the work on the table 35. As referred to above in this operation the first increment of movement of the ram results in a closure of the two switches 68 the same co-operating with the then preselected settings of the switches 56 and 58, Figure 6 to determine the particular speed of the selected tool to be placed in operation. As to this preselected setting of the switches 56 and 58 it is to be remembered that the manually operated setting of the cams 54 determines the setting of said switches which in turn determines the cutting speed of the tool then working.

Continuing the description of a manual operation of the mechanism the attendant, after completing the cutting operation during which he usually pauses a short period of time to effect what is known as a clean-up operation of the cutting tool, rotates the hand wheel to move the turret head upwardly. In the latter operation the turret head and drums 34 and 48 are indexed just before the ram reaches the end of its up stroke. The aforementioned cutting operation is then repeated until all of the cutting operations are completed thereby completing the cycle of operation of the drill press.

Describing now the operation of the mechanism constituting our invention, and incidentally describing parts of said mechanism not heretofore described, the closure of the switch 73, Figure 1, results in initiating the operation of the driving and indexing mechanism. At this time the ram 14 with its turret head 32 and depth stop drum 34 are positioned in their extreme up position disclosed in Figure 3; and the spindle speed control drum 48 is positioned as disclosed in Figures 5 and 6, the switches 56 and 58 having been preselected by the uppermost of the manually adjustable cams 54 shown in Figure 6. A drill chuck A, Figure 2, is at the time positioned immediately above and in line with the work piece 33; and the depth stop drum 34 is positioned so that a stop screw B, Figure 3, will cooperate with the stop 38 to determine the depth of the cut to be made by the cutting tool in said chuck.

The attendant will then close a starter switch 80, Figures 1 and 7, thereby, as is disclosed in Figure 7, energizing a solenoid D, Figure 4, of the valve 30; and this operation results in an energization of the motor 28 to move the ram 14 downwardly. In this operation, as with the manual operation described above, the normally closed switches 68 are closed during the first increment of movement of the ram; and this results in the rotation of the spindle at the desired speed. When the motor 28 is energized to effect its down operation a first and relatively long first stage of movement of its piston 26 is effected by means of a double ended, double acting hydraulic check unit 82, Figure 4. Describing this operation, oil in the unit 82, inserted through a filler opening 84, is forced, by the piston 86 of the unit, from a chamber 87 to a chamber 88 via conduits 89, 90, 91, and 92. The conduits 90 and 91 are interconnected by a solenoid and spring operated valve 93; and the conduit 91 is connected to ducts 94 and 95 in the casing of the check unit 82 by means of a manually adjustable bleed valve 96. In the aforementioned first stage operation the

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oil flows rather freely around the body of said valve. A check valve 97 mounted in the piston 86 permits a relatively free flow of oil from the chamber 88 to the chamber 87 via a spider-like thrust member 98 when the motor 28 is energized to move the ram to its up position. The down operation of the ram is steadied by a weight 77 secured to the casing member 64 by the chain and sprocket mechanism disclosed in Figure 3.

Now when the downwardly moving ram with its turret head moves down sufficiently for the plate 42 on the screw B to contact the roller 44, Figure 3 the normally open switch 46 is momentarily closed thereby energizing a coil C, Figure 7, of a feed relay; and this operation results in a closure of relay switches C¹ and C². The closure of switch C¹ operates to hold in the relay coil C it being remembered that the switch 68 is at the time closed; and the closure of the switch C² results in the energization of a solenoid 100, Figure 4, to close the valve 93. This operation results in the initiation of a so-called second stage operation of the motor 28; for the closure of the valve 93 results in a relatively slow bleed of oil from the chamber 87 via the bleed valve 96 only. There is thus effected, by the two-stage motor 28 a relatively fast and then a relatively slow downward movement of the ram. A spring loaded piston within an oil reservoir 99 provides means for maintaining the chamber 88 of the hydraulic check unit 82 full of oil at all times.

The cutting tool probably does its work cutting operation during the aforementioned second stage movement of the ram; and when said ram has reached the limit of its travel, determined by the adjustable screw B contacting the stop 38, the normally open switch 40 is closed thereby initiating the control of the up operation of the mechanism. The closure of switch 40 results in an energization of a time-delay relay-coil TD, Figure 7, and after a relatively short period of time, during which the cutting tool performs its clean up operation, a switch TD¹ is closed. The latter operation results in the energization of a solenoid U of the valve 30 thereby energizing the motor 28 to move the ram upwardly. This operation is in one stage however at a relatively slow rate the movement being cushioned by a hydraulic check unit 102, Figure 8, no claim to which is made. As to the structure of this unit a casing 104 houses a piston 106 connected by a rod 108 to a plate 110 secured to the top of the ram. A fill tube 112 provides a means for filling the unit with a suitable oil. In the upward movement of the ram check valves 114 close and said movement is held to a relatively slow rate by virtue of the bleed of oil through a relatively small opening 116 in the piston 106. The downward movement of the ram is not checked by the unit 102 inasmuch as oil is free to flow through relatively large openings 118 in the piston and through the then open check valves 114.

Continuing the description of the up movement of the ram 14 the switch 71, Figure 3, is closed when said ram reaches a position say about three-eighths of an inch from its uppermost position; and this operation results in the indexing of the turret head and drums 34 and 48 to prepare for another of the six cutting operations of the embodiment of our invention disclosed in Figure 2. Referring to Figures 5 and 6 there is disclosed switch means of our invention for controlling the down operation of the motor 28. A disk 120 sleeved on the shaft 50 and abutting the drum 48 is provided with spaced apart switch actuating screws 122 detachably mounted in its peripheral edge portion. As the drum is indexed, an operation just described, a screw 122 operates to momentarily close a switch 123, mounted on the support 51 in abutment with the switch 58, to operate the valve 30 to effect another down operation of the motor 28. It is to be remembered however that the turret head and drum 34 have completed their indexing operations just before the switch 123 is closed; and an inspection of

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Figure 5 will disclose that the clockwise rotation of the drum 48 serves to move the cam 54 to close the switches 56 and 58. As is disclosed in Figure 5 the screws 122 are positioned so that the switch 123 is only momentarily closed. This closure operation is however long enough to effect an operation of the valve 30. It is to be further noted from an inspection of Figure 5 that there is no screw 122 at the top of the drum 48 in said figure thereby providing a control which completes the cycle of automatic operations after the last of the six tools has done its work. The attendant may, of course, selectively omit one or more of said screws, to effect the desired operation of the mechanism, it being necessary, with the omission of the screw of a certain station operation, to manually close the switch 80 to initiate the operation at that station.

The setting up of the mechanism for the next tool operation is thus completed during the final three-eighths inch up movement of the ram the switch 68 controlling the coil C being opened during this increment of movement; and the opening of this switch results in the de-energization of the solenoid 100 thereby permitting a spring 124, Figure 4, to open the valve 93.

Completing the description of the electrical controls of our invention a transformer 126 provides the necessary relatively low voltage electrical current to the lower half of the controls disclosed in Figure 7, terminal boxes 128 and 129, Figure 1, provide a suitable housing for electrical controls, and a manually operated switch 130, Figure 7, provides control means for, at the will of the attendant, interrupting the down movement of the ram and returning the same with its turret head to its start, that is up position.

There is thus provided by our invention a relatively simple and easily serviced means for rendering a normally manually operated turret type drill press mechanism automatic in operation. With the mechanism of our invention there are four stages of bodily movement of a spindle, the two stages of movement on its down stroke, the so-called tool clean-up pause controlled by the time delay relay TD, and the cushioned up movement. Preferably, as is disclosed in the embodiment of our invention disclosed in Figure 5, the automatic cycle of operations is completed with the sixth indexing operation thus enabling the attendant to change the work piece 33 operated upon and, if desired, to change the setting of the tools on the turret head. With the mechanism of our invention one attendant can handle a plurality of machines; furthermore he may, by removing the proper switch actuating screw 122, stop the cycle of operations at a particular station; and he may, by removing a certain screw 122 and with a manual operation of the start switch 80, miss a certain station in the cycle of operations.

While the preferred embodiment of the invention has been described in considerable detail, we do not wish to be limited to the particular construction shown which may be varied within the scope of the invention, and it is the intention to cover hereby all adaptations, modifications and arrangements thereof which come within the practices of those skilled in the art to which the invention relates.

We claim:

1. The combination, with a turret type drill press mechanism comprising a fixedly mounted column, a ram slidably mounted on said column, a tool mounting indexible turret head mounted on said ram and bodily movable therewith, a plurality of cutting tools mounted on the turret head, an indexible stop means mounted on the ram and bodily movable therewith, power means for indexing the stop means and turret head and for driving the tools mounted on said head, and means, including control means indexible by said power means, for controlling said power means; of power means for effecting four stages of operation of the ram with its turret

head, that is a downward bodily movement thereof in two stages, a pause in said bodily movement while a tool mounted on the turret head is performing its cutting operation, and lastly an upward movement of the ram and turret head, said latter power means including a switch operating member mounted on the indexible control means and operable, with an operation of said means, to close a switch to effect a ram down operation of the four stage power means, and further including a switch actuated by the stop means to effect a ram up operation of the four stage power means, and also including control means, actuated by means mounted on the stop means, to effect the second stage operation ram down of the power means.

2. The combination, with a turret type drill press mechanism comprising a fixedly mounted column, a ram slidably mounted on said column, a tool mounting indexible turret head mounted on said ram and bodily movable therewith, a plurality of cutting tools mounted on the turret head, an indexible stop means, including a stop member for each tool, mounted on the ram and bodily movable therewith, power means for indexing the stop means and turret head and for driving the tools mounted on said head, and means, including control means indexible by said power means, for controlling said power means; of power means for effecting four stages of operation of the ram, that is a downward bodily movement thereof in two stages, a pause in said bodily movement while a tool mounted on the turret head is performing its cutting operation, and lastly an upward movement of the ram, said latter power means including control means mounted on the indexible control means and further including control means comprising a stop member operated switch unit for controlling the upward movement of the ram and control means, comprising a normally open switch for controlling the two stage downward operation of the ram, actuated by means mounted on the stop means.

3. The combination, with a turret type drill press mechanism comprising a fixedly mounted column, a ram slidably mounted on said column, a tool mounting indexible turret head mounted on said ram and bodily movable therewith, a plurality of cutting tools mounted on the turret head, an indexible stop means, including a relatively long cylindrically shaped stop member for each tool, mounted on the ram and bodily movable therewith, power means for indexing the stop means and turret head and for driving the tools mounted on said head, and means, including control means indexible by said power means, for controlling said power means; of power means for effecting four stages of operation of the ram and turret head unit, that is a downward bodily movement thereof in two stages, a pause in said bodily movement while a tool mounted on the turret head of the unit is performing its cutting operation, and lastly an upward movement of the units, said latter power means including control means mounted on the indexible control means and operable to control the downward movement of the ram, and further including switch means actuated by the several stop members and operable to control the upward movement of the ram, switch means actuated by means mounted on the stop means and operable to control the stage operating downward movement of the ram, and a normally closed switch mounted on the column actuated by a portion of the ram and operable to control the downward movement of the ram.

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