Dec. 26, 1950 R. E. PRICE 2,535,550

FEED MECHANISM

Filed Feb. 18, 1949

Fig 1

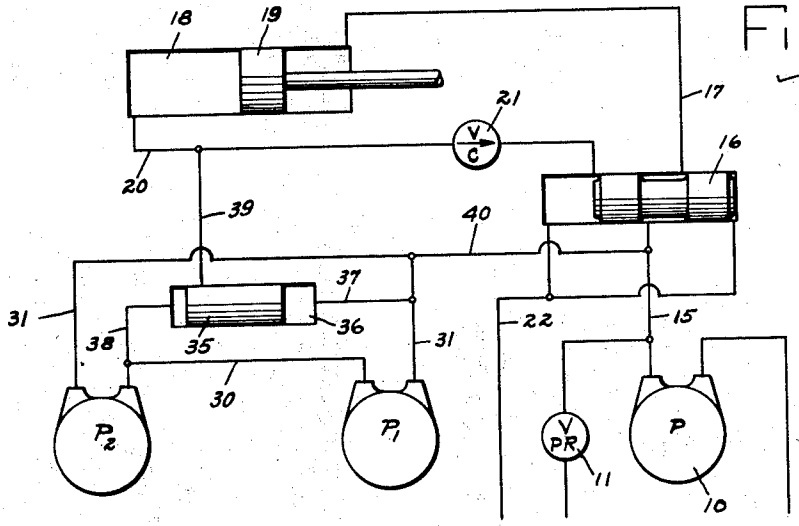
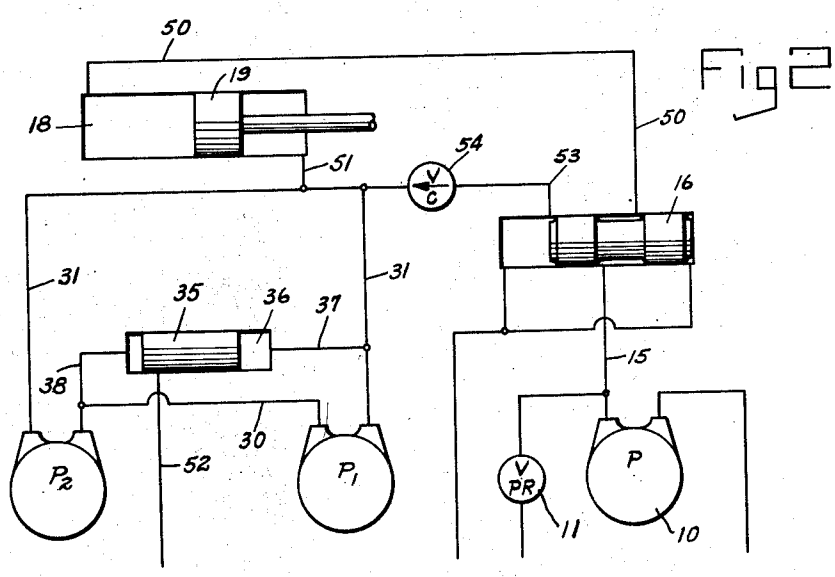


Fig 2



Inventor

RALPH E. PRICE

By

Hugh L. H. Rocke

Attorney

Patented Dec. 26, 1950 2,535,550

UNITED STATES PATENT OFFICE

2,535,550

FEED MECHANISM

Ralph E. Price, Highfield, Md., assignor to Landis Tool Company, Waynesboro, Pa.

Application February 18, 1949, Serial No. 77,218

6 Claims. (Cl. 60—52)

1

This invention relates to feed mechanisms for machine tools, particularly grinding machines. It relates more particularly to the operation of such mechanisms for that portion of a feed movement which occurs during the actual grinding operation.

These feed movements are often as slow as .00005" per second. The accuracy of the grinding operation is therefore dependent on a uniform and accurately controlled feed movement. In order to accomplish this, it is necessary to have a uniform delivery of oil to the feed mechanism.

In previous feed mechanisms, two factors have interfered with satisfactory operation of the feed mechanism: (1) variation in fluid delivery due to variation of viscosity caused by changes in temperature of the fluid and (2) variation in fluid delivery due to variation of pressure in the system. Where a slow feed is required such as that described above, the volume of fluid involved is very small. Leakage through even close clearances between running parts of a pump account for a large percentage of this volume.

It is, therefore, an object of this invention to overcome these obstacles and thus provide a feed mechanism which will be a decided improvement over apparatus now in use.

It is a further object to provide a delivery of oil to the feed mechanism which will be less affected by temperature or pressure in the system.

It is a further object to provide a differential pump circuit subject to uniform pressure throughout and thus eliminate leakage in the circuit.

A further object is to provide a constant flow of fluid in said circuit regardless of variation in viscosity of the fluid or fluctuations of pressure required to operate the feed.

The term "differential pumps" as used herein means pumps differing slightly in output and connected in series so that the smaller pump pumps from the larger to the extent of its capacity. The remaining fluid, which is the difference in output of the two pumps, is directed to the feed mechanism.

Figure 1 shows the invention as applied to control of the flow of fluid to one end of said cylinder.

Figure 2 shows the invention as applied to the control of the exhaust fluid from one end of the feed cylinder.

In Figure 1, fluid under pressure from a suitable tank or reservoir is supplied by pump 10 to which is connected a relief valve 11. Fluid under pressure from said pump passes through line 15 to reversing valve 16 which in the position shown directs said fluid through line 17 to the rod end of cylinder 18 to cause piston 19 to move to the left. Exhaust fluid is discharged from the head end of cylinder 18 through line 20, check valve

2

21, reversing valve 16 and exhaust line 22. To move piston 19 in the opposite direction, valve 16 is shifted to the left to connect line 17 with exhaust. Fluid from line 15 cannot pass through line 20 because of check valve 21. Fluid for moving piston 19 to the right is supplied by pump 10 at a pressure determined by the setting of relief valve 11 and at a rate determined by the capacities of differential pumps P1 and P2.

The output of P1 is slightly greater than that of P2. Fluid from P1 passes through line 30 to the inlet side of P2. Fluid from P2 passes through line 31 to the inlet side of P1.

A balancing valve consisting of valve piston 35 having equal areas at opposite ends thereof is slidably mounted in cylinder 36. One end of said cylinder is connected through line 37 to line 31. The other end of said cylinder is connected through line 38 to line 30. Adjacent the end of cylinder 36 to which line 38 is connected is a discharge passage 39 leading to line 20 and the head end of cylinder 18. Fluid under pressure is supplied to this metering pump circuit from line 15 through line 40 to line 31.

In operation, P2 pumps from P1 to the extent of its capacity. The excess fluid passes through line 38 to shift valve 35 to uncover passage 39 and permit the flow of fluid to the head end of cylinder 18.

Since the input of P1 and the output of P2 are connected together and to constant pressure and since the output of P1 and the intake of P2 are connected together and to the end of the balancing valve by line 38 which reflects the pressure of the opposite end of valve 36 which is connected by line 37 to constant pressure line 31, the input and output of both pumps P1 and P2 are all subject to equal pressure. The only difference in pressure anywhere in the circuit is that required to cause flow of the oil. Leakage from pressure drop with the variables encountered due to varying pressures and viscosities is therefore minimized. With these variables reduced to a minimum, the fluid supplied to the feed mechanism is substantially the exact difference in output of the two pumps. The result of this arrangement is to provide a substantially uniform feed at extremely slow speed.

In Figure 2 the same elements are utilized, but the circuit is somewhat different. Fluid under pressure is supplied by pump 10 through line 15 to reversing valve 16 from which it is directed through line 50 to the head end of cylinder 18 to cause piston 19 to move to the right. Exhaust fluid from the rod end of cylinder 18 passes through line 51 to the metering pump circuit. The rate of flow of said exhaust fluid into the metering pump circuit is the same as the discharge from said circuit through line 38, balancing valve 35 and exhaust passage 52.

When valve 16 is shifted to the left, it directs fluid under pressure from line 15 through line 53, check valve 54 and line 51 to the rod end of cylinder 13 to reset the feed mechanism by shifting piston 19 to the left. At the same time fluid under pressure from the same source enters the metering pump circuit through line 31 to replace the fluid discharged from balancing valve 35.

Thus, the metering pump circuit may be applied as a unit to any feed mechanism either to control the supply of fluid during the feed movement or to control the exhaust during said feed movement. In one case, the discharge from the balancing valve is the fluid supplied for driving the piston. In the other case, the rate of discharge from the balancing valve to a sump determines the rate of exhaust from cylinder 18 during the feed movement. In both cases, the metering pump circuit is maintained under a constant pressure through a connection with pump 10. Since the circuit is closed and maintained under constant pressure, leakage ceases to be a critical factor in its functioning. The balancing valve 35 permits a discharge of a fixed volume of fluid under all conditions, and thus variation in viscosity has no effect on the delivery of fluid for actuating the feed mechanism.

I claim:

1. A feed mechanism for a machine tool comprising a piston and cylinder, one of which is attached to the part to be moved, a supply of fluid under pressure for causing relative movement between said piston and cylinder including a reversing valve for directing said fluid alternately to opposite ends of said cylinder, means for controlling the rate of said relative movement during a feeding operation including differential metering pumps connected in a circuit in which fluid lines connect the outlet of each pump with the inlet of the other, a connection between said circuit and said supply of fluid under pressure, a balancing valve including a piston and cylinder having equal areas at each end a connection from one end of said valve to one of said lines, a connection from the other end of said valve to the other line, and connections between said balancing valve and one end of said feed cylinder for conducting a volume of fluid equal to the difference in output of said pumps.

2. A feed mechanism for a machine tool comprising a piston and cylinder, one of which is attached to the part to be moved, a supply of fluid under pressure for causing relative movement between said piston and cylinder including a reversing valve for directing said fluid alternately to opposite ends of said cylinder, means for controlling the rate of said relative movement during a feeding operation including differential metering pumps connected in a circuit in which fluid lines connect the outlet of each pump with the inlet of the other, a connection from said circuit to said fluid supply and to said feed cylinder, a balancing valve connected in parallel with said pumps, and connections between said pumps and one end of said feed cylinder including said balancing valve for controlling the flow of exhaust fluid from said cylinder.

3. A feed mechanism for a machine tool comprising a piston and cylinder, one of which is attached to the part to be moved, a supply of fluid under pressure for causing relative movement between said piston and cylinder including a reversing valve for directing said fluid alternately to opposite ends of said cylinder, means for controlling the rate of said relative movement

during a feeding operation including differential metering pumps connected in a circuit in which fluid lines connect the outlet of each pump with the end of the other, a connection from said circuit to said fluid supply and to said feed cylinder, a balancing valve connected in parallel with said pumps, and connections between said pumps and one end of said feed cylinder including said balancing valve for directing fluid under pressure to said cylinder.

4. A feed mechanism for a machine tool comprising a piston and cylinder, one of which is attached to the part to be moved, a supply of fluid under pressure for causing relative movement between said piston and cylinder including a reversing valve for directing said fluid alternately to opposite ends of said cylinder, means for controlling the rate of said relative movement during a feeding operation including differential metering pumps in a circuit in which fluid lines connect the outlet of each pump with the inlet of the other, a connection from said circuit to said fluid supply, a balancing valve connected in parallel with said pumps for maintaining a substantially uniform pressure in said circuit and for discharging a volume of fluid equal to the differential output of said pumps and connections between said pump circuit and said feed cylinder.

5. A feed mechanism for a machine tool comprising a piston and cylinder, one of which is attached to the part to be moved, a supply of fluid under pressure for causing relative movement between said piston and cylinder, including a reversing valve for directing said fluid alternately to opposite ends of said cylinder, means for controlling the rate of said relative movement during a feeding operation including differential metering pumps connected in a circuit in which fluid lines connect the outlet of each pump with the inlet of the other, a connection from said circuit to said fluid supply and to said feed cylinder, a balancing valve in said circuit for maintaining substantially equal pressures in all parts of said circuit.

6. A feed mechanism for a machine tool comprising a piston and cylinder, one of which is attached to the part to be moved, a supply of fluid under pressure for causing relative movement between said piston and cylinder, including a reversing valve for directing said fluid alternately to opposite ends of said cylinder, means for controlling the rate of said relative movement during a feeding operation including differential metering pumps connected in a circuit in which fluid lines connect the outlet of each pump with the inlet of the other, a connection between said circuit and said supply of fluid under pressure, a balancing valve connected in said circuit in parallel with said pump for maintaining equal pressures in said fluid lines, whereby the fluid from said fluid supply is metered exactly in accordance with the capacities of said differential pumps.

RALPH E. PRICE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,835,977	Ernst et al.	Dec. 8, 1931
1,835,979	Ernst et al.	Dec. 8, 1931
2,042,247	Blood	May 26, 1936