This invention relates to work rests for grinding machines, particularly work rests which are operated at one pressure for one portion of a grinding operation and at another pressure for another portion of the grinding operation.

The amount of force required to support a workpiece at different points in a grinding operation varies in accordance with the requirements of the particular type of work being ground. It is the purpose of this invention to provide means for exerting different forces on the work by the work rest at selected points in the progress of a grinding operation. The work rest pressure on a workpiece may vary and the points on the grinding cycle at which the pressure changes, may vary in accordance with requirements of a particular workpiece.

In the past, this has been accomplished by successively connecting pressure lines to a work rest, each line being connected through a different relief valve. Another device consisted of a pivotally mounted work rest assembly which was held against the work by opposing pistons, with a low pressure on the piston for a preliminary grinding operation and a high pressure for the finish grinding operation.

This invention represents an improvement over the first type of multi-pressure work rests in that each work rest shoe is advanced by means of a spring operated cam which, in turn, engages a reset piston, the different pressures being effected by subjecting the cam reset piston to different pressures opposing the spring which will determine the force exerted by the spring on the cam and thus the force exerted by the cam against the work rest shoe.

This invention represents an improvement over the second type of multi-pressure work rests in that the pressure is applied to the work rest shoe in a direct manner rather than through the pivoted bracket on which the work rest is mounted.

It is, therefore, an object of the present invention to provide a work rest operable to exert different forces on a workpiece.

Another object is to provide a work rest in which the actuating pressure is provided by resilient actuating means.

Another object is to provide a work rest in which the operation of the resilient means is controlled by fluid pressure.

Another object is to provide a work rest in which the pressure exerted on a workpiece is changed by changing the hydraulic back pressure which controls the resilient actuating means.

FIG. 1 is a hydraulic and electric diagram. FIG. 2 is an end elevation of a cam operated work rest. In FIG. 2, frame 10 is mounted on work carriage 11. The upper work engaging shoe 15 in frame 10 is slidable mounted for horizontal movement. The lower work engaging shoe 16 is supported on arm 17 pivotally supported on frame 10. Shoe 15 is mounted on plunger 18. Shoe 16 is actuated by plunger 19 through adjusting screw 20 in lug 21. Plungers 18 and 19 both have the same type of actuating mechanism. Therefore, only the actuating mechanism for plunger 18 will be described. In FIG. 1, where both actuating means are shown, the corresponding element of each plunger will be identified by the same reference numeral.

The actuating means for plunger 18 consists of housing 30 having an opening 31 in which is slidably mounted a cam 32. One end of cam 32 is in abutting relation with spring 33. The other end of cam 32 is in abutting relation through piston rod 34 of piston 35 in cylinder 36 which is a part of housing 30. The head end of cylinder 36 has an adjustable stop member 37 which determines the limited movement of piston 35 in one direction.

One end of plunger 18 extends through housing 30 to engage the inclined face of cam 32. Plunger 18 is held against cam 32 by spring 22 which also retracts plunger 18 when cam 32 is reset, this reset is similar to the one described in U.S. Patent 3,118,258, granted January 21, 1964.

The means for advancing and retracting grinding wheel 49 consists of a feed screw 41 having a piston 42 at one end slidably mounted in cylinder 43. Feed screw 41 is connected through a gear 44, shaft 45, gear 46, and worm 47 on shaft 48 which is rotatable by means of hand wheel 49. Gear 50 on shaft 48 engages a rack or screw 51 which is movable axially by means of piston 52 in cylinder 53. The wheel support represented by portion 55 may be advanced and retracted with feed screw 41 or relative to said feed screw 41 by rotation of shaft 45.

Operation

The feed movement is started by closing infed limit switch 3LS by means of a suitable operating lever. Closing limit switch 3LS completes a circuit to energize relay 5SCR.

Relay contact 5CR2 completes a circuit to energize infed valve solenoid 2. Relay contact 5CR1 is a holding contact to maintain the circuit through limit switch contact 6LS2 to relay 5CR after limit switch 3LS has been released.

Energizing valve solenoid 2 shifts feed pilot valve 60 to the right, directing fluid under pressure to the right hand end of feed reversing valve 61. Valve 61 shifts to the left to direct fluid under pressure to the head end of rapid feed cylinder 43. Piston 42 and cylinder 43 advance wheel support 55 and grinding wheel 49 into operative relation with workpiece W. When piston 42 reaches the end of its stroke, exhaust pressure in the rod end of cylinder 43 drops and valve VP is shifted to change the fluid connection to round out valve 75 and the head end of feed cylinder 53 from exhaust to pressure to shift piston 52 and screw 51 to the left. The movement of screw 51 in engagement with gear 50 rotates shaft 48 to move wheel support 55 relative to feed screw 41 for a grinding feed. During this portion of the feed movement, hand wheel 49 rotates with shaft 48.

At a predetermined point in the grinding operation, cam 70 on hand wheel 49 actuates limit switch 7LS which completes a circuit from normally closed relay contact 6CR1 to energize timer clutch relay TR. Relay contact TR1 completes a circuit to energize relay 7CR. Relay contact TR2 completes a circuit to hold relay TR. After a predetermined interval, normally closed relay contact TR3 times open and opens the circuit through normally closed relay contact 8CR1, to deenergize relay 26CR.

Relay contact 7CR1 completes a circuit to energize round-out valve solenoid 3 and shifts round out valve 75 to the right, cutting off the supply of fluid under pressure to the head end of cylinder 53, stopping the advance of wheel support 55 and grinding wheel 40, for a sparkout period.

Deenergizing relay 26CR opens the circuit through relay contact 26CR2 to deenergize work rest reset valve solenoid 14.

Selector valve 80 returns to central position, blocking the flow of fluid through valve 80 to cylinder 36, leaving as the only source of fluid under pressure for operating the work rest, the permanent low pressure supply from the pump through restrictions 81 and 82. This fluid is under a pressure which exerts a lesser force on piston 35.
in a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, and means to apply a low back pressure to said piston during part of the grinding operation and to apply high back pressure to said piston during another part of the grinding operation.

3. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, and means to apply a low back pressure to said piston during part of the grinding operation and to apply high back pressure to said piston during another part of the grinding operation.

4. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, and means to apply an adjustable back pressure to said piston so that said cam exerts a low pressure on said shoe during part of the grinding operation and a high pressure on said shoe during another part of the grinding operation.

5. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, means to apply an adjustable back pressure to said piston so that said cam exerts a low pressure on said shoe during part of the grinding operation and a high pressure on said shoe during another part of the grinding operation, and control means actuated by said feeding means to change from one pressure to another.

6. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, a valve operable in different positions to apply pressure on said piston less than said opposing spring pressure, exhaust pressure to permit full
spring pressure on said cam, and to apply pressure greater than said opposing spring pressure to reset said cam and releasing said hose, and control means responsive to said feeding means to actuate said valve at predetermined points in the advance of said grinding wheel during a grinding operation.

7. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, and means for supplying fluid under pressure to the end of said piston opposite said cam to reset said cam against said spring.

8. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, a supply of fluid under pressure, and a valve for controlling the pressure on one end of said piston to modify or overcome the effect of said spring on said cam and said work rest shoe.

9. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece for a grinding operation comprising a base, a plunger slidably mounted in said base and having means thereon for engaging and supporting a workpiece, means for holding said plunger against said workpiece comprising a free cam slidably mounted for movement in a direction transversely of the direction of movement of said plunger and having an inclined surface in operative engagement with said plunger, a first resilient means for holding said plunger against said cam, a second resilient means in abutting relation with one end of said cam for moving said cam in a direction to advance said plunger against said cam, means for supplying fluid under pressure to one end of said piston, a valve for controlling the flow of fluid under pressure to said piston, said valve being connected to different pressures including exhaust and operable in one position for directing fluid under pressure greater than said second resilient means for resetting said piston and said cam and in another position to connect said piston with a pressure less than that exerted by said second resilient means, said valve being operable in another position to connect said piston with exhaust so that said second resilient means act through said cam applies its full power on said plunger.

10. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece for a grinding operation comprising a base, a plunger slidably mounted in said base and having means thereon for engaging and supporting a workpiece, means for holding said plunger against said workpiece comprising a free cam slidably mounted for movement in a direction transversely of the direction of movement of said plunger and having an inclined surface in operative engagement with said plunger, a first resilient means for holding said cam against said cam, a second resilient means in abutting relation with one end of said cam for moving said cam in a direction to advance said plunger against said cam, a piston in abutting relation with the other end of said cam, means for supplying fluid under pressure to one end of said piston, a valve for controlling the flow of fluid under pressure to said piston, said valve being connected to different pressures including exhaust and operable in one position for directing fluid under pressure greater than said second resilient means for resetting said cam and said cam, and in another position to connect said piston with a pressure less than that exerted by said second resilient means, said valve being operable in another position to connect said piston with exhaust so that said second resilient means act through said cam applies its full power on said plunger, and control means operable by said feeding means for successively connecting said piston to said different pressures at predetermined points in the movement of said grinding wheel support.

11. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation comprising a base, a plunger slidably mounted in said base and having means thereon for engaging and supporting a workpiece, means for holding said cam against said cam, a piston in the path of said cam, a supply of fluid under different pressures, a valve for controlling the flow of fluid under pressure to one end of said piston, control means responsive to said feeding means to actuate said valve to one position for directing fluid under one pressure for retarding the movement of said piston and cam and thus exerting a relatively low pressure on said plunger, control means for positioning said valve in another direction to connect said piston with a lower pressure, thereby increasing the force exerted by said first mentioned resilient means on said plunger, and control means for positioning said valve in a third position for directing fluid under pressure against said piston greater than that exerted in the opposite direction by said first resilient means, to reset said cam against said first resilient means and to permit said second resilient means to retract said plunger.

12. A work rest for supporting a workpiece for a grinding operation comprising a base, a plunger slidably mounted in said base and having means thereon for engaging and supporting a workpiece, means for maintaining uniform pressure of said plunger against said workpiece comprising a free cam slidably mounted for movement in a direction transversely of the direction of movement of said plunger and having an inclined surface in operative engagement with said plunger, resilient means for moving said cam in a direction to advance said plunger, another resilient means for holding said plunger against said cam, a fluid pressure actuated piston in the path of said cam, and means for supplying fluid under pressure to the end of said piston opposite said cam to reset said cam against the first mentioned resilient means.

13. In a grinding machine, a grinding wheel support, a grinding wheel on said wheel support, feeding means for advancing said grinding wheel toward a workpiece for a grinding operation, a work rest for supporting a workpiece against said grinding wheel, a work rest shoe on said work rest for engaging and supporting a workpiece, a free cam engaging said work rest, a spring in abutting relation with one end of said cam for shifting said cam and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, and means for supplying fluid under pressure to the end of said piston opposite said cam to reset said cam against said spring.
and advancing said shoe against said workpiece, a fluid pressure actuated piston in abutting relation with the other end of said cam, a supply of fluid under different pressures, a selector valve for controlling the flow of fluid under pressure, control means responsive to said feeding means to actuate said valve to one position for directing fluid under one pressure for retarding the movement of said piston and cam, control means to position said valve in another position to connect said piston with a lower pressure and thus increase the force exerted by said shoe on said plunger, and control means for positioning said valve in a third position for directing fluid under pressure greater than that exerted by said spring to reset said cam against said spring.

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