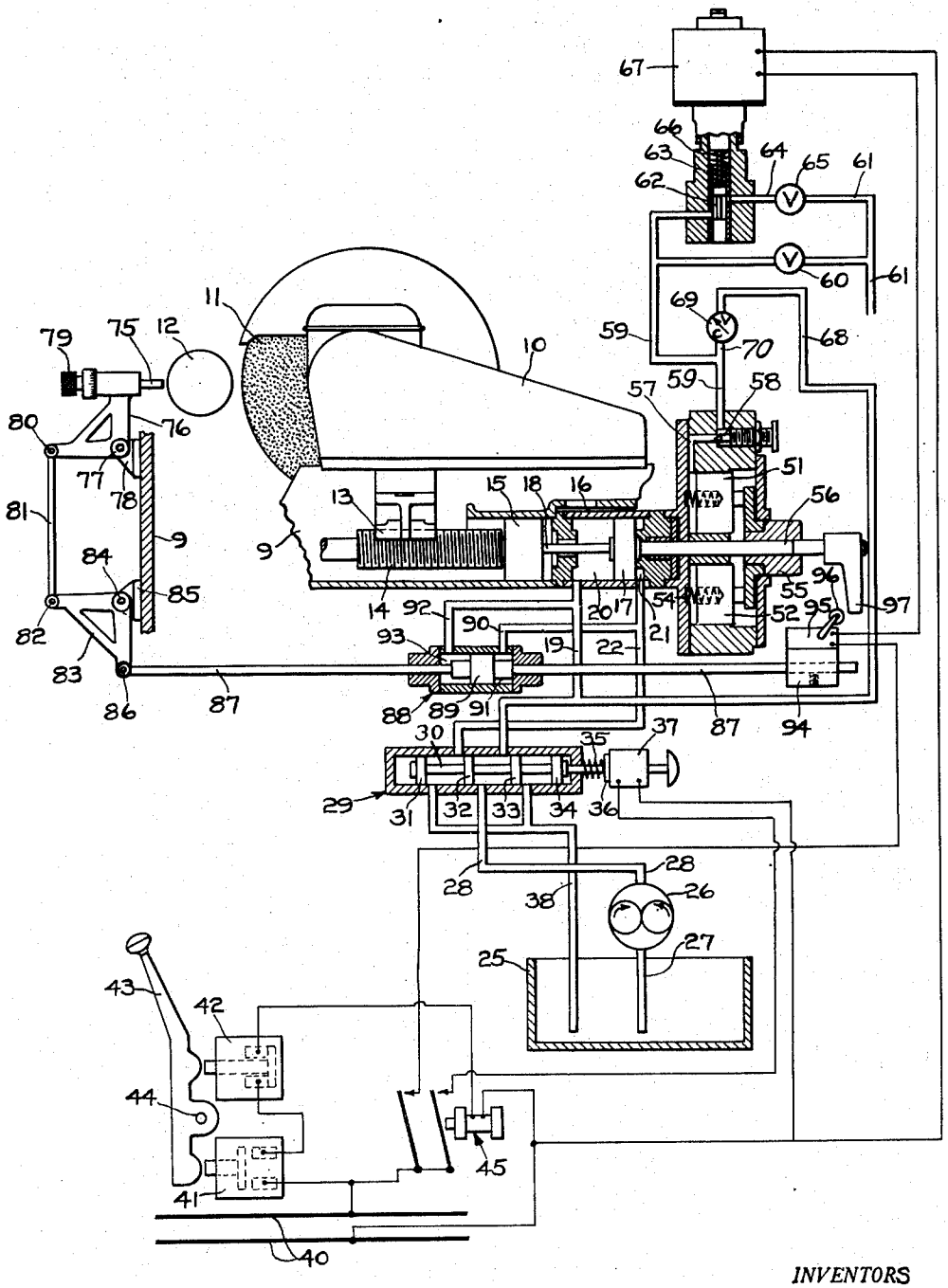
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HYDRAULICALLY OPERATED WHEEL FEEDING MECHANISM

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HYDRAULICALLY OPERATED WHEEL FEEDING MECHANISM

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The invention relates to grinding machines and more particularly to a grinding wheel feeding mechanism.

One object of the invention is to provide a simple and thoroughly practical grinding wheel feeding mechanism. Another object of the invention is to provide a hydraulically operated wheel feeding mechanism which is arranged to cause a rapid approaching movement of the grinding wheel, then a slow shoulder grinding feed of the wheel until the grinding wheel engages the peripheral surface of the work at which time the infeed is automatically reduced to a slower uniform body feed. Another object of the invention is to provide a wheel feeding mechanism in which a mechanism including a work engaging feeler automatically changes the rate of infeed when the periphery of the grinding wheel engages the body portion of the work to be ground regardless of the initial diameter of the body portion.

A further object of the invention is to provide a wheel feeding mechanism in which the rapid approaching or shoulder feed of the grinding wheel continues until the periphery of the grinding wheel engages the cylindrical body portion of the work at which time the feed is automatically reduced to a predetermined and uniform grinding feed. Another object of the invention is to provide a wheel feeding mechanism with a control means which is governed by the diameter of the work being ground for automatically changing the rate of infeed to a predetermined grinding feed when the grinding wheel engages the periphery of the work piece. Another object of the invention is to provide a hydraulically actuated electrically controlled feeding mechanism in which a work engaging feeler and control means governed thereby automatically changes the rate of feed of the grinding wheel to a grinding feed when the grinding wheel moves into engagement with the work piece being ground. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is

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shown one of various possible embodiments of the mechanical features of this invention, Fig. 1 is a diagrammatic showing of the hydraulically actuated electrically controlled grinding wheel feeding mechanism.

A grinding machine has been illustrated in the drawings comprising a base 9 which supports a transversely movable grinding wheel slide 10 on the usual V-way and flat way (not shown). The wheel slide 10 serves as a support for a rotatable grinding wheel 11. A rotatable work support is provided for rotatably supporting a work piece 12 in order that its peripheral cylindrical surface may be ground. The work support has not been illustrated since it is not considered to be a part of the present invention. A conventional work support comprising a head stock and a footstock may be utilized such as for example that shown in the expired U. S. patent to C. H. Norton, No. 762,838, dated June 14, 1904, to which reference may be had for details of disclosure not contained herein.

The wheel slide 10 is provided with a depending half nut 13 which meshes with or engages a rotatably mounted feed screw 14. The right hand end of the feed screw 14 is supported in a slidably mounted bearing 15. The screw 14 may be rotated by the old and well known manually operable cross feeding mechanism such as for example that shown in the above mentioned expired U. S. patent.

In order to feed the grinding wheel toward and from the work piece, a hydraulically operated mechanism is provided comprising a cylinder 16 which is fixedly mounted in the base 9. The cylinder 16 contains a slidably mounted piston 17 which is connected to a double end piston rod 18. The left hand end of the piston rod 18 is operatively connected to the slidably mounted bearing 15. As illustrated in the drawings, the hydraulic cylinder 16, the piston 17, and the piston rod 18 are arranged in axial alignment with the feed screw 14. When it is desired to move the grinding wheel to a rearward or inoperative position such as that shown in the drawings, fluid under pressure may be admitted through a pipe 19 into a cylinder chamber 20 to cause the piston 17 and associated parts to move toward the right into the position illustrated in the drawing. During this movement of the piston 17, fluid with-

in a cylinder chamber 21 may be exhausted through a pipe 22. Similarly, when it is desired to cause a forward feeding movement of the grinding wheel, fluid under pressure may be admitted through the pipe 22 into cylinder chamber 21 to cause the piston 17 to move toward the left and thus transmit a corresponding movement through piston rod 18, the slidably mounted bearing 15, the feed screw 14, the half nut 13, and the wheel slide 10 to cause the wheel 11 to approach the peripheral surface of the work piece 12. During this movement of the wheel slide 10, fluid within the cylinder chamber 20 may be exhausted through the pipe 19.

A fluid pressure system is provided comprising a reservoir 25. A motor driven pump 26 draws fluid through a pipe 27 from the reservoir 25 and passes fluid under pressure through a pipe 28 to a control valve 29. The control valve 29 is preferably a piston type control valve comprising valve stem 30 having formed integrally therewith a plurality of valve pistons 31, 32, 33 and 34. The valve stem 30 is normally held in its right hand end position by means of a compression spring 35 which surrounds the valve stem 30 and is interposed between the end face of the valve casing 29 and a flange 36 which is either formed integral or fixedly mounted on the valve stem 30. In the position of the valve as shown in the drawings, fluid under pressure passing through the pipe 28 enters a valve chamber located between the valve pistons 32 and 33 and passes out through the pipe 19 into the cylinder chamber 20 to cause the piston 17 to move toward the right into the position illustrated in the drawings. During this movement of the piston 17, fluid within the cylinder chamber 21 may exhaust through the pipe 22 into a valve chamber located between the valve pistons 31 and 32 and pass out through an exhaust pipe 38 into the reservoir 25.

In the preferred construction, the valve 25 is arranged to be automatically shifted into a reverse position to change the direction of flow of fluid under pressure by means of an electric solenoid 37. When the solenoid 37 is energized, in a manner to be hereinafter described, the valve stem 30 will be shifted toward the left against the compression of the spring 35 so that fluid under pressure passing through the pipe 28 will enter the valve chamber located between the valve pistons 32 and 33 and pass outwardly through the pipe 22 into the cylinder chamber 21 to cause an infeeding or approaching movement of the grinding wheel slide 10 and the grinding wheel 11.

In order to control the energization of the solenoid 37, power lines 40 are provided for supplying electrical current to the control system. A push button type starter switch 41 is provided which, when closed, serves to energize a relay switch 45. When the relay switch 45 is energized, a circuit is closed to energize the solenoid 37 and thereby shift the control valve 29 so as to cause a forward feeding movement of the grinding wheel 11. A push button type stop switch 42 is provided to facilitate stopping the forward feeding movement at any time it is desired and thereby deenergizing the solenoid 37 so that the released compression of the spring 35 will shift the control valve into the position illustrated in the drawings thereby causing the wheel slide 10 and the grinding wheel 11 to move to a rearward or inoperative position. A manually operable control lever 43 is pivotally supported on a stud 44 which is preferably supported in fixed relationship with the base 9. The control lever 43 serves to facilitate manual actuation of the switches 41 and 42. It will be readily apparent from the foregoing disclosure that when the control lever 43 is rocked in a counter clockwise direction, the starter switch 41 will be closed to initiate a forward feeding movement. Similarly, if the control lever 43 is rocked in a clockwise direction, the stop switch 42 will be opened so as to deenergize the relay switch 45 and thus cause the control valve to shift to cause the wheel slide 10 and grinding wheel 11 to move to an inoperative position.

A dash pot feed regulator 50 is provided for reducing the rapid approaching movement of the grinding wheel to a slow uniform grinding feed when the grinding wheel reaches a predetermined position. This regulator comprises a pair of dash pot pistons 51 and 52 arranged on diametrically opposite sides of the piston rod 18. This dash pot feed regulator is substantially the same as that shown in the prior U. S. Patent to W. H. Wood, No. 2,082,728, dated June 1, 1937, to which reference may be had for details of disclosure not contained herein. The dash pot pistons 51 and 52 are normally urged in a right hand direction by a pair of compression springs 53 and 54 which serve to return the dash pot pistons 51 and 52 to inoperative positions when the grinding wheel 11 is moved rearwardly to its inoperative position. A flanged collar 55 is adjustably mounted on a rearwardly extending portion 56 of the piston rod 18.

The rapid approaching movement of the grinding wheel 11 continues until the flanged collar 55 engages the ends of the dash pot pistons 51 and 52 and moves them toward the left. This movement serves to exhaust fluid from the dash pot cylinder chambers through a passage 57 and through a needle valve 58. By regulating the needle valve 58, the exhaust of fluid from the dash pot cylinders may be regulated so as to produce the desired feed.

Fluid exhausting through the needle valve 58 passes through a pipe 59 and through a throttle valve 60 and a pipe 61 which returns the exhausting fluid to the reservoir 25. In certain types of grinding operations it is desirable to provide not only a rapid approaching but also a slow shoulder grinding feed and then a slower uniform feed during the grinding of the peripheral body portion of a work piece. In order to provide the desired control of the exhausting fluid so as to obtain the different feeds desired, a normally open solenoid valve 63 is provided comprising a valve chamber 62. Fluid passing through the pipe 59 may pass through the chamber 62 and out through a pipe 64, through a second throttle valve 65 and through the pipe 61 into the reservoir 25. A compression spring 66 serves normally to maintain the valve in an open position. A solenoid 67 is provided which, when energized, causes an upward movement of the valve parts to close the valve and thereby to prevent fluid passing from the pipe 59 through the pipe 64.

As illustrated in the drawings, the shoulder grinding feed is determined by the setting of the needle valve 58 and the throttle valves 60 and 65. When it is desired to change from a shoulder grinding feed to a body grinding feed, the solenoid 67 is energized to close the valve 63 so that fluid exhausting from the feed regulator 50 through the pipe 59 may pass only through the throttle valve 60. The throttle valve 65 being cut off by the closing of the solenoid valve 63. By manipulation of the throttle valve 60, the desired

and predetermined body grinding feed may be obtained.

In order to refill the dash pot cylinders during the rearward movement of the grinding wheel 11 so that the feed regulator will be in condition for the next grinding operation, a pipe 68 is connected with the pipe 19 to pass fluid to a check valve 69, through a pipe 70 into the pipe 59. It will be readily apparent from the foregoing disclosure that in the position of the valves as shown in the drawing, fluid under pressure passing through the pipe 19 will pass through the pipe 68, through the check valve 69, the pipe 70, the pipe 59, through the needle valve 56, the passage 57 into the dash pot cylinders to positively move the dash pot pistons 51 and 52 toward the right and at the same time serving to fill the dash pot cylinder chambers for the next infeeding operation.

In order to attain one of the main objects of this invention namely to provide a highly efficient wheel feeding mechanism, it is desirable that the approaching feed or shoulder grinding feed be continued until the grinding wheel is about to engage the periphery of the work to be ground regardless of the initial diameter of the work. In the preferred construction a feeler actuated mechanism is provided which serves automatically to change to a body grinding feed as the grinding wheel 11 is about to engage the periphery of the work piece 12 to be ground. This mechanism preferably comprises an adjustably mounted work engaging feeler 75 which is supported on an upwardly extending arm of a bell crank lever 76. The bell crank lever 76 is pivotally supported by a stud 77 which is in turn supported by a bracket 78 fastened to the base 9. A micrometer adjusting knob 79 is provided to facilitate adjustment of the feeler 75 relative to the bell crank lever 76. A horizontally extending arm of the bell crank lever 76 is pivotally connected by a stud 80 with a vertically arranged connecting rod 81. The lower end of the rod 81 is connected by a stud 82 with a horizontally extending arm of a bell crank lever 83. The bell crank lever 83 is pivotally supported by a stud 84 on a bracket 85 which is fixed to the base 9. A downwardly extending arm of the bell crank lever 83 is connected by means of a stud 86 with a horizontally arranged piston rod 87.

It is desirable that the work engaging feeler be moved automatically into and out of operative engagement with the periphery of the work piece to be ground in timed relationship with the feeding movement of the grinding wheel 11. This is preferably accomplished by means of a hydraulically operated mechanism comprising a cylinder 88 and a piston 89. The piston 89 is fixedly connected to the double end piston rod 87. A pipe 90 connects a cylinder chamber 91 with the pipe 22. A pipe 92 connects a cylinder chamber 93 with the pipe 19.

With the control valve 29 in the position shown in the drawing, fluid under pressure passing through the pipe 19 to cause the piston 17 to move to its right hand end position, also passes through the pipe 92 to cause the piston 89 to move toward the right so as to cause the work engaging feeler 75 to move out of engagement with the work piece 12 when the grinding wheel 11 is moved to its right hand or inoperative position. Similarly, when the control valve 29 is shifted into the reverse position to initiate an infeeding movement of the grinding wheel 11, fluid under pressure is passed through the pipe 22 to cause the piston 17 to move toward the left and at the same time fluid under pressure is passed through the pipe 90 into the cylinder chamber 91 to move the work engaging feeler 75 into operative engagement with the work piece 12 when the infeeding movement of the grinding wheel 11 is started.

In order to effect a change of the infeeding movement of the grinding wheel from either an approaching or a shoulder grinding feed to a body feed, an adjustably mounted block 94 is mounted on the rearwardly extending portion 87 of the piston rod. The block 94 serves as a support for a normally open limit switch 95. The limit switch 95 is provided with an actuating roller 96 which is arranged in the path of a detent 97 which is adjustably supported on the rearwardly extending portion 56 of the piston rod 18. It will be readily apparent from the foregoing disclosure that the limit switch 95 is moved with the piston 89 as the feeler 75 is moved into or out of an operative position. The limit switch 95 is operatively connected to the solenoid 67. When the infeeding movement of the grinding wheel is started by energizing the magnetic starter switch 45, the feeler 75 will be moved into operative engagement with the work piece 12 by movement of the piston 89 which serves to move the block 94 and the limit switch 95 toward the left. The infeeding movement of the grinding wheel will continue first at a rapid approaching rate as caused by the piston 17 and then at a shoulder grinding rate as caused by the dash pot pistons 51 and 52 which movement will continue until the detent 97 engages the roller 96 and closes the limit switch 95. The closing of the limit switch 95 serves to energize the solencid 67 to close the valve 63. The closing of the valve 63 cuts off exhaust of fluid through the throttle valve 65 so that fluid exhausting from the dash pot cylinders may exhaust only through the needle valve 60 which is set for a predetermined body grinding feed. It will be readily apparent from the foregoing disclosure that movement of the feeler 75 as caused by the piston 89 will position the limit switch 95 so that the shoulder grinding feed will continue until the grinding wheel 11 is about to engage the peripheral surface of the work piece 12 regardless of the initial diameter of the work piece.

The operation of this improved feeding mechanism will be readily apparent from the foregoing disclosure. Assuming all adjustments to have been previously made, a work piece 12 is mounted in the machine, the pump 26 is started and the grinding wheel is also started in rotation for a grinding operation. The infeeding movement of the grinding wheel is initiated by movement of the control lever 43 in a counter clockwise direction to close the starter switch 41 which serves to close the relay switch 45 thus energizing the solenoid 37 to shift the control valve 29 so as to admit fluid under pressure through the pipe 22 to start a forward feeding movement of the piston 17 and grinding wheel 11. At the same time, fluid under pressure is passed through the pipe 90 to cause a movement of the piston 89 toward the left so as to move the work engaging feeler 75 into operative engagement with the periphery of the work piece 12. This movement serves to position the switch 95. The rapid approaching movement of the grinding wheel 11 continues until the flanged member 55 engages the dash pot pistons 51 and 52. The continued forward feeding movement caused by the piston 17 is then reduced to a predetermined shoulder grinding feed as governed by the needle valve 58, the

throttle valves 60 and 65. The shoulder grinding feed continues until the detent 97 engages the actuating roller 96 to close the limit switch 95. The closing of the limit switch 95 energizes the solenoid 67 to close the solenoid valve 63 thus cutting off exhaust of fluid through the throttle valve 65. The closing of the solenoid valve 63 then allows fluid to exhaust only through the throttle valve 60 which is adjusted to give the desired body grinding feed for grinding the peripheral surface of the work piece 12. The body grinding feed may continue until the work has been ground to the desired and predetermined size after which the control lever 43 may be shifted in a clockwise direction to actuate the stop switch 42 which serves to deenergize the magnetic switch 45 thus breaking the circuit to deenergize the solenoid 37 allowing the released compression of the spring 35 to return the valve 29 into the position shown in the drawing. The latter shifting of the control valve 29 serves to pass fluid through the pipe 19 to cause the piston 17 together with the grinding wheel 11 to move to the extreme right hand end position and at the same time serves to move the piston 89 toward the right to cause the work engaging feeler 75 to move to an inoperative position out of engagement with the work piece 12.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a grinding machine having a rotatable grinding wheel, a transversely movable wheel slide therefor, and a feeding mechanism for said slide to feed the slide rapidly toward and from a work piece to be ground, means to slow down the rapid approaching feed to a shoulder grinding feed, means including a work engaging feeler engageable with the work piece to be ground control means movable with said feeler automatically to slow down the shoulder feed to a predetermined body feed when the grinding wheel engages the periphery of the work to be ground, and means to move said feeler to and from an operative position which is operated in timed relation with the wheel feeding mechanism so that the feeler is moved into an operative position in engagement with the work when the wheel is moved toward the work piece.

2. In a grinding machine having a rotatable grinding wheel, a transversely movable slide therefor, a feeding mechanism for said slide including a fluid pressure piston and cylinder to feed said slide toward and from a work piece to be ground, means to slow down the rapid approaching feed to a shoulder grinding feed, means including a work engaging feeler which is movable into and away from engagement with the work piece to be ground automatically to slow down the shoulder feed to a slower predetermined body feed when the grinding wheel engages the periphery of the work to be ground, and means including a piston and cylinder to move said feeler toward and from an operative position which is operated in timed relation with said feed mechanism so that the feeler is moved into operative engagement with the work piece when the wheel is moved toward the work piece to be ground.

3. In a grinding machine having a rotatable grinding wheel, a transversely movable slide therefor, and a feeding mechanism therefor including a fluid pressure piston and cylinder to feed said slide toward and from a work piece to be ground, means including a dash pot feed regulator to slow down the rapid approaching feed to a shoulder grinding feed, means including a normally open solenoid valve in the exhaust line of said regulator, a work engaging feeler engageable with the periphery of the work piece to be ground, means including a normally open limit switch which is movable with said feeler which is arranged when actuated to close said solenoid valve automatically to slow down the infeed to a predetermined body feed when the wheel moves into engagement with the periphery of the work piece, and means including a detent movable with said feed piston to actuate said limit switch so as to automatically change the rate of infeed when the grinding wheel engages the work piece to be ground regardless of the initial diameter of the work piece to be ground.

4. In a grinding machine having a rotatable grinding wheel, a transversely movable slide therefor, and a feeding mechanism for said slide including a fluid pressure piston and cylinder to feed said slide toward and from a work piece to be ground, means including a dash pot feed regulator to slow down the rapid approaching feed to a predetermined shoulder grinding feed, a pair of throttle valves to control the exhaust of fluid from said regulator, a normally open solenoid valve between one of said throttle valves and the regulator, means including a work engaging feeler engageable with the periphery of the work piece to be ground, a piston and cylinder to move said feeler to and from an operative position, means including a normally open limit switch which is movable with said feeler piston which is arranged when actuated automatically to close said solenoid valve to slow down the infeed to a predetermined body feed, and means including an adjustable detent which is movable with said feed piston to actuate said limit switch when the grinding wheel moves into engagement with the work piece to be ground so as to automatically change the rate of infeed to a predetermined body feed regardless of the initial size of the work piece to be ground.

5. In a grinding machine having a rotatable grinding wheel, a transversely movable slide therefor, and a feeding mechanism for said slide including a fluid pressure piston and cylinder to feed said slide toward and from a work piece to be ground, means including a dash pot feed regulator to slow down the rapid approaching feed to a predetermined shoulder grinding feed, means including a normally open solenoid valve in the exhaust line of said regulator, means including a normally inoperative work engaging feeler which is engageable with the periphery of the work piece to be ground, a piston and cylinder to move said feeler to and from an operative position, fluid connections between said feed cylinder and said feeler cylinder which is arranged so that fluid under pressure simultaneously is admitted to the feed and feeler cylinders simultaneously to cause a forward feed of the grinding wheel and a movement of the feeler into operative engagement with the work, means including a normally open limit switch which is movable

with said feeler piston, said switch being arranged when actuated to close said solenoid valve automatically to slow down the infeed to a predetermined body feed, and means including an adjustable detent which is movable with said feed piston to actuate said limit switch when the grinding wheel moves into engagement with the work piece to be ground so as to automatically change the rate of infeed to a predetermined body speed regardless of the initial size of the work piece to be ground.

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