Dec. 12, 1933. H. ERNST 1,938,758

SPINDLE OSCILLATOR

Filed May 13, 1929 2 Sheets-Sheet 1

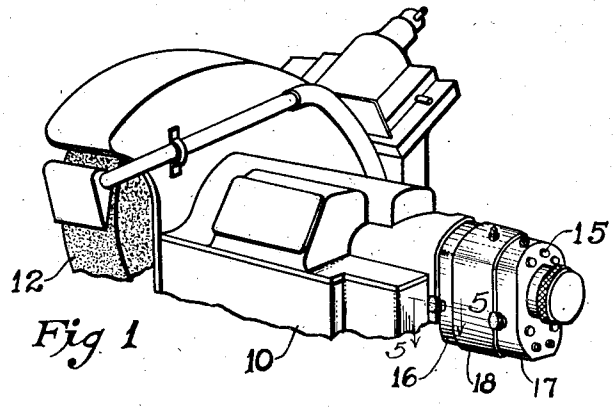


Fig 1

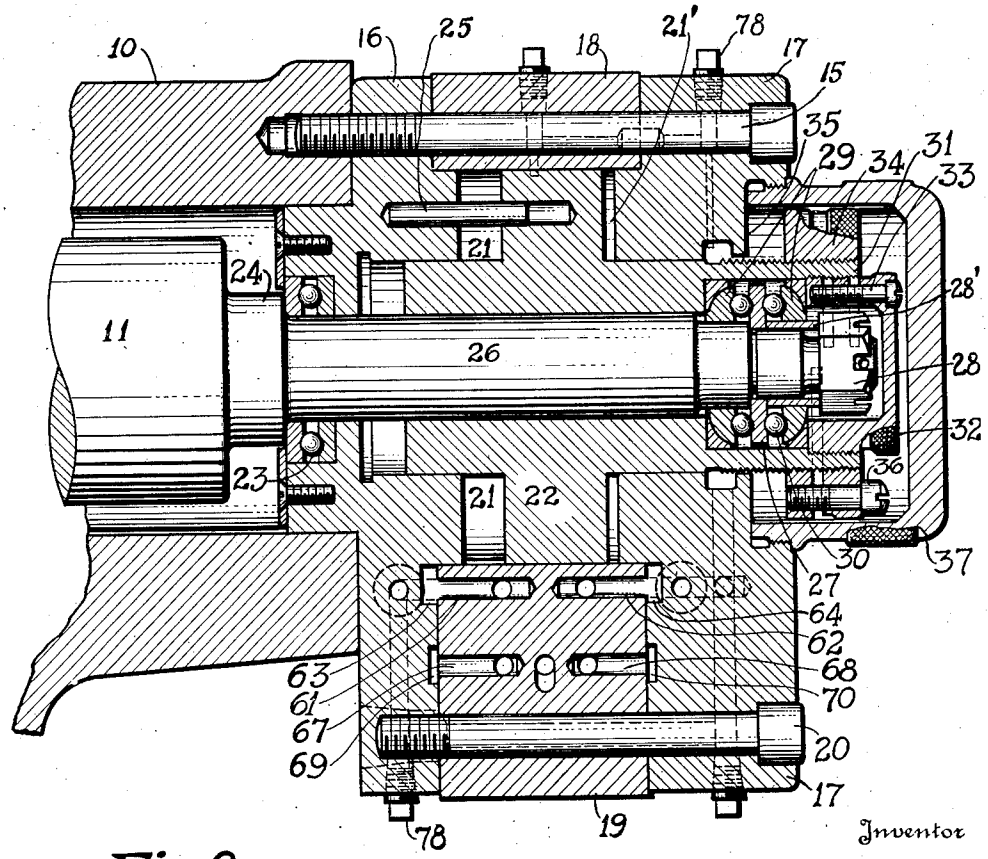


Fig 2

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SPINDLE OSCILLATOR

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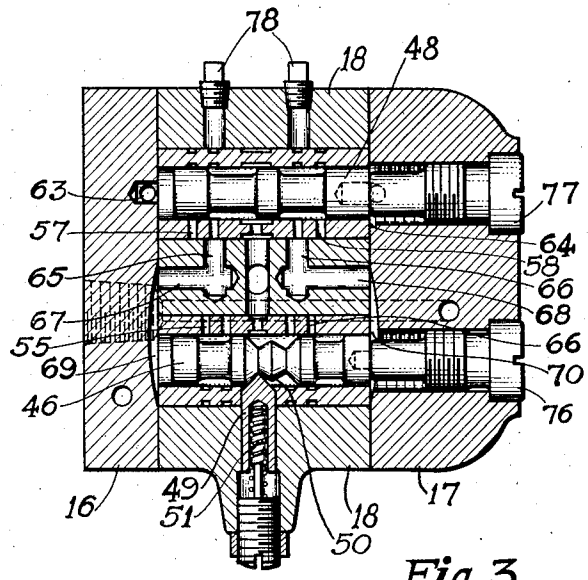
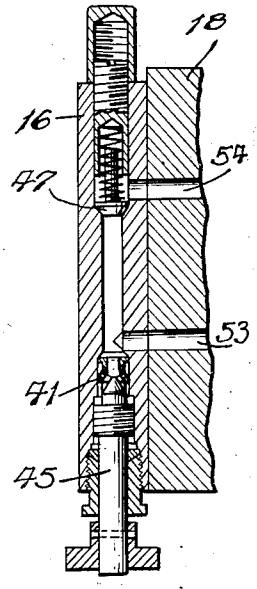


Fig 3

Fig. 5.



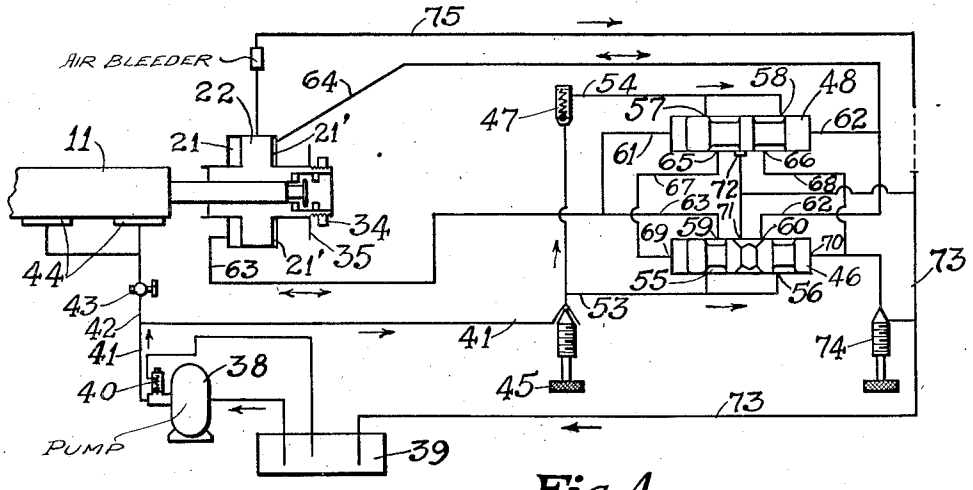
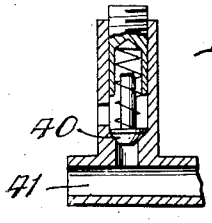


Fig 4

Fig. 6.



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SPINDLE OSCILLATOR

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Application May 13, 1929. Serial No. 362,552

15 Claims. (Cl. 60—52)

This invention relates to that type of mechanism commercially known as spindle oscillators adapted for use on a grinding machine or the like, and particularly to an oscillator unit that is actuated by fluid pressure means.

It is an object of this invention to provide a pressure actuating means for an oscillator unit having a minimum of moving parts.

A further object of this invention is to provide a pressure operated spindle reciprocating mechanism which may be readily adjusted to vary the extent of reciprocation, to retain the spindle in a stationary or non-reciprocating position or to increase or decrease the rate of reciprocation.

An additional object of this invention is the provision of mechanism which will satisfactorily utilize the energy in the pressure oiling system of a grinder or other machine tool for imparting power movement to a part of the tool such as for reciprocating a spindle or other unit.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in connection with the accompanying drawings, and it will be understood that any modifications in the structural details hereinafter disclosed may be made within the scope of what is claimed without departing from or exceeding the spirit of the invention.

Figure 1 is a perspective view of a portion of a grinding machine embodying this invention.

Figure 2 is a vertical section through the oscillator housing.

Figure 3 is section taken through the reversing and pilot valves.

Figure 4 is a diagrammatic view showing the operation of this invention.

Figure 5 is a sectional view of speed control and relief valves, the section being taken on line 5—5 of Figure 1.

Figure 6 is a sectional view of a relief valve.

In the drawings, wherein similar reference characters are used to designate corresponding parts throughout, the numeral 10 designates the head of a grinding machine having journaled therein the spindle 11 of a grinding wheel 12. It will be understood that these parts have been conventionally selected for the purpose of illustrating the application of the invention, since the oscillating unit hereinafter described may be applied to any other form of mechanism in which a relative reciprocation may be desired.

This unit is fastened to the head 10 by means of bolts 15 and comprises two end housing members 16 and 17 separated by an intermediate spacing member 18. The said housing members 16 and 17 and the intermediate spacing member 18 are secured to one another to form a unitary structure as by bolts or the like 20 and the intermediate spacing member 18 has formed at the lower end thereof a valve cage 19. The end housing members 16 and 17 form cylindrical guides for the reduced termini of the piston 22 which is reciprocatable in cylinder 21 formed interiorly of the spacing member 18. In the housing member 16 is placed the thrust bearing 23 for engagement with a shoulder 24 of the spindle 11, so that when the spindle is positively urged to the right to the position shown in Figure 2, and held in this position, the end thrust will be taken up and undue frictional retardation due to the pressure holding the spindle to the right will be eliminated.

A guide stud 25 carried by housing member 16 and received in a socket formed in piston 22 permits the said piston to reciprocate but not to rotate within the cylinder. Passing through the piston is the spindle extension 26, which has a thrust washer 27 affixed thereto by a nut 28 acting through a sleeve 28'. Thrust bearings 29 and 30 located on the spindle engage thrust washer 27, and are held in place by nut 32 internally threaded into extension 31 of the piston, to secure the parts together for joint reciprocation. A locking device such as a slot and a screw indicated at 33 serves to hold nut 32 against movement on the threads by pinching the slot in the nut against the contained threads in the piston extension 31. By these means, it is obvious that the reciprocation of the piston will, through the medium of the thrust washer 27, serve to similarly reciprocate the spindle and grinding wheel. To diminish the limits of reciprocation and to adjust the same, a nut 34 is threaded externally on piston extension 31, and by abutting against wall 35 of housing member 17, limits the left hand movement of the spindle. A locking device 36, similar to that at 33, secures the nut 34 in the desired adjusted position. A hollow cap nut 37 is threaded to housing member 17 and serves to protect the piston extension from dust, but allows easy access thereto for adjustment when desirable.

The reciprocation of the piston and spindle is caused by fluid pressure alternately acting against opposite sides of the piston, and the operation thereof will best be understood by reference to Figure 4 wherein it is diagrammatically illustrated. A pump 38 draws the fluid from a tank 39 and discharges same through a pressure

relief valve 40 into line or conduit 41 at the desired pressure as determined by the valve 40. The fluid preferably used is oil, and a branch line 42 leads through a choke 43 to supply the oil under a reduced pressure to the spindle bearings 44. Line 41 leads the fluid past a speed or rate valve 45, which may be manually adjusted to control the amount of oil flowing through the line, and hence thereby control the speed of reciprocation.

As illustrated in the drawings, the spindle is in the position where it has just completed its reciprocation to the right, and is about to be reversed. The movement of the spindle to this position was caused by the fluid flowing through line or conduit 53 into port or opening 55 of the reversing valve 46 and out port 59 to line 63 to cylinder 21 at the left side of the piston. The piston being at the extreme right position, no more fluid can flow through these lines, and the pressure builds up in branch line 54 until it exceeds the pressure, at which the relief valve 47 is set, whereupon the said valve is opened to permit the fluid to pass through line 54. The fluid now passes into port 58 of pilot valve 48 and out port 66 through line 68 to port 70 at the right end of reverser valve 46. Reverser valve 46 is held in the position shown by a load and fire detent 49 (see Figure 3) whose point may be depressed by ridge 50. As the pressure at port 70 accumulates behind the end of the reverser valve, it causes the valve to shift toward the left, and spring 51 of the detent 49 compresses or loads as the ridge 50 of the valve presses against the point of the detent. As soon as the point of the detent passes over the high point of the ridge, it acts to aid the movement of the reverser valve 46 to the left, positively firing it to its left position, closing off the connection between ports 55 and 59, and opening the connection between ports 56 and 60. At the same time, it connects port 59 with port 71 of the exhaust line 73 to the tank 39 and disconnects port 60 from port 71. As reverser valve 46 moves to the left, the fluid at its left end flows out of port 69 through line 67 into port 65 and out of port 72 of the pilot valve to exhaust line 73.

The valve 46 having reversed, relief valve 47 closes as the pressure of the fluid in line 53 flows into port 56, port 55 now being closed, and out of port 60 to line 62 which leads to the right end of the pilot valve moving the pilot valve to the left, thereby closing port 58, connecting port 65 to 57 and disconnecting it from port 72, port 72 being now connected to port 66. The pressure of the fluid then flows into line 64 leading to the right side of cylinder 21, causing the piston to move to the left and thereby axially shift the spindle, its movement to the left being adjustably limited by the stroke adjustment nut 34. The fluid in the cylinder 21 at the left side of the piston makes its exit through the same line 63 through which it had entered the cylinder, and flows through port 59 which is now connected to port 71 and into the exhaust, to return to the tank.

When the piston reaches its limit of movement to the left, the fluid again passes relief valve 47 in line 54 but this time to port 57, which is now connected to port 65 to line 67 leading to port 69 at the left end of the reverser valve. It then actuates the reverser valve 46 to the right in the same manner that it had actuated it to the left, and the fluid at its right end flows out port 70 through line 68 and port 66 to exhaust port 72. The fluid then moves through line 61, moving pilot valve to the right to the position shown, the fluid at its right end exhausting line 62 and port 60 to exhaust port 71. The pressure of the fluid then flows through ports 55 and 59 to line 63 to cylinder 21, and the next cycle of reciprocation is started. Should it be desired to stop the oscillation of the spindle, it is only necessary to open the stop valve 74, whereupon the pressure in line 68 will not accumulate behind the reverser valve at port 70, but instead will flow directly through line 73 to the tank without actuating the reverser valve, and the spindle will cease to reciprocate and will remain at the right end of its movement in the position shown. A drain line 75 is provided for any excess fluid escaping from the cylinder and couples through the exhaust line to the tank 39.

Plugs 76 and 77 threaded in housing member 17 form closures for the chambers containing the valves 46 and 48 respectively as well as end stops for the said valves, while affording ready accessibility to the reversing and pilot valves, so that said valves may be removed if desired without necessitating the disassembling of the housing. Cleanout plugs 78 are likewise placed at convenient points in the lines or conduits.

What is claimed is:

1. A reciprocating mechanism for a grinding machine or the like, including a non-rotatable reciprocable piston adjacent the spindle, means coupling the piston and spindle for joint reciprocatory movement, a housing enclosing the piston, pressure creating means, and means for alternately directing the flow of the pressure against opposite sides of the piston to cause reciprocation thereof comprising a valve cage formed integral with the housing, conduits leading from said pressure creating means through said valve cage to the piston, a reverser valve in said cage for directing the flow of pressure against alternate sides of said piston, a relief valve for operation when the piston has reached the end of a stroke to permit the pressure to by-pass said reverser valve, a pilot valve for directing said by-pass pressure to reverse said reverser valve, said pressure then operating to shift the pilot valve and to reciprocate the piston, and means for adjustably controlling the rate of pressure flow from the pressure creating means to thereby control the oscillation rate.

2. A fluid pressure actuable reciprocator for a grinding wheel spindle or the like, including a pressure source, a pressure line leading therefrom, an exhaust line, a double end cylinder having a piston reciprocable therein, conduits coupled with opposite ends of the cylinder, a reversing valve for selectively coupling either of the conduits with the pressure source and the other with the exhaust, means for automatically controlling movement of the reversing valve including a reciprocable pilot valve coupled with the piston pressure conduits for reversal of position in accordance with the pressure in one or the other of said conduits and a shunt pressure circuit completable through the pilot valve for actuation of the reverser valve in accordance with the setting of the pilot valve and means operative on increase of pressure in the piston actuating circuit for determining the operative effect of the shunt circuit.

3. A control mechanism for the hydraulic reciprocation of a machine tool part including a main actuating circuit for effecting movement of the part, a reverser valve for determining the di-

rection of hydraulic actuation of the part, a supplemental valve, a reversible reversing valve control circuit effective through said supplemental valve and reversed positions thereof, connections between said latter valve and the reversible reciprocating circuit for reversing the valve at each reversal in direction of actuation of the machine tool part, and means responsive to increase of pressure in the main actuating circuit for rendering the reverse valve circuit effective through the supplemental control valve.

4. The combination with a reciprocable machine tool part, of hydraulic means for controlling the reciprocations thereof including a reversible pressure system including the part, an hydraulically actuable reversing valve for the system, a supplemental valve coupled with the reversible system and reversible in conjunction therewith by normal actuating pressure, a control circuit for the main reversing valve having its effect determined by the position of the supplemental valve and means responsive to increase of pressure in the part actuating line for admitting pressure to the supplemental reverse valve control circuit.

5. The combination with a reciprocable machine tool part, of hydraulic means for controlling the reciprocations thereof including a reversible pressure system including the part, an hydraulically actuable reversing valve for the system, a supplemental valve coupled with the reversible system and reversible in conjunction therewith by normal actuating pressure, a control circuit for the main reversing valve having its effect determined by the position of the supplemental valve, means responsive to increase of pressure in the part actuating line for activating the supplemental reverse valve control circuit, and yieldable means for normally retaining the reversing valve in selected operative position.

6. The combination with a reciprocable machine tool part, of hydraulic means for controlling the reciprocations thereof including a reversible pressure system including the part, an hydraulically actuable reversing valve for the system, a cylinder valve coupled with the reversible system and reversible in conjunction therewith by normal actuating pressure, a control circuit for the main reversing valve having its effect determined by the position of the supplemental valve, means responsive to increase of pressure in the part actuating line for activating the supplemental reverse valve control circuit, yieldable means for normally retaining the reversing valve in selected operative position, and means for relieving pressure in the supplemental circuit to prevent actuation of the reverse valve thereby.

7. In a machine tool organization the combination with a reciprocable part thereof, of a reciprocating motor for effecting said movement of the part including a piston and a cylinder for the piston, means limiting the movement of the piston through the cylinder, conduits extending from opposite ends of the cylinder, an hydraulic pressure source, a pressure line extending therefrom, a reversing valve for connecting the pressure line with either of the cylinder conduits, a pilot valve operable by the hydraulic pressure source for determining the position of the reversing valve, connections between the pressure line and pilot valve for actuating said pilot valve by the pressure source, and connections between the pilot valve and reversing valve whereby to actuate the reversing valve by the hydraulic power source through the said pilot valve when the piston is limited in its movement in either direction.

8. In a spindle reciprocator the combination with a spindle, of hydraulic means for effecting a reciprocation thereof comprising a piston secured thereto at one end thereof, a housing surrounding the piston and forming a cylinder therefor, an hydraulic pressure source, means conveying the pressure source to the housing cylinder, a reversing valve in the housing controlling the flow of the hydraulic pressure source to opposite sides of the cylinder and piston, a pilot valve carried by the housing operatively coupled with the reversing valve for connecting the pressure source with opposite ends of the reversing valve, and means connecting the pilot valve through the reversing valve with the hydraulic pressure source for effecting actuation of the said pilot valve by the said pressure source.

9. In a device of the class described the combination with a grinding wheel spindle, a housing for the spindle, of means for reciprocating said spindle through its housing comprising a piston operatively connected with the spindle, a supplemental housing secured to the spindle housing and forming a cylinder for the piston, a reversible hydraulic circuit for reciprocating the piston and spindle through their housings, conduits in the circuit extending to the cylinder, means controlling the flow of the circuit to determine the rate of reciprocation of the piston and spindle, means operable by the circuit for reversing the effectiveness of the circuit, means interposed between the reversing means and cylinder for controlling the operation of the reversing means, and additional means operable by built up pressure in the circuit for effecting the operation of the reversing means by the said circuit through the interposed and controlling means.

10. In a machine tool organization the combination with a reciprocable part, of means for reciprocating the part comprising a piston secured to the part, a cylinder for the piston, an hydraulic pressure source, a pressure line leading therefrom, conduits extending from opposite ends of the cylinder, reversing means connecting the pressure line with either of the cylinder conduits, means controlling the flow of the pressure source through the pressure line to the conduits, a pilot valve operatively connected with the reversing valve, means operatively connecting the pilot valve with the cylinder conduits for effecting a shifting of the pilot valve and its connections with the reversing valve, and means in the pressure line operable by the pressure source for connecting the reversing valve and the pressure line through the pilot valve for actuating the said reversing means.

11. In a machine tool organization the combination with a reciprocable part, of means for reciprocating the part comprising a piston secured to the part, a cylinder for the piston, an hydraulic pressure source, a pressure line leading therefrom, conduits extending from opposite ends of the cylinder, reversing means connecting the pressure line with either of the cylinder conduits, means controlling the flow of the pressure source through the pressure line to the conduits, a pilot valve operatively connected with the reversing valve, means operatively connecting the pilot valve with the cylinder conduits for effecting a shifting of the pilot valve and its connections with the reversing valve, means in the pressure line operable by the pressure

source for connecting the reversing valve with the pressure line through the pilot valve for actuating the said reversing means, and means for interrupting the cyclic operation for stopping the reciprocations of the piston and spindle.

12. In a spindle reciprocating mechanism of the class described the combination of a spindle, a piston operatively connected with said spindle for effecting its reciprocation, an hydraulic pressure source including an hydraulic medium, a conduit for the medium, reverser means for connecting the conduit alternately with opposite ends of the piston, and means for effecting the operation of the reverser means including a pilot valve, a connection between the pressure conduit and the pilot valve for conveying the pressure to the valve, conduits between the pilot valve and reverser means for effecting the operation of the reverser means, and additional connections between the reverser means and pilot valve for shifting the pilot valve upon each reversal of the reverser means.

13. In a spindle reciprocating mechanism of the class described the combination of a spindle, a piston operatively connected with said spindle for effecting its reciprocation, an hydraulic pressure source including an hydraulic medium, a conduit for the medium, reverser means for connecting the conduit alternately with opposite ends of the piston, and means for effecting the operation of the reverser means including a pilot valve, a connection between the pressure conduit and the pilot valve for conveying the pressure to the valve, conduits between the pilot valve and reverser means for effecting the operation of the reverser means, additional connections between the reverser means and pilot valve for shifting the pilot valve upon each reversal of the reverser means, and throttle means in the pressure conduit for controlling the flow of the medium therethrough and the reciprocation of the piston.

14. In a spindle reciprocating mechanism of the class described the combination of a spindle, a piston operatively connected with said spindle for effecting its reciprocation, an hydraulic pressure source including an hydraulic medium, a conduit for the medium, reverser means for connecting the conduit alternately with opposite ends of the piston, and means for effecting the operation of the reverser means including a pilot valve, a connection between the pressure conduit and the pilot valve for conveying the pressure to the valve, conduits between the pilot valve and reverser means for effecting the operation of the reverser means, additional connections between the reverser means and pilot valve for shifting the pilot valve upon each reversal of the reverser means, throttle means in the pressure conduit for controlling the flow of the medium therethrough and the reciprocation of the piston, and additional means in the connection between the pilot valve and pressure conduit for normally preventing a flow of the medium therethrough but operable by the pressure for effecting said flow.

15. In a spindle reciprocating mechanism of the class described the combination of a spindle, a piston operatively connected with said spindle for effecting its reciprocation, an hydraulic pressure source including an hydraulic medium, a conduit for the medium, reverser means for connecting the conduit alternately with opposite ends of the piston, and means for effecting the operation of the reverser means including a pilot valve, a connection between the pressure conduit and the pilot valve for conveying the pressure to the valve, conduits between the pilot valve and reverser means for effecting the operation of the reverser means, additional connections between the reverser means and pilot valve for shifting the pilot valve upon each reversal of the reverser means, throttle means in the pressure conduit for controlling the flow of the medium therethrough and the reciprocation of the piston, and means in the conduit between the pilot valve and reverser means for releasing the pressure therein and thereby rendering the reverser means inoperative for stopping reciprocation of the piston.

HANS ERNST.