

April 1, 1969

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3,435,814

CRUSHING ROLL DRESSER FOR GRINDING WHEELS

Filed Jan. 4, 1966

Sheet 1 of 4

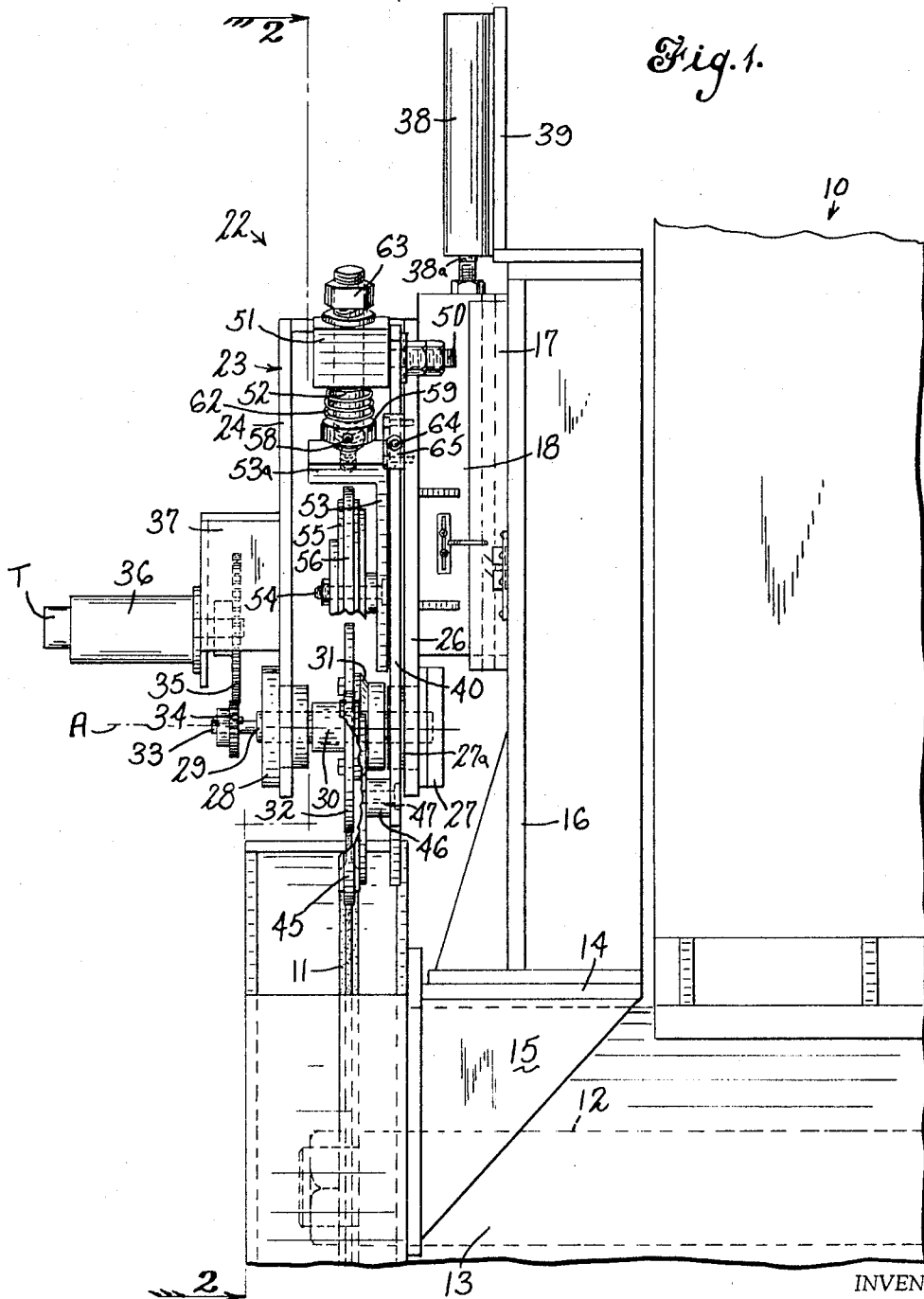


Fig. 1.

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Fig. 6.

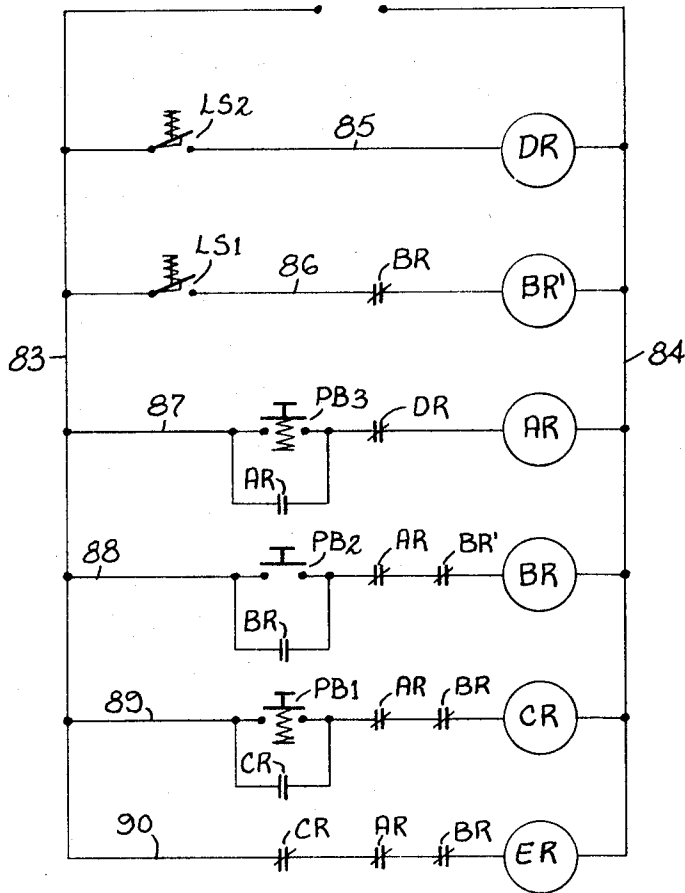
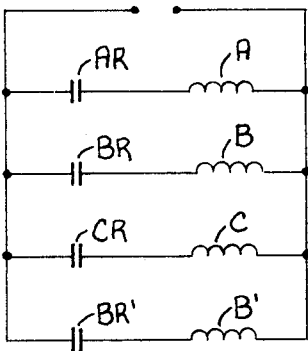


Fig. 7.



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CRUSHING ROLL DRESSER FOR GRINDING WHEELS

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10 Claims

ABSTRACT OF THE DISCLOSURE

A truing device for grinding wheels which includes a disc for contacting the periphery of a grinding wheel and sensing the peripheral speed thereof. An idler disc is arranged to engage the periphery of both the contact disc and a truing wheel to bring the truing wheel to the same peripheral speed as the grinding wheel. As the truing wheel is moved into engagement with the grinding wheel after it is brought up to speed, the idler disc is removed from engagement therewith and the truing wheel is driven by the grinding wheel.

This invention relates to grinding machines, and more particularly relates to grinding machines utilizing a crush-truing device to true the grinding wheel.

In grinding machines, the wheel must be periodically trued, that is, made concentric and given an accurate surface, and also the wheel must be sharpened by removing dull particles therefrom. One form of truing where the grinding wheel is formed and dressed by forcing it to rotate against a hardened steel roll is known as crush-truing. A disadvantage in crush-truing is that it has been necessary to practice crush-truing at very low grinding wheel speeds to prevent the grinding wheel from damaging the crusher roll. This requires that when a grinding wheel is to be crush-trued the grinding wheel speed must be greatly decreased, as by braking, to provide rapid deceleration of the wheel before crushing to minimize the lost grinding time. Also, during crush-truing the grinding wheel is driven at the speed of the crusher wheel by the crusher roll, usually through a low speed gear head motor.

While crush-truing provides an accurate truing of the grinding wheel, it detracts from the operating time of the machine in that the grinding wheel must first be slowed down or stopped and engaged by the crusher roll, the crushing operation performed, and the grinding wheel then brought back to operating speed. Such interruption detracts from the most economical use of the grinding machine. Grinding machines, like other machine tools, represent a large capital investment, and must experience very little, if any, non-operating time to justify such investment.

Accordingly, the present invention provides a crush-truing device which eliminates the requirement for decreasing the speed of the grinding wheel to perform crush-truing. The present invention provides a new and efficient apparatus for bringing a crusher roll into contact with the grinding wheel at the grinding speed of the wheel. The invention provides new and efficient means for sensing the surface speed of the grinding wheel, and bringing the crusher roll up to a speed of revolution which provides a surface speed of the crusher roll equal to the surface speed of the grinding wheel, and then bringing the crusher roll into contact with the grinding wheel and infeeding the crusher roll on the grinding wheel.

Accordingly, an object of this invention is to provide a new and improved crush-truing apparatus.

Another object of this invention is to provide new and

improved apparatus for crush-truing grinding wheels at grinding speeds.

Another object of this invention is to provide new and improved means for synchronizing the surface speed of the crusher roll with the surface speed of the grinding wheel.

A further object of this invention is to provide new and improved apparatus for crush-truing a grinding wheel which minimizes the time required for truing and allows crush-truing at grinding speeds.

Another object of this invention is to provide a new and improved method of crush-truing a grinding wheel.

The features of the invention which are believed to be novel are set forth with particularity and distinctly claimed in the concluding portion of this specification. The invention, however, both as to its organization, operation and method of practice, together with further objects and advantages thereof may best be appreciated by reference to the following detailed description taken in conjunction with the drawings, wherein:

FIG. 1 is a front elevation of a portion of a grinding machine including a crush-truing arrangement embodying the invention;

FIG. 2 is a sectional view of the grinding machine of FIG. 1 seen in the plane of lines 2—2 of FIG. 1;

FIG. 3 is a diagrammatic view of one phase of operation of the apparatus of FIGS. 1 and 2;

FIG. 4 is a diagrammatic view of another phase of operation of the apparatus of FIGS. 1 and 2;

FIG. 5 is a hydraulic system in schematic form illustrating a means of operating the apparatus of FIGS. 1 and 2;

FIG. 6 is a schematic diagram of an electric circuit for sequentially controlling the operation of the apparatus of FIGS. 1 and 2; and

FIG. 7 is a schematic diagram of the actuating solenoids of the hydraulic device of FIG. 5, as related to the control circuit of FIG. 6.

A grinding machine which may embody the invention is generally indicated by the reference numeral 10 and includes a grinding wheel 11 mounted to a spindle 12, driven by a conventional drive means, not shown. Spindle 12 is rotatably mounted in a wheel head 13. Rigidly mounted to machine 10 is a platform 14, extending from a flange member 15. A vertical column 16 extends from platform 14 and carries thereon a vertical guide member 17. Guidably movable in guide 17 is a slide member 18. Slide member 18 may move on ways in guide 17 or other suitable guide means. Carried on slide 18 is a housing member 22 having a portion 23 of general box shape including a front wall 24 and sidewalls 25 and 25a. The back wall of housing member 22 extends laterally therefrom to provide a plate-like member 26 for purposes hereinafter described.

Rotatably carried by plate 26 and front wall 24 in bearing brackets 27 and 28 is a spindle 29 having non-rotatably mounted thereto a hub 30 and cooperating collar 31 for mounting thereon a crusher roll 32 which is positioned directly above grinding wheel 11. A shaft portion of reduced diameter 33 extends from spindle 29 and has mounted thereon a gear 34 drivingly engaged by a gear 35 on the shaft of a hydraulic motor 36 mounted on a bracket 37 carried by front wall 24. Disposed within bearing brackets 27 and 28 are anti-friction bearing assemblies and suitable sealing means therefor (not shown) to rotatably mount spindle 29 in the bearing brackets 27 and 28.

In the arrangement as thus far shown it will be noted that crusher roll 32 is disposed directly above grinding wheel 11 and is adapted to be moved toward and from grinding wheel 11 along a center line which intersects the axis of crusher roll 32 and grinding wheel 11.

Slide 18, together with plate 22 and housing 23 carried thereby, are vertically reciprocal by means of the piston of a hydraulic cylinder 38 mounted on a bracket 39 carried on column 16. The function of cylinder 38 is to move the slide 18 such that crusher roll 32 is moved into and out of engagement with grinding wheel 11.

Pivotaly mounted about the axis of crusher roll 32, about bearing bracket 27 and, more specifically, portion 27a thereof, is a plate member 40 of generally triangular shape, as more clearly shown in FIG. 2. Plate 40 is pivotal about its axis by means of the piston of a hydraulic cylinder 41. Cylinder 41 is carried at the non-piston end thereof on a bracket 42 extending from housing portion 23 and pivotaly mounted to bracket 42 as by means of a pin 43. The piston rod 41a of cylinder 41 is attached to a bracket 44 carried by plate 40. Thus by actuation of cylinder 41 plate 40, which moves vertically with housing 22, is also pivoted either clockwise or counterclockwise with respect thereto, as will hereinafter be described.

Rotatably mounted to plate 40 is a synchronizing disc 45 which is carried on the shank of a mounting member 46 secured to plate 40 as by means of a bolt 47. The shank portion of member 46 carries an anti-friction bearing assembly (not shown) upon which rotates a collar 48 upon which the synchronizing disc 45 is mounted. Synchronizing disc 45, as will hereinafter be more fully explained, is adapted to contact the peripheral surface of grinding wheel 11 and sense the speed or peripheral velocity thereof.

Pivotaly mounted to plate 40 at the upper portion thereof by means of a pin 50 is a block 51 having a shaft 52 extending therethrough and into a member 53 supported thereon. A non-rotative shaft 54 is carried in support member 53 and by means of an anti-friction bearing assembly thereon (not shown) rotatably mounts a collar 55 for carrying an idler wheel 56 thereon. Positioned on shaft 52 by means of a set screw 58 is a spring seat 59. Positioned about shaft 52 between spring seat 59 and block 51 is a coil spring 62 arranged to bias shaft 52 and member 53 carried thereby in a generally vertical direction and urge idler wheel 56 into contact with synchronizing disc 45. Shaft 52 is threaded at the upper portion thereof to receive an adjusting nut 63 whose position thereon determines the lower limit of the vertical position of idler disc 56.

Pivotal movement of plate 40 in a clockwise direction is limited by the setting of an adjusting screw 64 carried in a bracket 65 on plate 26 and positioned thereon by a lock nut 66. In a similar manner counterclockwise movement of plate 40 is limited by a bolt 67 threadably received in the upper flange 53a of member 53 and locked in position by means of a nut 68. The head of bolt 67 engages a stopping surface 69 defined on one sidewall 25b of housing portion 23.

Support member 53 is biased downwardly by spring 62 toward synchronizing disc 45 and held in engagement thereon by bias of spring 62. Spring 62 will urge member 53 downwardly until nut 63 contacts block 51. This bias of spring 62 will also tend to move idler disc 56 into contact with crusher roll 32. However, such lateral movement is prevented by bolt 67 engaging surface 69 until plate 40 is pivoted clockwise about axis A by cylinder 41. Stopping bolt 67 will limit any movement of plate 40 which might tend to cause idler disc 56 to ride up and over synchronizing disc 45.

In an operative position prior to commencing a crushing operation, crusher roll 32, idler disc 56 and synchronizing disc 45 are in the position shown in FIG. 3 with respect to grinding wheel 11.

During grinding operation of the grinding wheel 11, the piston 38a of cylinder 38 is retracted holding crusher roll 32 above the surface of grinding wheel 11 and the piston of cylinder 38 is also retracted holding synchronizing disc 45 out of contact with grinding wheel 11. The

stopping bolt 67 engages surface 69 and holds idler disc 56 in engagement with synchronizing disc 45 and out of engagement with crusher roll 32. This condition is illustrated in FIG. 3.

When a trueing operation is to be performed, hydraulic motor 36 is actuated and through gears 35 and 34, and spindle 29 brings crusher roll 32 up to a speed such that the periphery thereof is moving at substantially the same velocity as the periphery of grinding wheel 11. This may be determined by a tachometer driven by motor 36 and having suitably calibrated means for indicating the speed of crusher roll 32. Cylinder 41 is then actuated to pivot plate 40 clockwise about axis A. When this occurs, idler disc 56 under the bias of spring 62 is urged downwardly and laterally into engagement with crusher roll 32, and motion is imparted to idler disc 56 and synchronizing disc 45. Synchronizing disc 45 then comes into contact with grinding wheel 11, and crusher roll 32, idler disc 56 and synchronizing disc 45 are in the position shown in FIG. 4. The synchronizing disc 45 in contact with grinding wheel 11 now senses the peripheral speed thereof and drives idler disc 56 at this peripheral speed. The drive to crusher roll 32 by hydraulic motor 36 was ceased prior to or simultaneously with actuation of cylinder 41, and idler disc 56 brings crusher roll 32 up to a speed of rotation such that the velocity of its periphery is identical to or essentially the same as that of the peripheral velocity of grinding wheel 11.

Next, slide 18 is moved downwardly by piston 38 to bring crusher roll 32 into engagement with the grinding wheel and simultaneously the piston 41a of cylinder 41 is retracted to pivot plate 40 counter-clockwise and remove synchronizing disc 45 from engagement with grinding wheel 11. At this time cylinders 38 and 41 are actuated simultaneously so that synchronizing disc 45 leaves engagement with the grinding wheel 11 and the crusher roll 32 is brought into engagement therewith, and also stop 67 engaging surface 69 moves idler disc 56 out of engagement with crusher roll 32. Now, crusher roll 32 will be driven by grinding wheel 11 which is still rotating at its grinding speed and crush-trueing of grinding wheel 11 will be accomplished. The trueing of the crusher roll to the grinding wheel is regulated by the flow of hydraulic fluid to cylinder 38 and means are provided to predetermine and limit the depth of cut of the crusher roll on the grinding wheel. Limit switches LS1 and LS2 are adjustably positioned on guide 17 and arranged to be actuated by an adjustably positionable arm AR on slide 18. As will be more fully explained hereinafter, when switch LS1 is closed, cylinder 41 retracts plate 26 and cylinder 38 moves slide 18 down. When switch LS2 is closed cylinder 38 retracts slide 18.

When the crushing operation has been completed, hydraulic fluid is introduced and discharged from cylinder 38 to move slide 18 upwardly and crusher roll 32 out of engagement with grinding wheel 11. At this time the relative position of crusher roll 32 to synchronizing disc 45 and idler disc 56 is as shown in FIG. 3. During the crushing operation, the relationship of these elements is as shown in FIG. 2.

The cylinders 38 and 41 together with hydraulic motor 36 are operated by a hydraulic circuit generally designated by the reference 70, FIG. 5.

Such system comprises a source of hydraulic fluid 71, a pump P adapted to supply hydraulic fluid under pressure through lines 72, 73 and two-way valve 74 to cylinder 38 which is normally in a position to allow introduction of fluid to retract the piston 38a thereof. Valve 74, upon energization of solenoid A, is moved to a position such that fluid is introduced into cylinder 38 to extend the piston thereof, thereby moving slide 18 downward and crusher roll 32 thereon toward the grinding surface of wheel 11. The piston 41a of cylinder 41 is normally in a retracted position through the application of hydraulic fluid through line 75 when solenoid B is energized and

solenoid B' de-energized. When solenoid B' is energized hydraulic fluid is introduced thereto through line 76 and piston 41a is extended to pivot plate 40 clockwise and move synchronizing disc 45 towards engagement with the roll. Hydraulic fluid is supplied to motor 36 through line 78 and exhausted therefrom through valve 80. The hydraulic fluid exhausted from the cylinders 38 and 41 and motor 36 is returned to the source through line 81. Pressure relief valve 82 is placed in line 83 bypassing the pump P back to source 71. The operation of the hydraulic circuit of FIG. 5 and the mechanism as a whole may be more fully understood by reference to the schematic diagram, FIGS. 6 and 7.

FIG. 6 illustrates the electrical control circuitry, and FIG. 7 exemplifies the solenoid operating circuitry. In FIG. 7, the relays which control the sequencing of operation are shown connected in parallel across control bus lines 83 and 84 connected to a suitable source of control voltage. In the circuit of FIGS. 6 and 7, relays and the contacts controlled thereby, bear the same identifying reference throughout.

To initiate a trueing cycle, switch PB1 is depressed energizing relay CR in line 89 which latches itself in and further picks up its contact in series with solenoid C, FIG. 7. Solenoid C then moves valve 80 to the position shown in FIG. 5 and motor 36 is energized to bring crusher roll 32 to a speed of rotation to give it a peripheral velocity substantially approximating the peripheral velocity of the grinding wheel. When motor 36 has attained a desired speed of rotation as may be indicated by tachometer T, switch PB2, line 88, is closed to energize relay BR which picks up its contact in that line and latches itself in and also opens its contact in line 89 to de-energize relay CR, and solenoid C to de-activate hydraulic motor 36. If desired, a hydraulic clutch (not shown) may be utilized to connect motor 36 to gear 34 and may be actuated by the relay ER in line 90. It will be noted that relay ER is energized when relay CR picks up its contact in line 90 to clutch the shaft of motor 36 to gear 34 and bring crusher roll 32 up to the desired speed. When this construction is utilized energization of relay BR opens line 90 and de-energizes relay ER which would declutch motor 36 from gear 34.

When relay BR is energized it picks up its contact in series with the coil of solenoid B, FIG. 7. Solenoid B operates two-way valve 77 and supplies fluid to cylinder 41 to extend the piston thereof and pivot plate 40 clockwise to bring synchronizing disc 45 into contact with the periphery of grinding wheel 11. As plate 40 is pivoted clockwise, idler disc 56 under the bias of spring 62 moves into engagement with crusher roll 32. At this time, crusher roll 32, idler 56 and synchronizing disc 45 are rotating in the direction shown in FIG. 4. The rotation previously imparted to crusher roll 32 by hydraulic motor 36 cushions any shock which might otherwise occur by rotating idler disc 56 moving into contact with an otherwise non-rotating crusher roll. At this time, synchronizing disc 45 attains a peripheral velocity equal to the peripheral velocity of grinding wheel 11 as does idler disc 56 and therefore crusher roll 32.

Then relay AR in line 87 is energized by closing switch PB3. Relay AR is latched in by closing of its contact bridging the terminals of switch PB3 and picks up its contact in series with solenoid A. Solenoid A then positions two-way valve 74 to produce extension of the piston 38a of cylinder 38 and move crusher roll 32 towards grinding wheel 11. The normally closed AR contact in line 88 is opened and relay BR is de-energized. Solenoid B is then de-energized and valve 77 is biased to its neutral position. Just prior to crusher roll 32 engaging grinding wheel 11, slide 18 contacts a first limit switch LS1 in line 86 which closes line 86 and energizes relay BR'. Relay BR' then picks up its contact in series with solenoid B'. Hydraulic fluid is then introduced through line 75 to cylinder 41 to cause retraction thereof and counter-clock-

wise pivotal motion of plate 40. Then, as stop 67 hits surface 69, idler disc 56 will ride up on synchronizing disc 45 which is moved out of engagement with grinding wheel 11 just before crusher roll 32 moves into engagement therewith. At this time crusher roll 32 is rotating at a speed which produces a peripheral velocity equal to the peripheral velocity of the surface of grinding wheel 11.

Crusher roll 32, upon making engagement with grinding wheel 11 is driven thereby as it is infed by cylinder 38 at a predetermined slow rate set by a flow-regulating valve (not shown) incorporated in cylinder 38. The extent of the infeed of crusher roll 32 on grinding wheel 11 is determined by the setting of a second adjustable limit switch LS2, shown as operated by slide 18. When slide 18 closes limit switch LS2 relay DR is energized and drops out its normally closed contacts in line 87 to de-energize relay AR. Relay AR then drops out its contact in series with the coil of solenoid A and two-way valve 74 is operated under the bias of spring 74a to its normal position. Hydraulic fluid is now supplied to cylinder 38 through line 72 causing retraction of the piston thereof and raising of slide 18 to its retracted position.

At this time, the crusher roll 32 has accomplished trueing of the grinding wheel 11 at grinding speed of the wheel and is now being retracted. With this arrangement no grinding machine time is lost in decelerating the grinding wheel for crush-trueing and then accelerating the grinding wheel to bring it back up to operative grinding speed.

While a first preferred operating sequence has been disclosed, it will be apparent that the hydraulic motor 36 may be utilized through crusher roll 32 to bring idler disc 56 and synchronizing disc 45 up to approximate peripheral speed by having all initially in engagement, engaging the grinding wheel 11 with the synchronizing disc 45, then moving plate 40 counterclockwise as slide 18 is moved downwardly so that stopping bolt 67 engages surface 69 and moves idler disc 56 out of engagement with crusher roll 32 before crusher roll 32 engages grinding wheel 11. For this operation a neutral position of piston 41a is selected such that bolt 67 is not in engagement with surface 69. Such engagement would occur only upon retraction of piston 41a from or through a neutral position.

This may be accomplished by the addition of a return spring between solenoid B' and valve 77 similar to return spring 77a, so that valve 77 is returned to a neutral position when solenoid B' is de-energized when limit switch LS1 is opened when slide 18 is raised following a trueing operation.

Accordingly it may be seen that the objects of the invention set forth above as well as those made apparent in the preceding description are efficiently attained. While preferred embodiments of the invention have been set forth for purposes of disclosure, other embodiments thereof as well as modifications to the disclosed embodiments may be made without departing from the scope of the invention. Accordingly, the appended claims are intended to cover all embodiments of the invention as well as modifications to the disclosed embodiments thereof which do not depart from the spirit and scope of the invention.

What is claimed is:

1. In a grinding machine including a grinding wheel; support means carried by said grinding machine, a crusher roll, a support member rotatably mounting said crusher roll, said support member being movable on said support means to bring said crusher roll into engagement with the grinding wheel and move it away therefrom, a contact disc rotatably mounted on said support member for engaging the periphery of the grinding wheel and sensing the surface velocity thereof, an idler disc engageable with the peripheries of said contact disc and said crusher roll to bring the peripheral velocity of said crusher roll to essentially the same peripheral velocity as the grinding wheel and means for moving said support member to

bring said crusher roll into engagement with the grinding wheel at said like surface velocity.

2. The apparatus of claim 1 wherein said means for moving is arranged to infeed said crusher roll on the grinding wheel while said crusher roll is driven by the grinding wheel.

3. The apparatus of claim 1 further including means biasing said idler disc into engagement with said contact disc.

4. The apparatus of claim 1 further including means for withdrawing said contact disc from the grinding wheel before said crusher roll engages the grinding wheel.

5. The apparatus of claim 2 further including means for predetermining the extent of infeed of said crusher roll on the grinding wheel and causing said support member to withdraw said crusher roll from the grinding wheel when said predetermined degree of infeed has been obtained.

6. The apparatus of claim 1 further including drive means for initiating rotation of said crusher roll and means responsive to said contact disc being moved into engagement with the grinding wheel for de-activating said drive means.

7. The method of crush-trueing a grinding wheel with a crusher roll which comprises the steps of sensing the peripheral speed of the grinding wheel, imparting to the crusher roll a rotational speed which produces a peripheral speed thereof essentially equal to the peripheral speed of the grinding wheel while said crusher roll is out of engagement with the grinding wheel, bringing the periphery of the rotating crusher roll into engagement with the periphery of the grinding wheel, rotatably driving the crusher roll solely by the grinding wheel contact therewith, and feeding the crusher roll in upon the grinding wheel while it is so driven.

8. In a grinding machine including a grinding wheel; support means carried by said grinding machine, a crusher roll, a support member rotatably mounting said crusher roll, said support member being movable on said support means to bring said crusher roll into engagement with the grinding wheel and move it away therefrom, a plate member pivotally mounted to said slide member about the axis of rotation of said crusher roll, a disc rotatably carried on said plate member, said plate member being pivotal to bring said disc into engagement with said grinding wheel, an idler disc carried on said plate and responsive to pivotal movement of said plate member for engaging said crusher roll and said disc and bringing said crusher roll to a speed of rotation to impart thereto a peripheral velocity essentially equal to the peripheral

velocity of said grinding wheel, means for moving said support member to bring said crusher roll into engagement with said grinding wheel and means responsive to movement of said crusher roll toward said grinding wheel to move said idler disc from engagement therewith.

9. In a grinding machine including a grinding wheel; support means carried by said grinding machine, a crusher roll, a support member rotatably mounting said crusher roll, said support member being movable on said support means to bring said crusher roll into engagement with the grinding wheel and move it away therefrom, means for sensing the surface velocity of the grinding wheel, means responsive to said sensing means for producing rotation of said crusher roll to produce a like surface velocity thereof, means for moving said support member to bring said crusher roll into engagement with the grinding wheel at said like surface velocity, means for disengaging said rotation producing means, and means for feeding said crusher roll into said grinding wheel as said grinding wheel drives said crusher roll.

10. In a grinding machine including a grinding wheel; support means carried by said grinding machine, a crusher roll, a support member rotatably supporting said crusher roll, said support member being movable on said support means to bring said crusher roll into engagement with the grinding wheel and move it away therefrom, plate member mounted to said support member for pivotal movement, a disc rotatably mounted to said plate member and adapted to be brought into engagement with the grinding wheel, an idler disc, hanger means for supporting said idler disc, said hanger means being pivotally mounted to said plate member and spaced from the axis of rotation of said idler disc, biasing means acting to bias said idler disc into engagement with both said crusher roll and said sensing disc, and means preventing said idler disc from moving into engagement with said crusher wheel when said plate member is positioned to hold said synchronizing disc from engagement with the grinding wheel.

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