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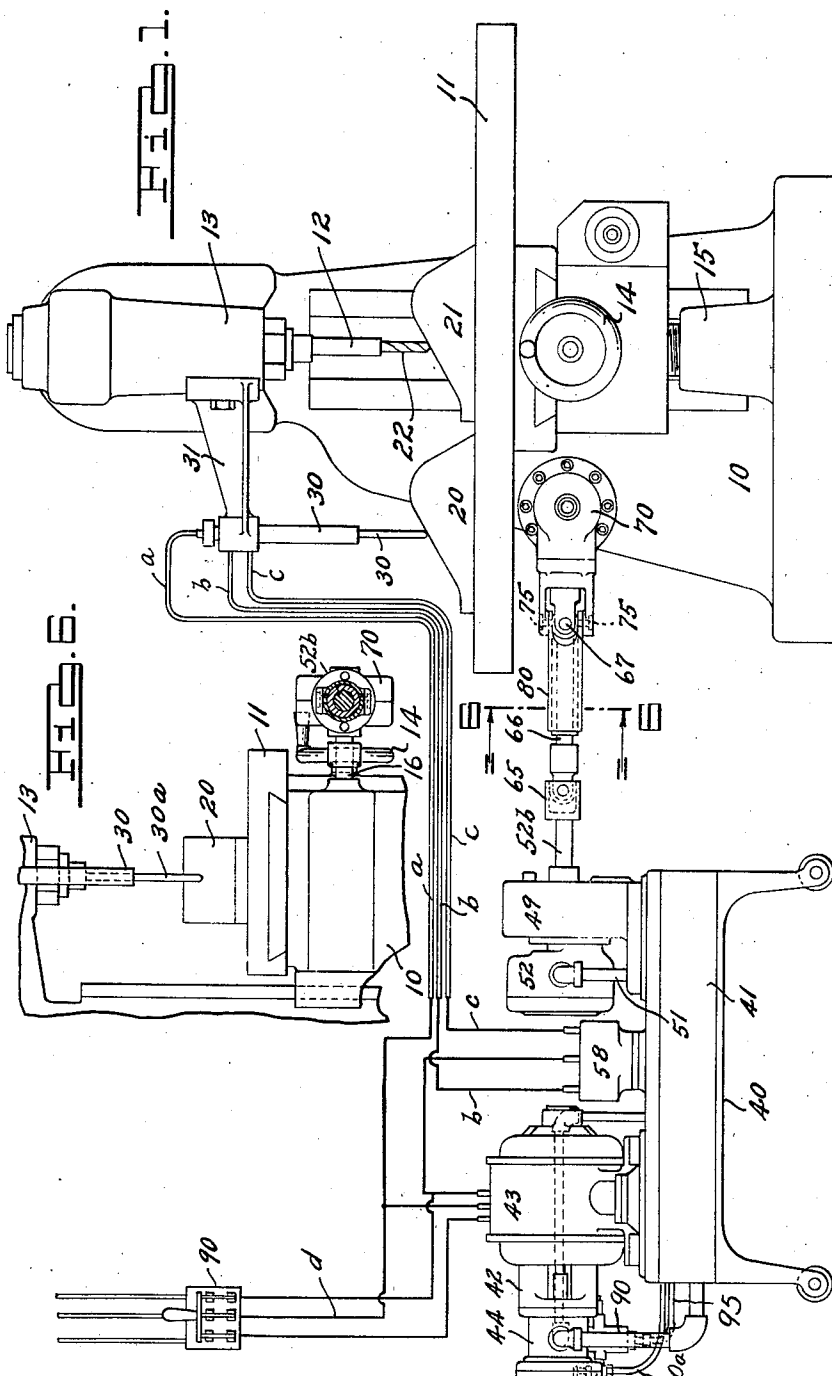
O. E. ROSEN

2,138,208

DUPLICATING MACHINE

Filed April 21, 1937

3 Sheets-Sheet 1



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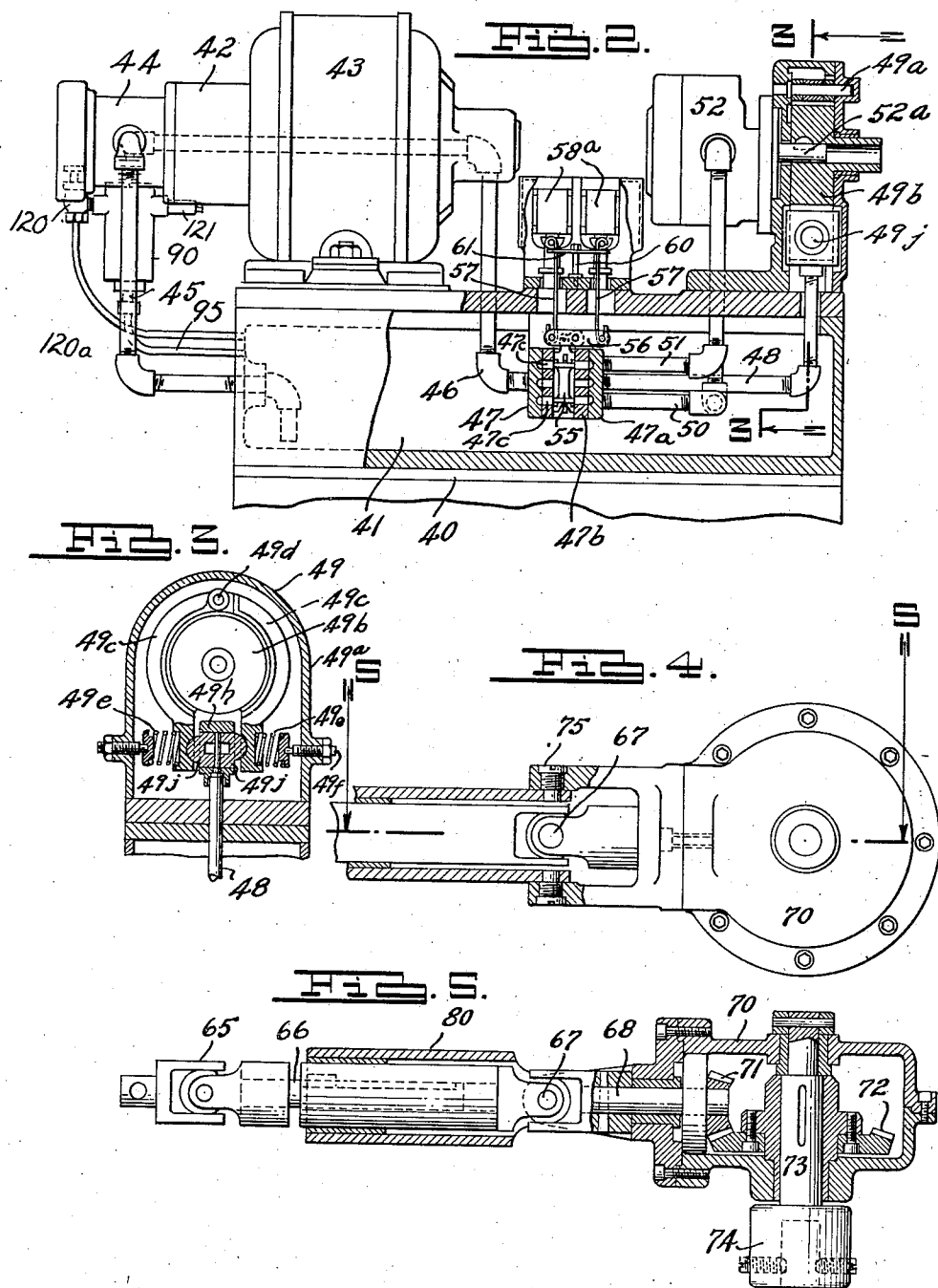
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3 Sheets-Sheet 2



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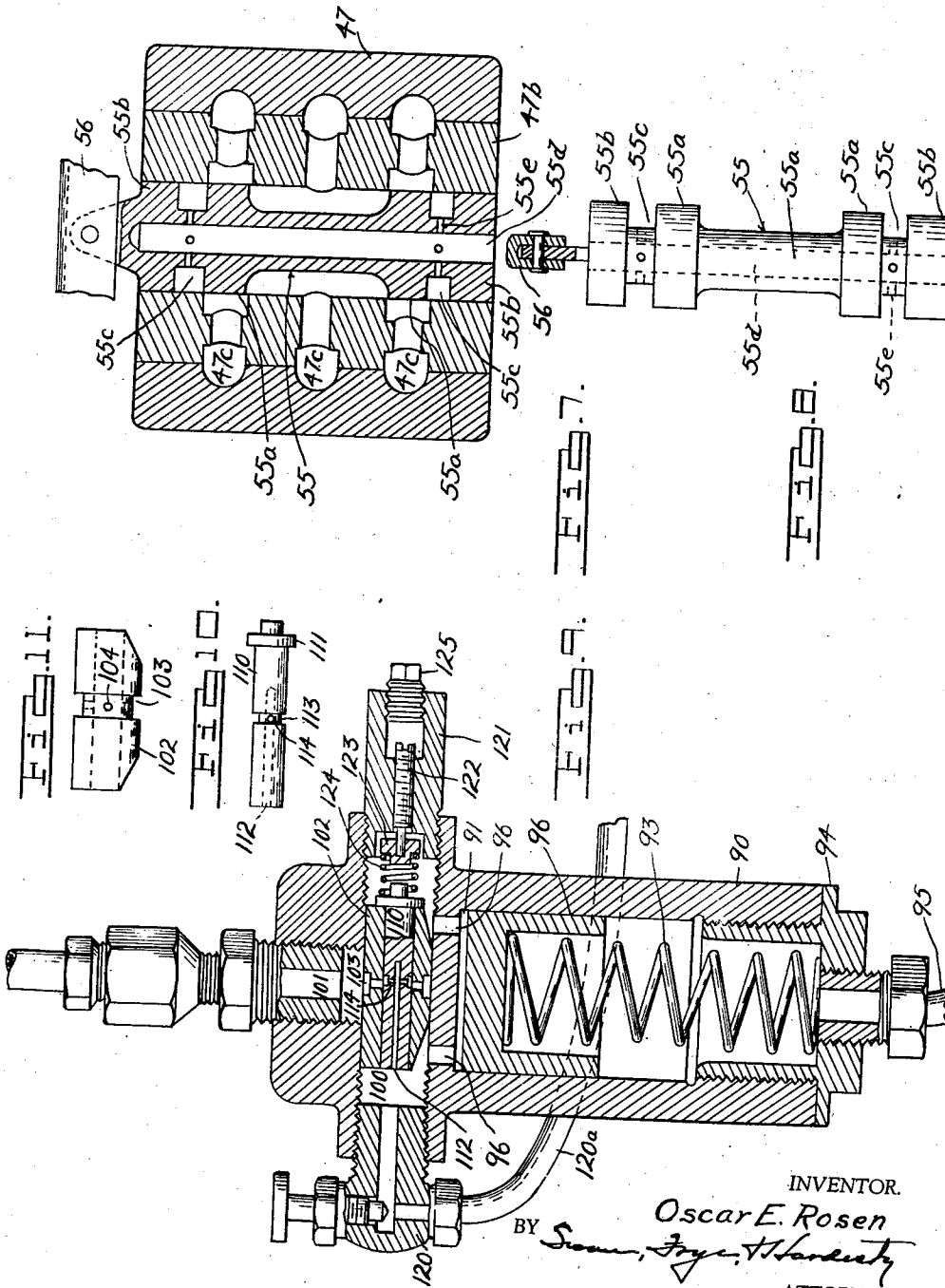
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UNITED STATES PATENT OFFICE

2,138,208

DUPLICATING MACHINE

Oscar E. Rosen, Detroit, Mich.

Application April 21, 1937, Serial No. 138,140

9 Claims. (Cl. 90—13.5)

The present invention relates to profiling machines or machines for reproducing contours, and has among its objects a machine of this type which is simple, efficient and long lived.

5 Another object is a machine of the character indicated which involves an operating unit easily and quickly attached to substantially any cutting or boring machine of either the vertical or horizontal type.

10 Another object is an operating unit which though itself of small size, will efficiently operate a great range of sizes of such cutting machines.

Still other objects will readily occur to those skilled in the art upon reference to the following specification and the accompanying drawings, in which

Figure 1 is a view in elevation of a vertical spindle type of boring machine with the operating unit attached.

Figure 2 is a longitudinal partially sectional view of the operating unit upon a somewhat larger scale.

Figure 3 is a section on line 3—3 of Figure 2.

Figure 4 is a partial sectional view of the driving connection, and

Figure 5 is a section on line 5—5 of Figure 4.

Figure 6 is a section on line 6—6 of Figure 1.

Figure 7 is an enlarged sectional view of the valve means for controlling direction of operation.

Figure 8 is an elevation of the valve plunger.

Figure 9 is a central vertical section of the pressure control means.

Figures 10 and 11 are perspective views of details of the latter.

In the drawings, in Figure 1 is shown a cutting machine of the vertical spindle type having the usual base 10 supporting a horizontally and vertically movable work table 11, and having the tool carrying spindle 12 rotatably mounted in the upper portion 13 of the machine. Mounted within the supporting portion of the machine are the usual driving means for the spindle 12 and the usual feed means for moving the work table automatically. Such machines are usually provided with means for disconnecting the automatic feed or work table moving means and with shafts extending to the outside to permit hand feed when desired, such a hand operable means is indicated by the hand wheel 14 for moving the table forward and backward.

In such machines, there is also provided means for elevating and lowering the work table and such means is indicated at 15 as a screw jack,

operable either by power means or by hand from a suitable shaft 16 extending to the outside to which the operating unit is attached.

In making use of such a machine, for the present purpose, a suitable pattern 20 is fixed to the table 11, and a block of material 21, preferably roughly shaped, is also fixed to the table and a suitable cutter 22 fixed in the spindle 12.

With this arrangement, the automatic vertical feed is disconnected and the hand vertical feed shaft is used in conjunction with the operating unit as indicated above, the longitudinal movement of the table 11 carrying the work 21 and pattern being caused in the usual manner, and, as the longitudinal movement takes place, the operating unit provides for the necessary vertical movement of the work to cause the cutter to reproduce the profile of the pattern 20 on the work piece 21. With each longitudinal cut, the table may be moved forward and its longitudinal movement reversed either by hand or suitable automatic means.

The operation of the operating unit to move the table up or down in accordance with the profile of the pattern will be controlled by a suitable tracer 30 carried upon an arm 31 mounted upon the cutting machine, and having the same relation to cutter 22 as the pattern 20 has to work 21. This tracer may be of any suitable construction, but is preferably of the form shown in my co-pending application, Serial No. 82,362, filed May 28th, 1936, and consists of a housing having mounted therein a projecting pointer 30a capable of slight vertical movement and in such movement assuming a neutral position or moving to one side or the other of the neutral position and therein completing one or the other of two electric circuits.

These two circuits include controls in the operating unit and cause the latter to move table 11 up or down according to whichever circuit is completed.

The operating unit is shown to the left of Figure 1 and more in detail in Figure 2. It consists, as shown, of several elements mounted upon a wheeled base 40 which includes a tank 41, the cover of which serves as a table for the elements now to be described.

As seen best in Figure 2, the elements referred to are, first, a motor-pump unit 42, the motor 43 being directly connected to a pump 44, arranged to draw liquid, preferably a suitable oil, from tank 41 through conduit 45 and deliver it under high pressure through conduit 46 to valve housing 47. From the valve housing the liquid is

either spilled back into tank 41 or forced through conduit 48 to the brake element 49 and through one or the other of conduits 50 and 51 to the hydraulic motor 52, the particular conduit being determined by the position of the valve 55 in housing 47.

This valve assembly comprises a housing 47 which is generally cylindrical with a vertical axial passage receiving valve 55. The housing 47 is preferably of a suitable casting 47a, having a hardened and ground liner 47b, with three circumferential chambers 47c formed in the inner wall. These chambers 47c communicate with the conduits 46, 48, 50, and 51—conduits 46 and 48 being connected to the middle chamber 47c and conduits 50 and 51 being connected to the lower and upper chambers respectively.

The valve member 55 is spool shaped as shown and provided with flanges having their outer peripheries of a width slightly less than the width of a chamber 47c and so spaced that, when in neutral position as shown in Figure 2, fluid from conduit 46 flowing into the middle chamber 47c passes from the valve 55 to both upper and lower chambers 47c and on out of the housing at the top and bottom, without materially raising the pressure in the middle chamber.

When, however, the valve 55 is lifted or lowered a short distance, flow is cut off from the middle chamber to one of the others and likewise prevented from flowing out of the ends of the housing. When the valve 55 is lifted, flow into conduits 51 and 48 is permitted and flow into conduit 50 is prevented. The reverse action takes place when the valve is lowered.

The valve assembly 47 to 55 is shown enlarged in Figures 7 and 8 but without the conduit or solenoid connections. In these figures the plunger 55 is shown more in detail and is shown as having the valve flanges 55a and guide flanges 55b with a circumferential channel 55c between each valve flange and its adjacent guide flange. Further, the plunger is bored axially as at 55d, the bore extending entirely through and being open at both ends, is provided with passages 55e connecting the channels 55c with the axial bore 55d. With this construction, when the hydraulic fluid is discharged from either the upper or lower passage 47c, it may flow freely through both ends of passage 55d, and thus there is no unbalanced reaction tending to interfere with the free movement of the plunger. When the valve 55 is moved from its neutral position, for example, lifted, pressure builds up in conduit 48 and acts upon the brake in element 49 to release the latter and allow fluid entering conduit 51 to flow to and actuate the hydraulic motor 52 in one direction, the fluid flowing out of motor 52 through conduit 50 and spilling back into tank 41 from the lower end of housing 47. As soon, however, as the valve 55 is returned to neutral position, pressure drops in conduits 51 and 42 and the brake in element 49 immediately stops motor 52.

As will be seen from Figure 2, the valve 55 is supported upon a lever 56 pivoted at its center upon the valve housing 47 and connected at its ends to links 57, each of which in turn is connected to one of the armatures of a pair of solenoids 58 so arranged that energization of either will lift its end of the lever 56. Since the valve 55 is connected to the lever at one side of its fulcrum, one of the solenoids will raise the valve when energized and the other will depress or lower it.

In order to maintain the valve accurately in

its neutral position when neither solenoid is energized, a post 60 is placed upon the base plate between links 57 and a flat spring 61 fixed thereon. This spring extends laterally under the armatures of the solenoids and is so formed as to equalize their positions but permit the action of either one when energized.

The brake element 49, shown in section in Figure 3, consists of a housing 49a enclosing a drum 49b around which is a brake comprising two shoes 49c pivoted and strongly anchored at 49d. The free ends of shoes 49c are normally pressed toward each other, and made to grip the drum 49b by springs 49e adjustable in their pressure by suitable screws 49f.

The free ends of shoes 49c are spaced apart and between them is positioned a small cylinder 49h connected to conduit 48 and containing two oppositely acting pistons 49j arranged to thrust against the ends of the brake shoes and spread them apart to release the brake when the pressure in conduit 48 exceeds that of springs 49e.

The brake device as shown in Figures 2 and 3 may be modified by omitting the pressure cylinder release means connected through conduit 48 and the brake operated as a continuously acting friction means.

The drum 49b is shown as the connecting element between motor 52 and its shaft 52a and the drive shaft 52b connected to the cutting machine.

In view of the fact that the operating unit is arranged to be portable, it is desirable to be able to connect it to a cutting machine without the necessity of exact alignment. This is accomplished by providing suitable universal joints in the drive shaft between the brake element 49 and the machine. Such an arrangement is shown best in Figures 1, 4 and 5.

In these figures the shaft 52b is shown as rather short and connected through a universal joint 65 to another shaft section 66 and this, through a second universal joint 67 to a third shaft section 68, the latter being mounted in suitable bearings in a gear housing 70 and fixed to a bevel gear 71 acting on a suitable ring gear 72 keyed to a short shaft 73 and carrying means 74 by means of which it may be connected to the proper feed shaft 16 of the cutting machine.

The housing 70 is provided with an extension bearing sleeve 80 extending along shaft section 66 in order to take the reaction when torque is applied to the shaft 52b. This sleeve is hinged as at 75 on an axis perpendicular to the axis of shaft 73 and at some distance therefrom.

As mentioned above, the action of the operating unit will be governed by a suitable tracer 30 having three current leads, a, b, c, attached thereto, the lead a, for example, being attached to the one conductor d of a three phase wiring system while leads b and c each lead to one of the solenoids 58a. The other ends of the windings of solenoids 58a will also be connected to the conductor d.

When, therefore, the main switch 90 is closed, movement of the tracer point 30a in either direction from a central neutral position will energize the corresponding solenoid 58a and thereby cause actuation of motor 52 in a corresponding direction.

Because of the high pressure developed by the pump 44 when the valve 55 is moved to direct the fluid into either of the upper or lower conduits 47c, it is desirable to relieve such pressure temporarily so as to smooth out the operation.

For this purpose the device indicated at 90 is tapped into the high pressure line. This device is a pressure chamber resembling to some extent the pressure chamber used on pulsating pumps, but its action is controlled to render it active only momentarily.

The construction of the device is shown best in Figures 9 to 11 which show it to consist of a pressure chamber 91, cylindrical in form and bored to receive a piston 92 backed by a strong spring 93. The lower end of the chamber is closed by a screw plug 94 provided with a drain 95 leading back to the main reservoir any liquid which may leak by the piston.

The upper end of the chamber 91 is closed except for two passages 96 which connect it with a cross passage or chamber 100 into which also opens centrally the fluid inlet 101 connected in suitable fashion to the high pressure line 46. Fixed in the cross passage 100 is a sleeve 102 of the form shown in Figure 11. This is, as shown, provided with a circumferential groove 103 communicating through a plurality of openings 104 with the axial opening in the sleeve. The sleeve is also beveled at both ends as shown at 105 so as not to interfere with the passages 96.

Slidably fitted in the sleeve 102 is a valve member 110 consisting of a plunger, flanged at one end, as at 111, to act as a stop and axially bored as at 112 for approximately one-half its length from the other end. This plunger 110 is likewise circumferentially grooved, as at 113, with the groove in communication with the bore 112 through a plurality of openings 114. The length of the plunger and location of the groove 115 is such that, when the plunger is all the way in against the stop flange 111, the groove is opposite the passages 104 in the sleeve 102, and the groove 113 open to inlet 101.

One end of cross passage 100 is closed by a regulable valve 120 and the other end by a plug 121 bored and threaded axially to receive an adjusting screw 122 carrying at its inner end a pad 123 between which and the flanged end of a plunger 110 is a suitable spring 124 tending to hold the plunger in the sleeve against the stop flange 111. The outer end of the axial bore in plug 121 is preferably counterbored and closed by a suitable plug 125.

With this device tapped into the high pressure line, when the pressure builds up in the line due to the movement of the valve plunger 55, fluid starts to flow into chamber 91, through inlet 101, the grooves 103 and 113, passage 112, chamber 100 and one of the openings 96. However, a quick flow thus started, out of passage 112 in plunger 110 produces a reaction on this member, thrusts it backward against spring 124 and cuts down the flow. By providing openings from chamber 91 to both ends of the cross passage 100, pressure on the ends of plunger 110 is equalized and no unbalanced resistance to its movement is present.

The valve 120 is provided for the purpose of further regulating the action of the pressure fluid. When the valve is opened and a small proportion of the fluid allowed to flow out through conduit 120a back to the reservoir, the action of the fluid upon the motor 52 is further retarded.

What I claim is:

1. A tracer controlled operating unit for a feed screw of a cutting machine comprising a motor adapted to be continuously operated, a shaft adapted to be operated in either a forward or reverse direction or alternately and connected

to a feed screw, hydraulic power transmission means connecting the motor and shaft and means controlled by said tracer for determining the direction and continuance of said power transmission.

2. A tracer controlled operating unit for a feed screw of a cutting machine comprising a motor adapted to be continuously operated, a fluid pump directly connected thereto, a reversible fluid motor actuable by fluid from said pump, valve means movable to determine the direction of actuation of said fluid motor and containing by-pass means to permit non-operation of the latter, said fluid motor being connected to said feed screw to actuate the same, and tracer controlled means to determine the condition of said valve means and thereby the actuation and direction of said screw.

3. A tracer controlled operating unit for a feed screw of a cutting machine comprising a motor adapted to be continuously operated, a fluid pump directly connected thereto, a reversible fluid motor actuable by fluid from said pump, valve means movable to determine the direction of actuation of said fluid motor and containing by-pass means to permit non-operation of the latter, said fluid motor being connected to said feed screw to actuate the same, and brake means associated with said fluid motor and feed screw.

4. A tracer controlled operating unit for a feed screw of a cutting machine comprising a motor adapted to be continuously operated, a fluid pump directly connected thereto, a reversible fluid motor actuable by fluid from said pump, valve means movable to determine the direction of actuation of said fluid motor and containing by-pass means to permit non-operation of the latter, said fluid motor being connected to said feed screw to actuate the same, and brake means operatively associated with said feed screw and said valve means and releasable only during actuation of said fluid motor.

5. A tracer controlled operating unit for a feed screw of a cutting machine comprising a motor adapted to be continuously operated, a fluid pump directly connected thereto, a reversible fluid motor actuable by fluid from said pump, a chambered member into which said pump delivers fluid under pressure and from which said fluid is delivered to said fluid motor, valve means in said member movable to any one of the three positions in one of which fluid may exhaust from said member and in the others of which fluid is directed to said fluid motor, a brake releasable by fluid pressure also connected to said member and to which fluid is supplied only when said valve is in either of said other positions, and tracer controlled means for moving said valve means.

6. In a tracer controlled operating unit such as set forth in claim 1, means for momentarily relieving the pressure in said transmission means when the controlling means directs shaft operation.

7. In a tracer controlled operating unit such as is set forth in claim 2, means for momentarily relieving the pressure in the pump fluid output when said valve is changed from by-pass condition to shaft operating condition.

8. In a tracer controlled operating unit such as is set forth in claim 3, means for momentarily relieving the pressure in the pump fluid output when said valve is changed from by-pass condition to shaft operating condition.

9. A tracer controlled operating unit for a feed

screw of a cutting machine comprising a motor adapted to be continuously operated, a fluid pump directly connected thereto, a reversible fluid motor actuable by fluid from said pump,
5 valve means movable to determine the direction of actuation of said fluid motor, said fluid motor

being connected to said feed screw to actuate the same, and tracer controlled means to determine the condition of said valve means and thereby the actuation and direction of said screw.

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