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FEED CUSHIONING MECHANISM

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This invention relates to feed mechanisms for metal working machines, and particularly to cushioning devices for such mechanisms.

In metal working machines, particularly grinding machines where a rapid feed movement is effected by a piston, and thru endwise movement of a feed screw and associated parts, such as a nut or the like, on the part being moved there is a certain amount of back lash between said parts. If the rapid movement is checked suddenly, the inertia of the sliding member will cause said member to continue at a rapid rate to a point depending upon the amount of back lash. Former attempts to solve this problem utilized a back lash piston connected to the sliding member, but operating against pump pressure. Furthermore, the back lash piston was under pump pressure at all times and any fluctuation in this pressure during feeding affected the performance of the feeding mechanism adversely.

The purpose of this invention is to remedy this condition by means of a piston and cylinder, one of which is directly connected to the sliding member. Said cylinder is connected to the forward cushioning section of the power cylinder by means of a fluid passage. When fluid under pressure is directed to withdraw the sliding member to inoperative position, it acts also on the second piston which thus assists in the withdrawal movement. When the slide is moved toward operative position, both cylinders are connected to the exhaust passage, in which a flow control valve determines the rate of exhaust, and, therefore, the rate of movement of the slide during the cushioned part of the stroke. The back pressure built up due to this restricted exhaust for cushioning is also effective against the second piston, which being connected directly to the slidipart, will counteract the effect of inertia on the slide and prevent said slide from dumping ahead of the driving side of the feed screw.

In the drawings, Figure 1 is an end elevation partly in section of a grinding machine wheel slide.

Figure 2 is a hydraulic diagram showing the method of applying my invention to a feed mechanism.

Numerals 10 indicates part of the bed of a grinding machine, 11 a wheel support slidably mounted thereon, and 12 a grinding wheel rotatably mounted on said support. This wheel support may be fed manually by a mechanism consisting of handwheel 13, shaft 14 having a worm gear (not shown) thereon, a worm wheel 15 on vertical shaft 16, and a worm wheel 17 on said vertical shaft engaging feed screw 18. Said feed screw acts as a rack for worm wheel 17.

Means for moving said wheel support 11 by power consists of a rapid feed piston 20 directly connected to screw 18. Said piston is mounted in cylinder 21 and supplies a rapid feed movement. When moved bodily endwise by piston 20, said screw is in engagement with worm wheel 17 which it carries with it said worm wheel, the shaft 16 on which it is mounted, and, therefore, the wheel support 11. A positive stop 25 in the path of said screw limits the rapid feed movement. The slow feed is effected by rotation of said screw in engagement with said worm wheel with the end of said screw in contact with said positive stop. The means for rotating said screw consists of a piston 30 and cylinder 31 positioned with the axis thereof perpendicular to that of said feed screw. Piston rod 32 has rack teeth 33 which engage a pinion 34 secured to the shaft of feed screw 18. Rotation of said screw causes worm wheel 17 to move relative there to carrying support 11 along with it.

A cylinder 40 formed in bed 10 contains a piston 41, one end of which is attached to wheel support 11. A passage 45 connects the forward end of said cylinder with the forward end of cylinder 21.

Fluid under pressure is supplied to the feed mechanism by a pump 50 thru a line 51 to reversing valve 52. Said valve may be shifted manually by means of a knob 53 to direct fluid alternately to passages 55 and 56.

To start the feed movement the operator pulls knob 53 thus connecting line 51 with passage 56. Fluid in passage 56 flows thru check valve 57 and throttle valve 58 thru line 59 to the head end of cylinder 21. The function of throttle valve 59 is to determine the rate of the rapid feed movement, as will be indicated later. Piston 20 moves to the right under the force of an unrestricted flow of fluid under pressure and exhaust fluid escapes unrestricted thru passage 55 and exhaust line 60. Fluid in passage 56 is also conducted thru passage 65 to cylinder 31 to start the grinding feed portion of the feeding mechanism.

As piston 20 moves forward it passes across the end of passage 55 thus cutting off the flow of exhaust fluid therefrom. Exhaust fluid then flows thru line 70 and throttle valve 75. Check valve 76 is closed to exhaust fluid. A pressure is built up in the exhaust fluid due to the throttle valve and the movement of piston 20. The rate of movement of said piston during this part of the
stroke is determined by the setting of valve 15. The pressure thus built up is transmitted thru passage 45 to cylinder 40 and piston 41. Since piston 41 is connected directly to the wheel support 11, and independently of piston 29, any tendency of the support to jump ahead upon the slow down of piston 20 due to inertia and lost motion or back lash is checked by the pressure against piston 41. This pressure continues until screw 18 engages stop 28 at which time it becomes zero. The feeding movement which follows is thus free from the effect of a fluctuating retarding pressure.

The combined area of piston 41 and piston 29 minus the screw 18 is substantially the same as that of the other end of piston 29. This permits the use of a greater volume of fluid and a larger orifice in the throttle valve for a given amount of cushioning. At the same time the added area of the piston 41 allows a lower operating pressure when the wheel support 11 is moved in the opposite direction. In order to move support 11 in the opposite direction the operator pulls knob 53 and directs fluid under pressure thru passage 55. Said fluid enters the rod end of cylinder 31 to reset the grinding feed piston 33. Fluid also passes thru check valve 16 and line 10 to cylinders 21 and 40. Exhaust fluid from the head end of cylinder 21 escapes thru passage 56 until said passage is cut off by piston 20. Thereafter, exhaust fluid must escape thru line 53 and throttle valve 58. Thus the rearward movement of the support 11 is cushioned and a jarring stop prevented.

I claim:

1. In a metal working machine, a movable slide, means for moving said slide including a piston and cylinder and hydraulic connections therefor, means for resisting the operation of said moving means at a predetermined point in the movement of said slide including a throttle valve in the exhaust line, a back lash piston and cylinder one of which is connected directly to said slide and connections from said back lash cylinder to the exhaust passage of said slide moving means between said power cylinder and said throttle valve, the pressure built up against said throttle valve being effective to resist movement of said back lash piston.

2. In a metal working machine, a movable slide, means for moving said slide including a feed screw a piston and cylinder for effecting longitudinal movement of said screw and slide, longitudinally spaced exhaust passages in said cylinder one of said passages being free and the other having an adjustable restriction therein, a back lash mechanism consisting of a piston and cylinder one of which is connected to said slide independently of said slide moving means, said exhaust passages being connected also to said back lash cylinder, said free exhaust passage being so located that it is cut off by relative movement between said first mentioned piston and cylinder.

3. In a metal working machine, a movable slide, manually actuated means for moving said slide including a screw, power means operable through said screw for moving said slide including a piston and cylinder, a positive stop for determining the extent of movement of said screw and slide, means for checking the movement of said piston as the screw approaches the stop, and means for applying an opposing force directly against the slide only at the instant of checking, including a second piston and cylinder one of which is attached to said slide, a common exhaust system for said cylinders and means operable in response to movement of said first mentioned piston for throttling the flow of fluid thru said exhaust system.

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