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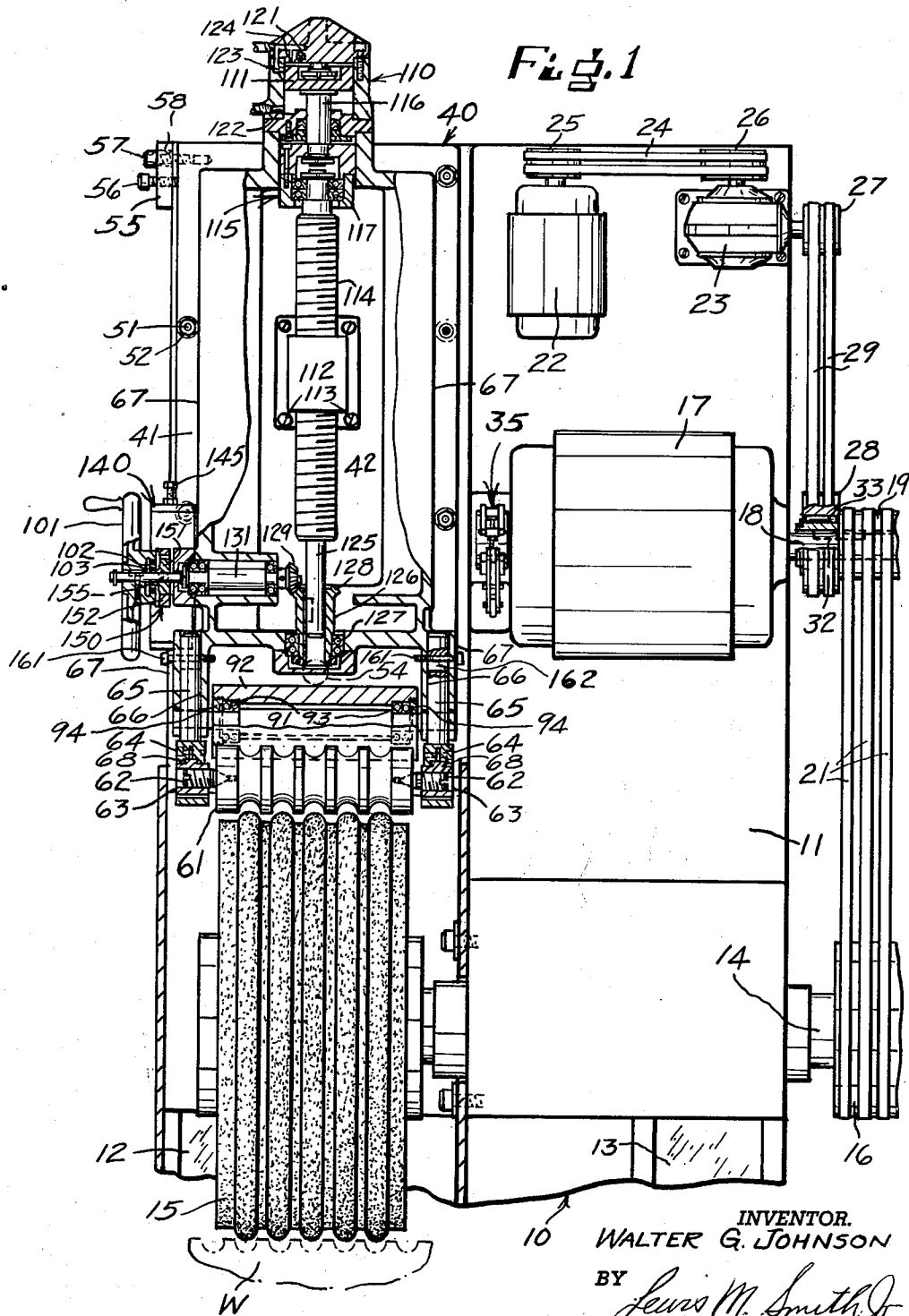
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3,125,087

CRUSH TRUING DEVICE FOR GRINDING MACHINES

Filed June 11, 1962

2 Sheets-Sheet 1



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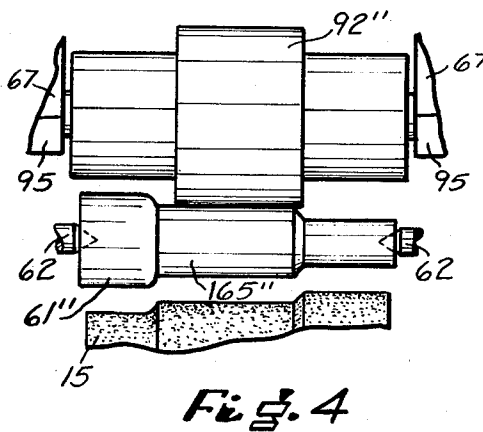
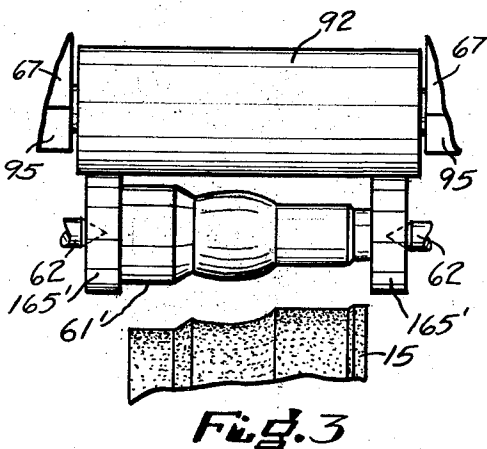
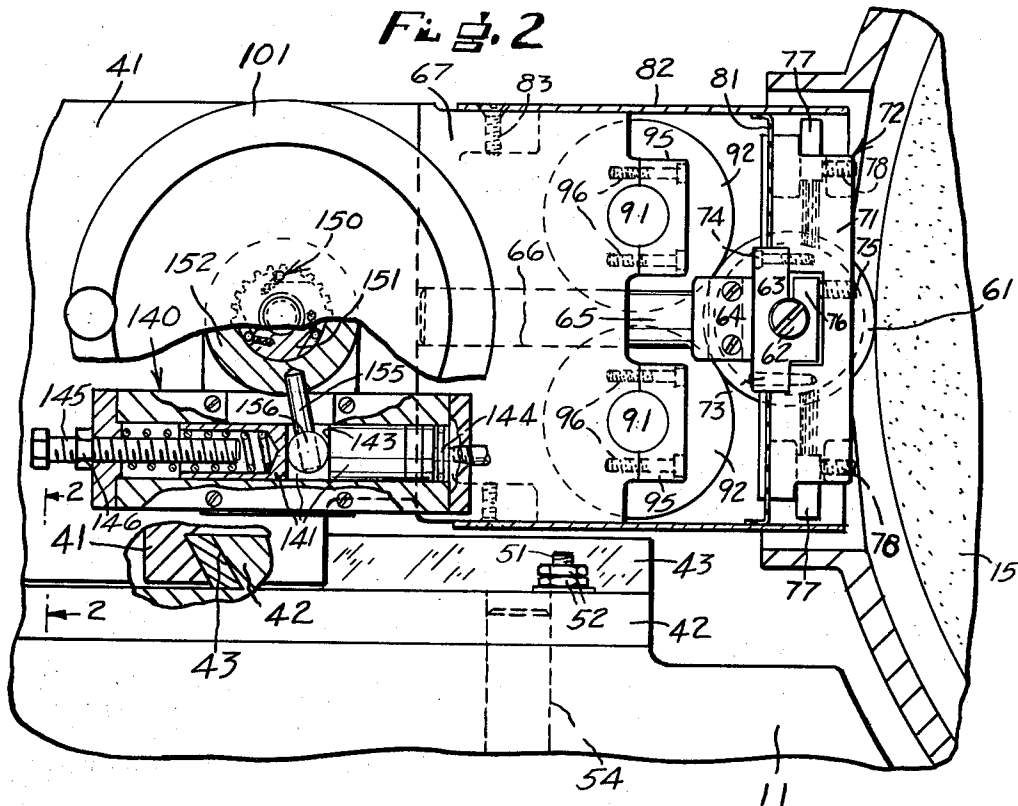
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2 Sheets-Sheet 2



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CRUSH TRUING DEVICE FOR GRINDING MACHINES

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11 Claims. (Cl. 125—11)

The present invention relates to a grinding machine and more particularly to a crush truing device operable periodically first to establish and thereafter to maintain the desired contour on the face of a grinding wheel rotatably mounted on a grinding machine.

Since crush truing operations inherently involve the application of a substantial load on the bearing supports for a crushing roll as it is moved into bearing engagement with the surface of a grinding wheel, the provision of adequate bearing support for the crushing roll poses a serious problem, especially in view of the necessity for providing adequate protection of the bearing support from the intrusion of the abrasive material inevitably present in substantial quantities at the site of grinding and truing operations.

The instant invention contemplates a crush truing device for use on a cylindrical grinding machine including means for feeding a crushing roll toward the periphery of a grinding wheel mounted upon the wheel slide of such a grinding machine, while the grinding wheel is rotated at a relatively low speed by suitable auxiliary drive means mounted on the grinding machine for this purpose. The crush truing device characterizing the instant invention includes a structural arrangement providing maximized support for the crushing roll by means of multiple heavy duty anti-friction bearing assemblies so arranged that the crushing roll may be replaced readily without disassembling the structural elements enclosing the anti-friction bearing assemblies, with the advantageous result that these bearing assemblies need not be exposed to abrasive particles when the crushing roll is changed.

While not limited to such an application, the device comprising the instant invention is particularly useful on relatively large roll grinding machines for grinding and for refinishing the large rollers used in rod mills to form and finish steel rods. Since these rod mill rolls are typically more than a foot in diameter and up to eight feet in length, the grinding wheel used to finish and to recondition these rolls is preferably up to a foot in width. Accordingly, the improved support for the crushing roll and the structural arrangement facilitating the replacement of the crushing roll embodied in the instant invention are particularly important in this heavy duty application involving the use of a relatively long crushing roll and the generation of substantial forces over a large working area during the crushing operation.

An object of the present invention is the provision of a crush truing mechanism arranged so that the crushing roll may be changed quickly without disassembling the structural elements supporting and enclosing the precision bearing assemblies supporting the crushing roll.

Another object is the provision, in a crush truing mechanism, of multiple precision bearing assemblies for supporting a crushing roll which are fully enclosed in multiple back-up rolls disposed in bearing engagement with the crushing roll so that they support and precisely position the crushing roll as it is forced into bearing engagement with a grinding wheel during a crush truing operation.

Still another object is the provision of a crush truing mechanism including a pair of back-up rolls mounted on a truing slide for free rotation about spaced parallel axes so that both back-up rolls are disposed in bearing engagement with a common crushing roll at multiple spaced in-

2

tervals along the length of a crushing roll during a crush truing operation in order to provide bearing support for a crushing roll which is distributed relatively uniformly over the entire length of the crushing roll.

A further object is the provision of a crush truing mechanism arranged to provide effectively distributed support for a relatively long crushing roll suitable for crush truing the entire peripheral face of a wide grinding wheel in a single crushing operation.

Other objects and advantages of the instant invention will become apparent from consideration of the following description in relation to the showing in the drawings wherein:

FIG. 1 is a partial plan view with portions broken away of the preferred embodiment of the instant invention shown in operative relation to portions of a typical grinding machine,

FIG. 2 is a detailed side elevation, partially in section, of a portion of the preferred embodiment of the instant invention,

FIG. 3 is a schematic partial plan view of an alternative configuration of the crushing roll and the back-up rolls of the instant invention, and

FIG. 4 is a schematic partial plan view of another alternative configuration of the crushing roll and the back-up rolls of the instant invention.

Referring now to the drawings, wherein like reference numerals refer to like or corresponding parts and more particularly to the showing in FIG. 1, a wheel driving assembly generally designated by the reference numeral 40 embodying the instant invention is illustrated in operative relation to a cylindrical grinding machine including a base generally designated by the reference numeral 10 provided with slideways 12 and 13 slidably supporting a wheel slide 11 supporting a spindle assembly 14 rotatably supporting a grinding wheel 15 on one end thereof and a sheave 16 on the other end thereof. The wheel slide 11 also supports a wheel drive motor 17 provided with a drive shaft 18 supporting a sheave 19 connected to the sheave 16 by drive belts 21.

The grinding machine assembly illustrated in FIG. 1 is provided with means for rotating the grinding wheel 15 at a relatively low speed during the wheel truing operation. As illustrated in FIG. 1, the auxiliary wheel drive means includes an auxiliary drive motor 22 and a gear reducer 23, both mounted upon the wheel slide 11 and operatively interconnected by drive belts 24 interconnecting sheaves 25 and 26 respectively secured to the auxiliary drive motor 22 and the gear reducer 23. The gear reducer 23 is in turn operatively connected to the grinding wheel 15 by means of a sheave 27 mounted on the output shaft of the gear reducer 23 and a sheave 28 mounted on the shaft 18 of the wheel drive motor 17 so that sheaves 27 and 28 may be interconnected by drive belts 29.

From consideration of the showing in FIG. 1, it will be evident that the auxiliary drive also includes the spindle assembly 14 supporting the grinding wheel 15, the sheaves 16 and 19, and the drive belts 21 of the main drive. In fact, the sheaves 19 and 28 may both be secured to the motor drive shaft 18 by a common key 32.

The sheave 28 is preferably provided with an over-running clutch assembly 33 so that the auxiliary drive means including auxiliary drive motor 22 and gear reducer 23 will remain stationary when the wheel drive motor 17 is operating. On the other hand, since the wheel drive motor 17 operates at a much higher speed than auxiliary drive motor 22, the wheel drive motor 17 is provided with a conventional brake assembly 35 which may be actuated by suitable means such as a solenoid so that the brake assembly 35 is operable to stop the rotation of the wheel drive motor 17 whenever it is deenergized before the auxiliary drive motor 22 is operated.

Referring now both to the showing in FIG. 1 and to the showing in FIG. 2, it will be evident that the truing slide 41 of the wheel truing assembly 40 may conveniently be slidably supported on the upper surface of the wheel slide 11 by means of a slideway 42 provided with a dove tail 43 associated with an adjustable gib 44 for sliding engagement with opposing surfaces 45 on the underside of the truing slide 41 in the manner well known in the art. The relationship between the dove tail 43, the gib 44 and one of the surfaces 45 of the truing slide 41 is best illustrated in the detailed cross section superimposed on FIG. 2 and shown rotated 90° from the section indicated by section line 2—2 of FIG. 2.

While the slideway 42 may be conveniently secured to the wheel slide 11 by a plurality of attachment bolts 51 and nuts 52, its proper precise alignment relative to the wheel slide 11 may be facilitated by providing sufficient clearance around the attachment bolts 51 to permit limited displacement of the slideway 42 about a pin 54 projecting from the upper surface of the wheel slide 11. The displacement of the slideway 42 about the pin 54 may be controlled accurately by a suitable precision adjustment means which may comprise a lug 55 secured to and projecting upwardly from the wheel slide 11, a first stop screw 56 threadably engaging the lug 55 and bearing against the slideway 42, and a second stop screw 57 threadably engaging the slideway 42 and passing through a clearance hole 58 in the lug 55 so that its head bears against the lug 55.

The truing slide 41 comprises a hollow elongated housing supporting a crushing roll 61 at the end of the truing slide nearest the grinding wheel 15 for free rotation about a horizontal axis parallel to the axis of rotation of the spindle assembly 14 supporting the grinding wheel 15. In the embodiment of the instant invention illustrated in FIGS. 1 and 2, the crushing roll 61 is supported on a pair of conically pointed screws 62 threadably engaged in a pair of supporting blocks 63 adjustably secured to the head end portions 64 of a pair of supporting rods 65 slidably supported in a pair of suitable openings 66 extending lengthwise of the opposite side walls 67 of the truing slide 41. The respective supporting blocks 63 may be adjusted vertically relative to the respective end portions 64 of the respective supporting rods 65 by means of dove tail slides 68 and secured in the proper positions by tightening pairs of lock screws threadably engaging the respective head end portions 64 of the supporting rods 65. The opposite side members 71 of a rectangular frame assembly generally designated by the reference numeral 72 may be secured to the respective supporting blocks 63 by suitable attachment means such as the taper pin 73 and the screw 74 shown in FIG. 2. The rectangular frame assembly 72 supports locking screws 75 threadably engaged therewith for bearing arrangement against clamping lugs 76 on the respective supporting blocks 63 to secure the respective screws 62 in the desired fixed relation to the respective supporting blocks 63. In addition, the rectangular frame assembly 72 supports an opposed pair of brush assemblies 77 secured therein by clamp screws 78 so that the ends of the brushes extend into engagement with the surface of the crushing roll 61. The rectangular frame assembly 72 also supports a diaphragm 81 disposed in sliding engagement around its periphery with the inner surface of a shroud 82 secured to the truing slide 41 by attachment screws 83.

Since very substantial forces are generated between the grinding wheel 15 and the crushing roll 61 during the crush truing operation, the crushing roll 61 must necessarily be supported for rotation by bearing means protected against the intrusion of abrasive material and capable of withstanding the substantial forces imposed thereon. As illustrated in FIGS. 1 and 2, the bearing means backing up the crushing roll 61 comprises a pair of vertically spaced horizontally disposed shafts 91 each supporting a back-up roll 92 on a spaced pair of anti-friction

bearing assemblies 93 secured within shouldered recesses at the opposite ends of the back-up rolls 92 by retaining covers 94 encircling the shafts 91 and threadedly engaged with the ends of the back-up rolls 92. The opposite ends of each shaft 91 are secured in a pair of supports attached to or formed integrally with the side walls 67 of the truing slide 41 each including a cap 95 secured by a pair of attachment screws 96, as shown in FIG. 2.

By means of the structural configuration described above, the crushing load imposed along the length of the crushing roll 61 by its engagement with the periphery of the grinding wheel 15 is opposed by the surfaces of the respective back-up rolls 92 disposed in bearing engagement with multiple segments of the peripheral surface of the crushing roll 61 spaced at intervals along its length as shown best in FIG. 1.

A crush truing operation on the grinding wheel is performed as indicated generally above by displacing the crushing roll 62 radially toward the grinding wheel 15 with the grinding wheel rotating at a relatively low speed suitable for such an operation until the shape of the crushing roll 61 is impressed upon the periphery of the grinding wheel 15 as indicated in FIG. 1 by bearing engagement between the crushing roll 61 and the grinding wheel 15.

This operation can be performed manually by rotating the hand wheel 101 to advance the crushing roll 62 into engagement with the grinding wheel 15. However, this operation is preferably performed either semi-automatically or automatically by actuation of a suitable feeding mechanism which may comprise hydraulically actuated components such as those illustrated in FIGS. 1 and 2.

As illustrated in FIG. 1, the truing slide 41 is provided with a cylinder assembly generally designated by the reference numeral 110 fixedly secured to one end thereof and the slideway 42 is coupled to a piston 111 through a full nut 112 fixedly secured to the slideway 42 by attachment screws 113, an elongated screw 114, a coupling assembly 115, and a piston rod 116 secured to the piston 111. Since the piston 111 is enclosed by the cylinder assembly 110, the application of pressure fluid through ball check valve 121 to the rearward or upper end of the cylinder assembly 110 as seen in FIG. 1, with the piston 111 disposed as shown in FIG. 1, will displace the truing slide 41 so as to withdraw the crushing roll 61 from the grinding wheel 15. Conversely, with the piston 111 disposed at the other end of the cylinder assembly 110, the application of pressure fluid through the port 122 to the front or lower end of cylinder assembly 110 as seen in FIG. 1 will produce the movement of truing slide 41 necessary to advance the crushing roll 61 toward the grinding wheel 15, first at a relatively rapid rate determined by the rate at which exhaust fluid passes through the port 123 and then at a slower rate determined by the rate at which exhaust fluid passes through the restricted throttle valve 124 after the piston 111 blocks the port 123.

Since the feed screw 114 is secured to the coupling assembly 115 by means of anti-friction bearing assemblies 117, it is freely rotatable relative to the coupling assembly 115 notwithstanding the fact that it is fully constrained lengthwise of the piston rod 116 by the coupling assembly 115, and since the feed screw 114 is threadably engaged in the nut 112, the rotation of the feed screw 114 in the nut 112 produces displacement of the coupling assembly 115, the piston rod 116 and the piston 111 relative to the nut 112 and the slideway 42 to which it is fixedly secured. Since the piston 111 interacts with the cylinder assembly 110, the rotation of feed screw 114 produces a corresponding displacement of the truing slide 41 relative to the slideway 42 in the absence of any change in the disposition of the cylinder assembly 110 relative to the piston 111. Therefore the feed screw 114 constitutes a differential adjusting means for the position of the truing slide 41 relative to the slideway 42.

In order to clarify the showing of the crushing roll 61 in FIG. 1, the crushing roll 61 is shown spaced from

the grinding wheel 15 notwithstanding the fact that the piston 111 is shown bottomed at the rear end of the cylinder assembly 110 to position the truing slide 41 in the forward position it reaches at the end of a crush truing operation in which the crushing roll 61 must be fully engaged with the grinding wheel 15. In order to achieve the proper relationship between the crushing roll 61 and the truing slide 41 for a crush truing operation, the differential adjusting means comprising the feed screw 114 described above may be rotated by the control means described immediately below in the proper sense and by the proper amount to effect the proper relationship between the position of the crushing roll 61 and the position of the truing slide 41 as determined by the position of the surface of the grinding wheel 15.

The control means selectively operable to rotate the feed screw 114 includes a shaft extension 125 at the forward end of the feed screw 114 keyed in sliding engagement with a sleeve 126 rotatably secured to the truing slide 41 by means of an anti-friction bearing assembly 127 and provided with a bevel gear 128 formed integrally therewith. The control means for rotating the feed screw 114 also includes a bevel gear 129 engaging bevel gear 128 and fixedly secured to one end of a shaft 131 rotatably supported in the truing slide 41 upon spaced anti-friction bearing assemblies and in turn supporting the hand wheel 101 at its other end outside truing slide 41. Since the hand wheel 101 is keyed to shaft 131 in sliding engagement therewith, displacement of the truing slide 41 relative to the slideway 42 along the dove tail 43 can be effected manually by rotation of the hand wheel 101, as noted above.

The control means for rotating feed screw 114 as shown in FIGS. 1 and 2 additionally includes a cylinder assembly generally designated by reference number 140 enclosing a piston 141 biased to the right within cylinder assembly 140 as seen in FIG. 2 by a biasing spring 142 and arranged to be displaced to the left within cylinder assembly 140 as seen in FIG. 2 by the application of pressure fluid to the right hand end of piston 141 through the orifice 144 in the right hand end of cylinder assembly 140 as seen in FIG. 2. The piston stroke produced by the application of pressure fluid to piston 141 is limited by the adjustable stop screw 145 secured in fixed relation to the cylinder assembly 140 by lock nut 146.

With the hand wheel 101 disposed to the right on shaft 131 as seen in FIG. 1, the feed screw 114 already operatively connected to the shaft 131 and thence to the hand wheel 101 in the manner described above is also operatively connected to the piston 141 through an internal gear 102 formed integrally with the hand wheel 101 engaged with an external gear 103 formed integrally with or fixedly secured to the inner driven element 151 of a conventional overrunning clutch assembly generally designated by the reference numeral 150 and thence through the outer driving element 152 of the clutch assembly 150 provided with a pin 155 projecting radially therefrom and having a circular head 156 disposed in closely inter-fitting sliding engagement with a transverse slot 143 in the piston 141.

With the actuating mechanism described immediately above included in the control means for rotating the feed screw 114 by moving the hand wheel 101 to the right as seen in FIG. 1, the semi-automatic or automatic application of pressure fluid to piston 141 after each crush truing operation will rotate the clutch 150 and thence the shaft 131 to produce rotation of the feed screw 114 sufficient to effect displacement of the truing slide 41 relative to the slideway 42 in the sense and through the distance necessary to compensate for the reduction in the size of the grinding wheel 15 resulting from the previous crush truing operation, so that the crushing roll 61 is properly positioned relative to the grinding wheel 15 for the next crush truing operation.

Before the crush truing operation is performed on the

grinding wheel 15, the grinding wheel must be withdrawn from the work piece W by retracting the wheel slide 11. Next, the wheel drive motor 17 is deenergized and brought to rest by engaging brake assembly 35 until the shaft 18 stops rotating. Then the brake assembly 35 is released and the auxiliary drive motor 22 is energized to rotate the grinding wheel 15 at a relatively low speed for the crush truing operation. Finally, pressure fluid is applied to the front or lower face of piston 111 as seen in FIG. 1 to move the crushing roll 61 into engagement with the periphery of the grinding wheel 15. When the crushing roll 61 has rolled in bearing engagement with the periphery of the grinding wheel 15 for a time sufficient to restore the desired contour to the face of the grinding wheel 15, the truing slide 14 and the crushing roll 61 supported thereby are withdrawn from the grinding wheel by applying pressure fluid to the rear or upper face of piston 111 as seen in FIG. 1.

When the crushing roll 61 has been withdrawn from the grinding wheel 15, the auxiliary driving motor 22 is deenergized and the wheel drive motor 17 is once again energized to bring the grinding wheel 15 up to the normal grinding speed. Thereafter, the grinding operation may be resumed by feeding the wheel slide 11 toward the work piece W.

While the back-up rolls 92 are shown as plain cylinders, a configuration generally satisfactory for use with many crushing roller configurations, it is to be understood that the surface contour of the back-up rolls 92 may be modified as necessary to provide additional bearing support along the length of the crushing roll 61. When the back-up rolls 92 are shaped as shown in the drawings, the replacement of a worn crushing roll or the substitution of a crushing roll of a different configuration may be accomplished very quickly simply by displacing the hand wheel 101 to the left as seen in FIG. 1 to disengage the gears 102 and 103 so that the truing slide 41 can be moved a substantial distance along the slideway 42 toward the rear of the machine. Thereafter it is merely necessary to withdraw the supporting rod 65 from the openings 66 in the truing slide 41 and then to insert supporting rods 65 for a different crushing roll 61 in the same openings 66.

While the wheel truing assembly 40 is illustrated in a position such that the truing slide 41 moves horizontally along the slideway 42, it is equally satisfactory when disposed so that the truing slide 41 may be moved radially of the grinding wheel along any convenient radius thereof. For example, the slideway 42 may be mounted above the grinding wheel so that the truing slide 41 moves vertically along the slideway 42.

When the truing slide 41 is so disposed that the crushing roll 61 is located beneath rather than above or on one end of the truing slide 41, it may be constrained against inadvertent detachment from the truing slide by any suitable releasable retaining means such as the retaining screws 161 threadably engaging the truing slide 41 and passing through slots 162 in the respective rods 65 as illustrated in FIG. 1, positioned and proportioned so that the retaining means does not preclude rolling engagement between the crushing roll 61 and the back-up rolls 92. Alternatively, the retaining means may comprise spring biased plungers engaging transverse slots or annular grooves in the rods 65 or other suitable quick release latch means.

Even when the wheel truing assembly 40 is disposed as illustrated in FIGS. 1 and 2, releasable lost motion restraining means may be provided as described above to engage the slidably mounted frame supporting the crushing roll 61, in order to limit the displacement of the crushing roll 61 relative to the truing slide 41 except when the restraining means is released while the crushing roll is being changed.

FIG. 3 illustrates an alternate embodiment of the instant invention particularly suitable for use in the case

of a crushing roll 61' so shaped that it does not include a substantial peripheral area of a constant diameter so located as to provide effective bearing engagement with the back-up rolls 92. As illustrated in FIG. 3, the crushing roll 61' includes a pair of spaced portions 165' of equal diameter for engagement with the back-up rolls 92. While the simplified view in FIG. 3 shows only one back-up roll 92, it is to be understood that this embodiment of the instant invention contemplates the use of a pair of back-up rolls 92 arranged as shown in FIG. 2.

FIG. 4 illustrates a further variation of the instant invention particularly suitable for use with a crushing roll 61'' having one or more substantial portions 165'' having a constant diameter smaller than the largest diameter of the crushing roll 61''. In this instance, the back-up rolls 92 must be replaced with back-up rolls 92'' including one or more enlarged portions of constant diameter so disposed axially of the back-up rolls 92 that they engage the mating portions of constant diameter on the crushing roll 61'', as shown in FIG. 4.

Since many modifications of this invention may be made to suit various applications of its inventive features, it is to be understood that the embodiments of this invention described above and illustrated in the accompanying drawings are to be interpreted as illustrative and not in a limiting sense, and that the scope of this invention is defined by the claims appended hereto.

What is claimed is:

1. Crush truing apparatus for grinding wheels comprising,
 - a supporting means mounted for sliding movement radially toward and away from a grinding wheel,
 - a first bearing means supported upon said supporting means,
 - a first back-up roll rotatably supported by and enclosing said first bearing means,
 - a second bearing means supported upon said supporting means,
 - a second back-up roll rotatably supported by and enclosing said second bearing means, and
 - a crushing roll rotatably supported upon said supporting means so that it is disposed between said back-up rolls and a grinding wheel and immediately adjacent to both of said back-up rolls,
 whereby the bearing load imposed upon said crushing roll by a grinding wheel as said supporting means is moved toward a grinding wheel during a crush truing operation is transmitted from said crushing roll to said back-up rolls and thence to said supporting means through said first and said second bearing means.
2. Crush truing apparatus for grinding wheels comprising,
 - a supporting means mounted for sliding movement radially toward and away from a grinding wheel,
 - a first spaced coaxial plurality of bearing assemblies fixedly supported upon said supporting means,
 - a first back-up roll rotatably supported by and enclosing said first plurality of bearing assemblies,
 - a second spaced coaxial plurality of bearing assemblies fixedly supported upon said supporting means,
 - a second back-up roll rotatably supported by and enclosing said second plurality of bearing assemblies, and
 - a crushing roll releasably supported upon said supporting means so that it is disposed between said back-up rolls and a grinding wheel and is maintained in rolling engagement with both of said back-up rolls when said crushing roll operatively engages a grinding wheel,
 whereby the bearing load imposed upon said crushing roll by a grinding wheel as said supporting means is moved toward a grinding wheel is transmitted from said crushing roll to said back-up rolls and thence to

said supporting means through said first and said second pluralities of bearing assemblies.

3. Crush truing apparatus for grinding wheels comprising,
 - a supporting means mounted for sliding movement radially toward and away from a grinding wheel,
 - a first array of antifriction bearing means supported upon said supporting means concentric of a first fixed axis,
 - a first generally cylindrical back-up roll supported by and enclosing said first array of antifriction bearing means for rotation about the first fixed axis,
 - a second array of antifriction bearing means supported upon said supporting means concentric of a second fixed axis parallel to the first fixed axis,
 - a second generally cylindrical back-up roll supported by and enclosing said second array of antifriction bearing means, and for rotation about the second fixed axis,
 - a crushing roll both slidably and rotatably supported upon said supporting means so that it is disposed between said back-up rolls and a grinding wheel and having at least one portion of its periphery maintained in rolling engagement with both of said back-up rolls as long as said crushing roll operatively engages a grinding wheel,
 whereby the bearing load imposed upon said crushing roll as said supporting means is moved toward a grinding wheel is transmitted from said crushing roll to said back-up rolls and thence to said supporting means through said first and said second arrays of antifriction bearing means.
4. Crush truing apparatus for grinding wheels comprising,
 - a housing mounted for sliding movement radially toward and away from a grinding wheel,
 - a first pair of antifriction bearing assemblies supported upon said housing in axially spaced relation on a first fixed axis,
 - a first generally cylindrical back-up roll supported by and enclosing said first pair of antifriction bearing assemblies and rotatable thereon about the first fixed axis,
 - a second pair of antifriction bearing assemblies supported upon said housing in axially spaced relation on a second fixed axis parallel to said first axis,
 - a second generally cylindrical back-up roll supported by and enclosing said second pair of antifriction bearing assemblies and rotatable thereon about the second fixed axis,
 - a crushing roll of a predetermined contour including a spaced plurality of cylindrical peripheral portions having equal diameters, and
 - a supporting frame slidably supported upon said housing adjacent to said back-up rolls including opposed centers rotatably supporting said crushing roll so that said crushing roll is disposed between said back-up rolls and a grinding wheel with its cylindrical peripheral portions having equal diameters maintained in rolling engagement with both of said back-up rolls whenever said crushing roll is disposed in operative engagement with a grinding wheel,
 whereby the bearing load imposed upon said crushing roll as said housing is moved toward a grinding wheel is transmitted from said crushing roll to said back-up rolls and thence to said housing through said first and said second pairs of antifriction bearing assemblies.
5. Crush truing apparatus for grinding wheels comprising,
 - a supporting means mounted for rectilinear movement radially toward and away from a rotating grinding wheel,
 - first and second bearing means mounted upon said supporting means respectively concentric of first and

second spaced axes both located in fixed relation to said supporting means,
 first and second back-up rolls respectively rotatably mounted concentric of said first and said second bearing means,
 a crushing roll movably supported upon said supporting means adjacent to said first and said second back-up rolls so that it is maintained in rolling engagement with both of said back-up rolls by engagement of said crushing roll with a rotating grinding wheel to be trued thereby.
 6. Crush truing apparatus for grinding wheels comprising,
 a supporting means mounted for rectilinear movement radially toward and away from a rotating grinding wheel,
 first and second bearing means mounted upon said supporting means respectively concentric of first and second spaced axes both located in fixed relation to said supporting means,
 first and second back-up rolls respectively rotatably mounted concentric of said first and said second bearing means,
 a crushing roll movably supported upon said supporting means adjacent to said first and said second back-up rolls so that it is maintained in rolling engagement with both of said back-up rolls by engagement of said crushing roll with a rotating grinding wheel to be trued thereby, and
 releasable lost motion retaining means for said crushing roll effective to limit displacement of said crushing roll relative to said supporting means.
 7. Crush truing apparatus for grinding wheels comprising,
 a supporting means mounted for rectilinear movement radially toward and away from a grinding wheel rotating about its central axis,
 first and second spaced coaxial pluralities of bearing assemblies mounted upon said supporting means respectively concentric of first and second spaced axes both located in fixed relation to said supporting means and both parallel to the central axis of a rotating grinding wheel,
 first and second back-up rolls respectively rotatably mounted concentric of and so as to enclose said first and said second pluralities of bearing assemblies,
 a crushing roll rotatably and otherwise movably supported upon said supporting means adjacent to and displaceable relative to said first and said second back-up rolls so that it is biased into rolling engagement with both of said back-up rolls by engagement of said crushing roll with a rotating grinding wheel to be trued thereby, and
 releasable lost motion retaining means for said crushing roll effective to limit displacement of said crushing roll relative to said back-up rolls.
 8. In a grinding machine including means rotatably supporting a grinding wheel for movement into and out of engagement with a work piece and drive means selectively operable to rotate the grinding wheel at a first relatively higher speed for grinding operations and at a second relatively lower speed for crush truing operations, apparatus for crush truing the grinding wheel comprising,
 a housing supported upon the grinding machine for movement radially toward and away from the grinding wheel,
 a first bearing means supported upon said housing,
 a first back-up roll rotatably supported by and enclosing said first bearing means,
 a second bearing means supported upon said housing,
 a second back-up roll rotatably supported by and enclosing said second bearing means,
 a supporting frame movably supported upon said housing,

a crushing roll rotatably supported upon said supporting frame and disposed so that it is maintained in rolling engagement with said first and said second back-up rolls whenever said crushing roll is moved into operative engagement with the periphery of the grinding wheel, and
 means operable when the grinding wheel is withdrawn from engagement with a work piece and when the drive means is operating at the relatively lower speed to move said housing toward the grinding wheel until said crushing roll is forced into full engagement with the grinding wheel by said back-up rolls.
 9. In a grinding machine including means rotatably supporting a grinding wheel for movement into and out of engagement with a work piece and drive means selectively operable to rotate the grinding wheel at a first relatively higher speed for grinding operations and at a second relatively lower speed for crush truing operations, apparatus for crush truing the grinding wheel comprising,
 a housing slidably supported upon the grinding machine for movement radially toward and away from the grinding wheel,
 a first array of antifriction bearing means supported upon said housing on a first fixed axis,
 a first generally cylindrical back-up roll rotatably supported by and enclosing said first array of antifriction bearing means,
 a second array of antifriction bearings means supported upon said housing on a second fixed axis parallel to the first fixed axis,
 a second generally cylindrical back-up roll rotatably supported by and enclosing said second array of antifriction bearing means,
 a supporting frame movably supported upon said housing,
 a crushing roll rotatably supported upon opposed centers projecting from said supporting frame and disposed so that it is maintained in rolling engagement with said first and said second back-up rolls whenever it is moved into operative engagement with the periphery of the grinding wheel, and
 means operable when the grinding wheel is withdrawn from engagement with a work piece and when the drive means is operating at the relatively lower speed to move said housing toward the grinding wheel until said crushing roll is forced into full engagement with the grinding wheel by said back-up rolls.
 10. In a grinding machine including means supporting a grinding wheel for rotation about a horizontal axis and for movement into and out of engagement with a work piece and also including drive means selectively operable to rotate the grinding wheel at a first relatively higher speed for grinding operations and at a second relatively lower speed for crush truing operations, apparatus for crush truing the grinding wheel comprising,
 a housing slidably supported upon the grinding machine for movement radially toward and away from the grinding wheel,
 a first pair of spaced antifriction bearing assemblies fixedly supported upon said housing, both concentric of a first fixed horizontal axis,
 a first generally cylindrical back-up roll rotatably supported by and enclosing said first pair of antifriction bearing assemblies,
 a second pair of spaced antifriction bearing assemblies fixedly supported upon said housing, both concentric of a second fixed horizontal axis,
 a second generally cylindrical back-up roll rotatably supported by and enclosing said second pair of antifriction bearing assemblies,
 a supporting frame movably supported upon said housing and provided with opposed centers projecting therefrom on a common horizontal axis,

11

a crushing roll rotatably supported upon said opposed centers and disposed so that it is maintained in rolling engagement with said first and said second back-up rolls whenever it is moved into engagement with the periphery of the grinding wheel, and
 means operable when the grinding wheel is withdrawn from engagement with a work piece and when the drive means is operating at the relatively lower speed to move said housing toward the grinding wheel until said crushing roll is forced into full engagement with the grinding wheel by said back-up rolls.
 11. A grinding machine including
 a base,
 means mounted upon said base rotatably supporting a grinding wheel for engagement with a work piece, wheel drive means operable to rotate the grinding wheel about its central axis,
 a housing slidably supported upon the grinding machine for movement radially toward and away from the rotating grinding wheel during a crush truing operation on the grinding wheel,
 a first bearing means supported upon and in a fixed location relative to said housing,
 a first generally cylindrical back-up roll supported by and enclosing said first bearing means and freely rotatable thereon about an axis parallel to the central axis of the grinding wheel,

12

a second bearing means supported upon and in a fixed location relative to said housing,
 a second generally cylindrical back-up roll supported by and enclosing said second pair of bearing means and freely rotatable thereon about an axis parallel to the central axis of the grinding wheel,
 a supporting frame movably supported upon said housing,
 a crushing roll rotatably supported upon said supporting frame and disposed so that it is maintained in rolling engagement with said first and said second freely rotatable back-up rolls whenever it is moved into operative engagement with the periphery of the grinding wheel during a crush truing operation, and
 means operable when the grinding wheel is disengaged from a work piece to move said housing toward the grinding wheel until said crushing roll is forced into full engagement with the grinding wheel by said back-up rolls and then to move said housing away from the grinding wheel until said crushing roll is withdrawn from engagement with the grinding wheel.

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