Sept. 24, 1963 R. E. PRICE 3,104,501

ADJUSTABLE FOLLOWER FOR CROWNING MECHANISMS

Filed May 3, 1962 4 Sheets-Sheet 1

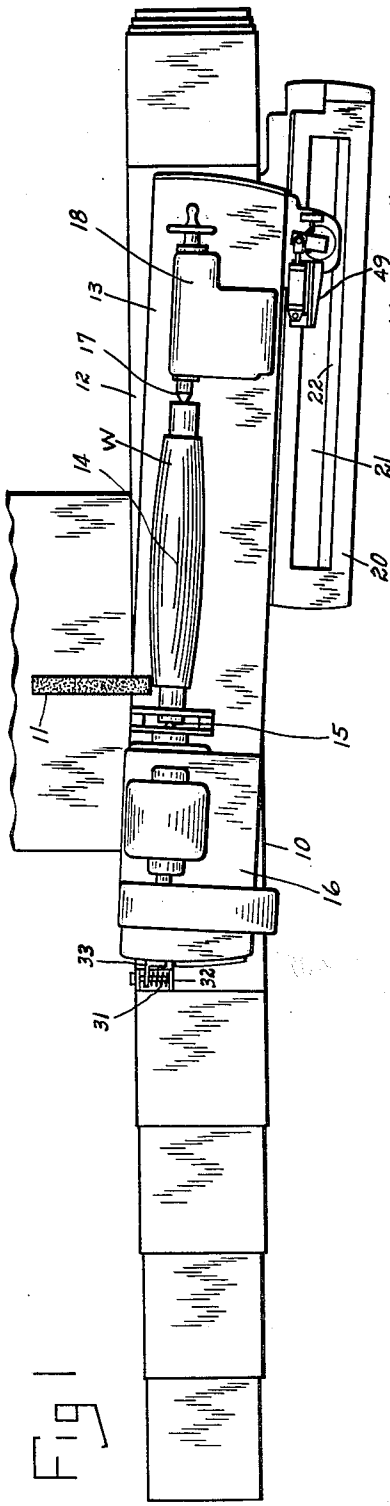


Fig. 1

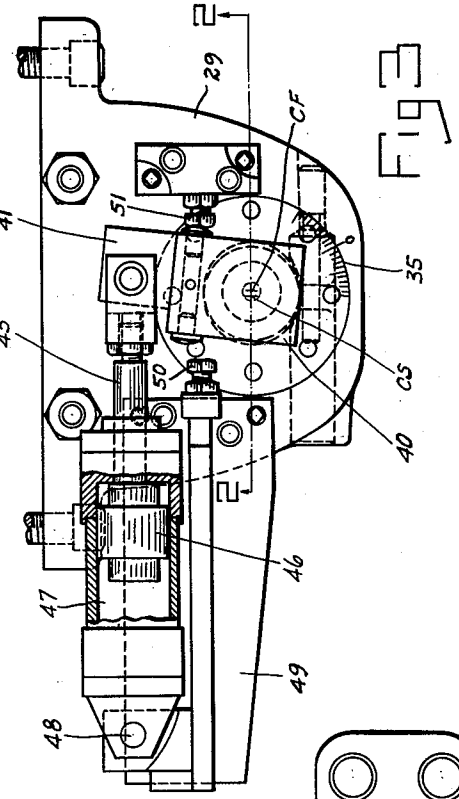


Fig. 3

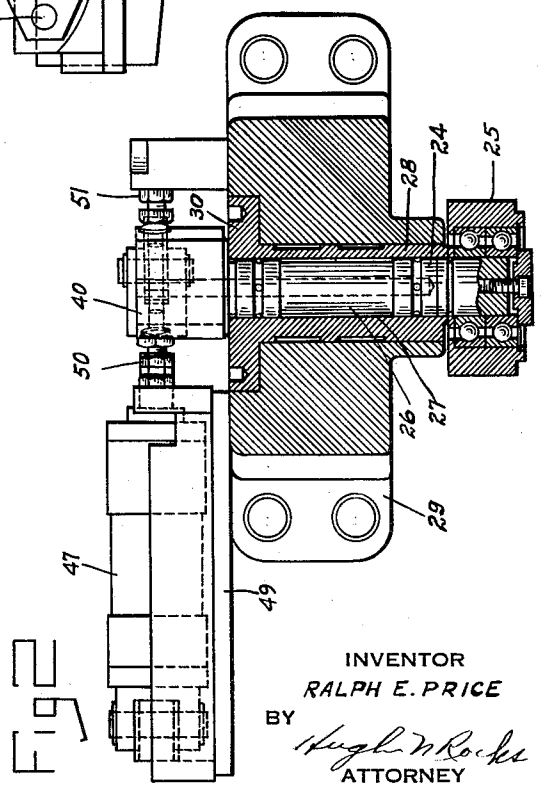


Fig. 2

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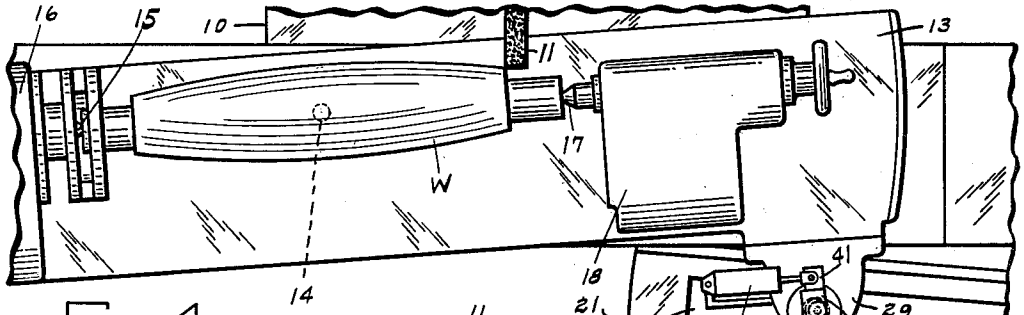


Fig 4

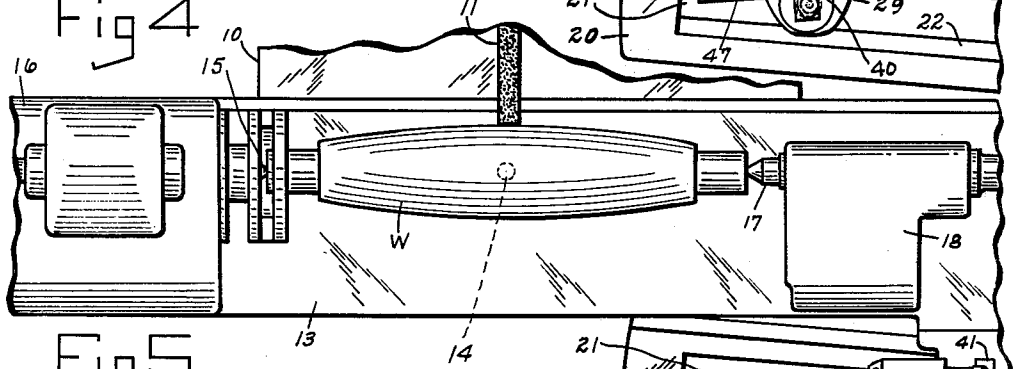


Fig 5

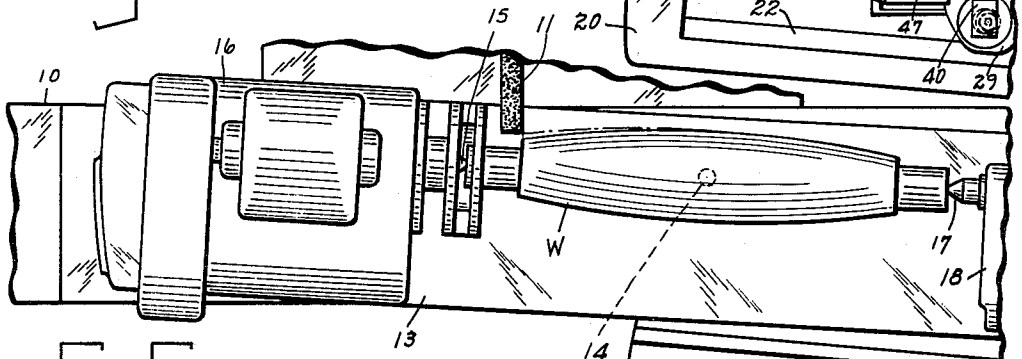


Fig 6

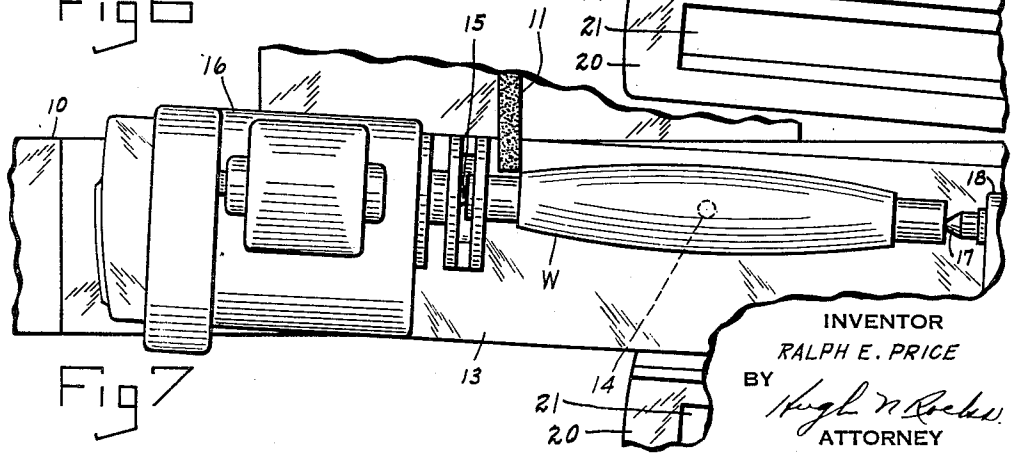


Fig 7

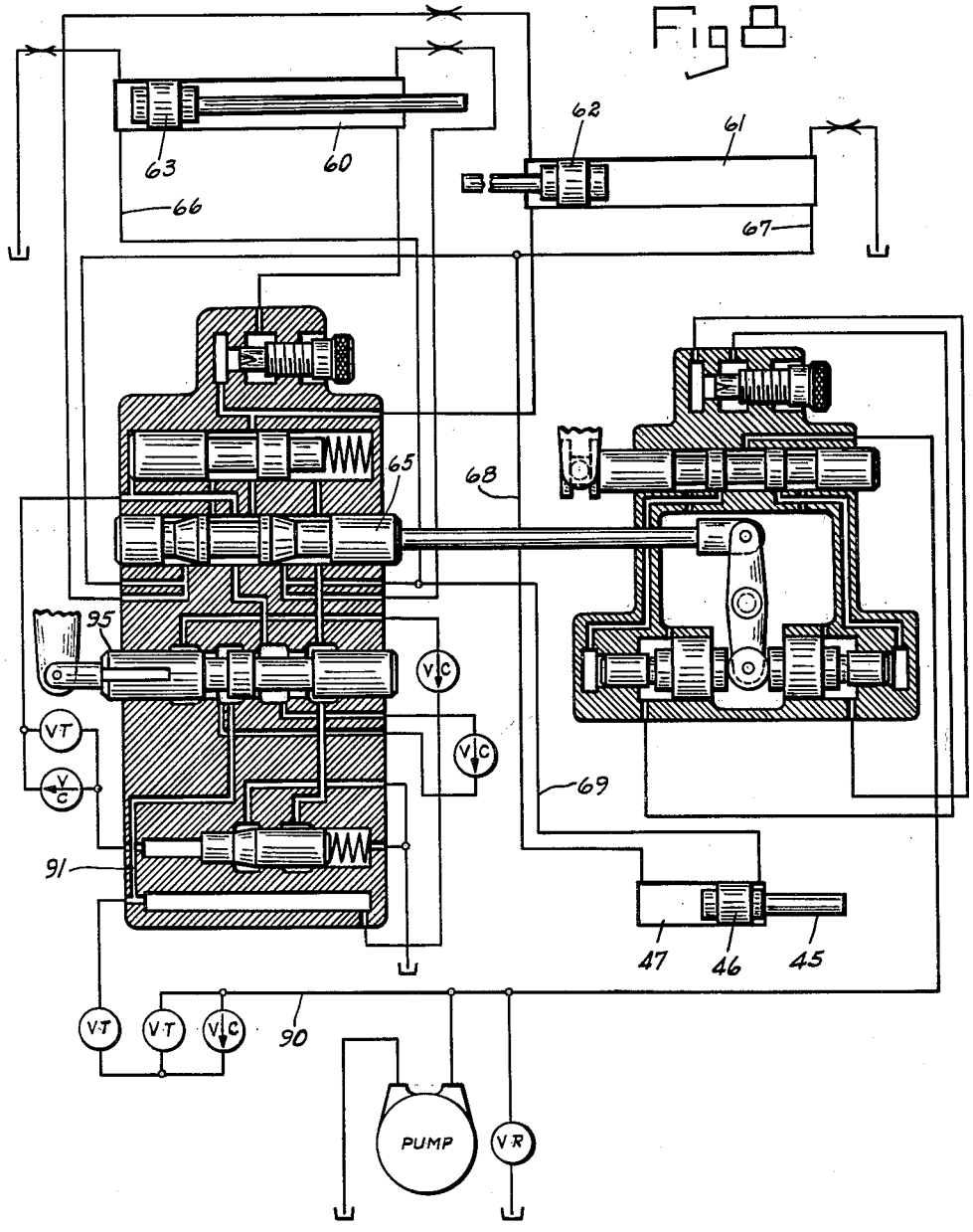
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ADJUSTABLE FOLLOWER FOR CROWNING MECHANISMS

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Fig 8



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ADJUSTABLE FOLLOWER FOR CROWNING MECHANISMS

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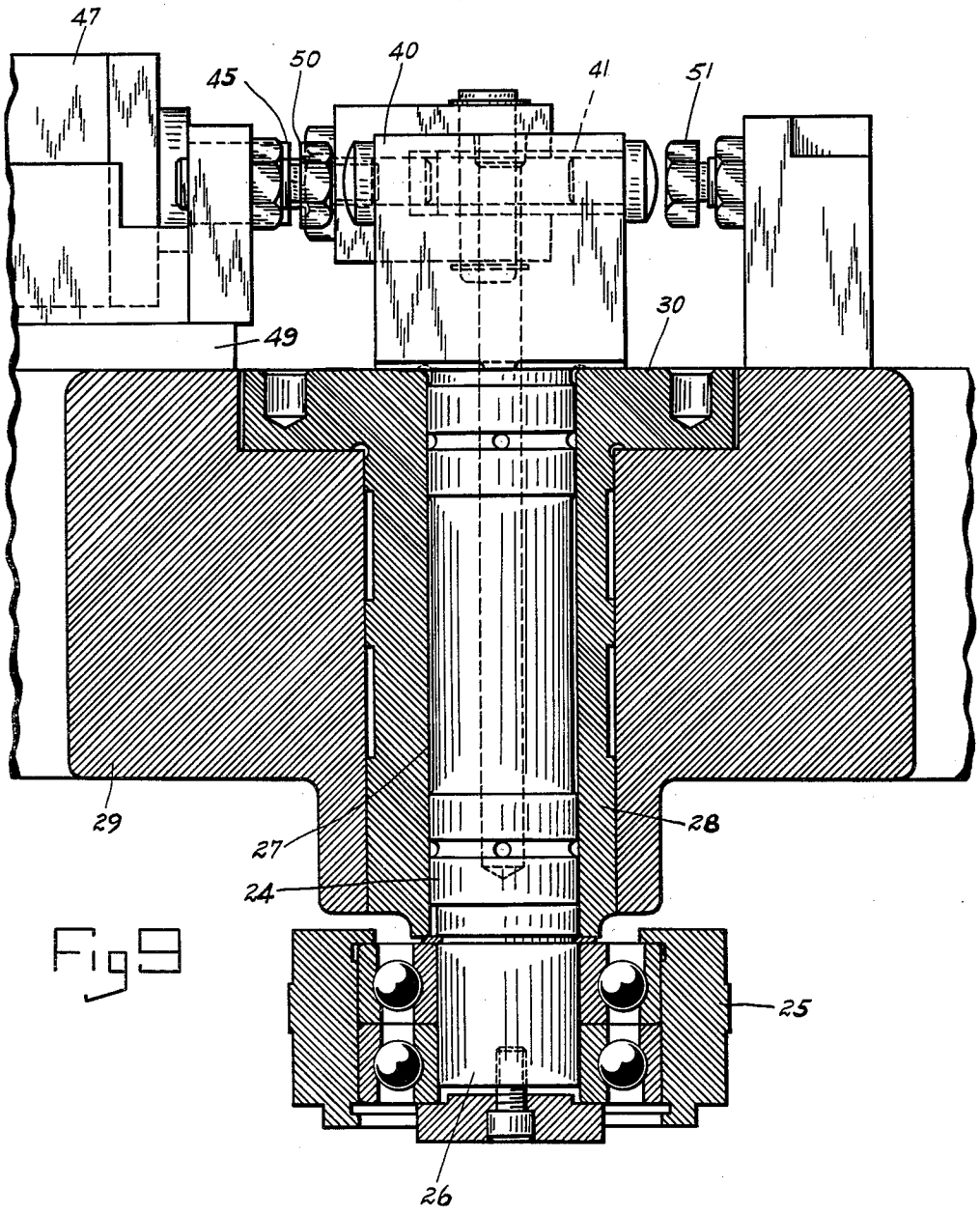


Fig 9

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United States Patent Office 3,104,501 Patented Sept. 24, 1963

3,104,501

ADJUSTABLE FOLLOWER FOR CROWNING MECHANISMS

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Filed May 3, 1962, Ser. No. 192,196
6 Claims. (Cl. 51—94)

This invention relates to grinding machines for grinding steel mill rolls, particularly small rolls having a crowned surface.

Rolls of this type are usually ground on a conventional cylindrical grinding machine with an attachment for swinging the work supporting table as the work is traversed past the grinding wheel.

One type of attachment is known as a sine bar crowning attachment and consists of an angularly adjustable guide member mounted in a suitable position on the bed of the machine and a follower for engaging the guide member. The follower is mounted in a supporting member attached to the work table. One characteristic of this type of crowning mechanism is that as the work passes the grinding wheel from the end to the mid-point, the leading edge of the grinding wheel does most of the grinding. As the mid-point of the work passes the grinding wheel, the point of contact between the wheel and work changes from the leading edge to the trailing edge of the wheel. This change in point of contact and the grinding by the trailing edge sometimes results in roll surface characteristics which are usually unobjectionable. However, for some types of work, such a surface is undesirable.

It is, therefore, an object of the present invention to provide means for maintaining a predetermined operative relation between the grinding wheel and the work.

Another object is to provide means whereby the grinding pressure between the wheel and the work is gradually reduced as the work moves past said wheel.

Another object is to change the relation between the guide member and the work table at each end of the traverse movement of the workpiece whereby the grinding pressure between the work and grinding wheel will be reduced after the mid-point of the work passes the grinding wheel.

FIG. 1 is a plan view of a grinding machine, showing the relation between the workpiece and the grinding wheel at the beginning of a traverse movement to the left.

FIG. 2 is a front elevation, partially in section along the line 2—2 of FIG. 3, of a hydraulically adjustable follower.

FIG. 3 is a plan view of the hydraulically adjustable follower.

FIG. 4 is a plan view showing the relative position of the work and wheel at the beginning of a traverse movement to the right.

FIG. 5 is a plan view showing the relative position of the work and wheel at the mid-point of a traverse movement to the right.

FIG. 6 is a plan view showing the relative position of the work and wheel at the end of a traverse movement to the right.

FIG. 7 is similar to FIG. 1 in that it is a plan view showing the relative position of the work and wheel at the beginning of a traverse movement to the left.

FIG. 8 is a hydraulic diagram showing the connection between the traverse motor and cylinder 47.

FIG. 9 is an enlarged sectional view of a part of FIG. 2.

Bed 10 of a grinding machine has a grinding wheel 11 suitably mounted thereon. Work carriage 12 is slidably mounted on bed 10 for longitudinal movement relative to

grinding wheel 11. Work table 13 is mounted on carriage 12 to swing about a pivot point 14. Workpiece W is rotatably supported on center 15 of headstock 16 and center 17 of footstock 18. Guide bar 20 is attached to the front of bed 10 and is angularly adjustable in a horizontal plane.

Guide member 20 has a groove or guide way 21. On one side of groove 21 is a guide bar 22. Follower roller 25 is rotatably mounted on an eccentric portion 24 on shaft 26. Shaft 26 is mounted in an eccentric bore 27 in sleeve 28. Sleeve 28 is rotatably mounted in bracket 29 and has a flange portion 30 flush with the upper surface of bracket 29. Bracket 29 is attached to work table 13. The upper face of flange 30 has a graduated portion 35. A zero point on bracket 29 adjacent said graduation 35 serves to indicate the extent and direction of the angular adjustment of sleeve 28. This adjustment is used only for set-up. The center of sleeve 28 is indicated by CS. The center of follower 25 is indicated by CF.

Table 13 is urged in a clockwise direction to hold follower 25 against guide bar 22 by means of a spring 31, one end of which is attached to bracket 32 on carriage 12, the other end of which bears against bracket 33 on table 13.

On the upper end of shaft 26 is formed a head member 40 having a reduced portion 41 connected to piston rod 45 on piston 46 in cylinder 47. Cylinder 47 is mounted to swing about a pivot 48 in an extension 49 of bracket 29. The extent of angular adjustment of sleeve 28 is determined by a pair of adjustable stops 50 and 51 in the path of oscillation of head member 40.

When piston 46 is in the right hand position shown in FIG. 1, it has shifted shaft 26 and portion 24 in a clockwise direction. This movement acting through bracket 29 shortens the distance between follower 25 and table 13 to swing said table also in a clockwise direction. This adjustment is effected when table 13 and carriage 12 move into the position shown in FIGS. 1 and 7. The extent of this adjustment is exaggerated as in FIG. 6 for the purpose of illustration. Actually, the work and grinding wheel 11 remain in contact at all times, but during the last portion of each stroke, the angular adjustment of the work which was effected at the beginning of the stroke, results in a gradual decrease in pressure between the wheel and the work. During the later part of the stroke, there is a corresponding decrease in stock removal which may reach the point where pressure is insufficient for grinding action although the wheel and work remain in contact.

When piston 46 is shifted to the left as shown in FIGS. 4 and 5, it turns shaft 26 and portion 24 in a counterclockwise direction which lengthens the distance between follower 25 and table 13, shifting table 13 in a counterclockwise direction with the right hand end of workpiece W engaging the grinding wheel 11 with increased pressure.

The means for reversing work carriage 12 consists of a pair of cylinders 60 and 61 which may be attached to carriage 12. The outer ends of cylinders 60 and 61 are connected to reversing valve 65 through passages 66 and 67 respectively. Passage 68 leads from passage 67 to the left end of cylinder 47. Passage 69 leads from passage 66 to the right end of cylinder 47. Fluid under pressure for cylinders 60, 61 and 47 is supplied by the pump through lines 90 and 91 and start and stop valve 95 to reversing valve 65. With the exception of cylinder 47 and its connection to the reversing mechanism, the hydraulic system shown in FIG. 8 is similar to that shown in Patent 2,867,058, granted January 6, 1959 and Patent 2,977,933, granted April 4, 1961.

Operation

When valve 65 is in the left hand position, it directs fluid under pressure through passage 67 to the right hand

end of cylinder 61 to cause movement of piston 62 and carriage 12 to the left. At the same time, fluid under pressure passes from passage 67 through passage 68 to the left hand end of cylinder 47, shifting piston 46 to the right and rotating sleeve 28 and table 13 in a clockwise direction.

When valve 65 is in the right hand position, fluid under pressure is directed through passage 66 to the left hand end of cylinder 60 to move piston 63 and carriage 12 to the right. At the same time, fluid under pressure passes from passage 66 through passage 69 to the right hand end of cylinder 47, shifting piston 46 to the left and rotating shaft 26, eccentric portion 24 and table 13 in a counter-clockwise direction.

At the beginning of the movement of carriage 12 to the right, table 13 is swung in a counter-clockwise direction to increase the pressure between workpiece W and grinding wheel 11. When the mid-point of the work passes grinding wheel 11, the result of the adjustment of table 13 is such that the pressure between the work and grinding wheel 11 is gradually reduced for the remainder of the traverse movement in that direction, although the wheel and work may remain in contact.

When reversing valve 65 is shifted to cause carriage 12 to move to the left, table 13 is rotated in a clockwise direction to effect engagement between the work and grinding wheel 11. This engagement continues until the mid-point of the work passes grinding wheel 11 and the pressure between the wheel and the work is gradually reduced.

During the portion of the traverse movement of the work from the end to the center of the work, the contact between the work and grinding wheel 11 begins at the leading edge of the wheel and most of the grinding is performed on this portion of the wheel. As the center point of the work moves past the grinding wheel 11, the point of contact gradually shifts from the leading edge toward the trailing edge. If the face of grinding wheel 11 is straight rather than convex or concave, the transfer of contact from the leading edge towards the trailing edge may result in a period of intermittent contact between the grinding wheel 11 and the work with a corresponding defective finish on the work surface being ground.

After the work has made several passes across grinding wheel 11, the wheel breaks down on both the leading and trailing edges, leaving a sort of irregular convex surface, which is somewhat flatter than an arc. This shape can be approximated by dressing grinding wheel 11 manually or by means of a profile bar so that it is unnecessary to depend upon breakdown of grinding wheel 11 during grinding, to obtain a profile whereby the transfer of contact from the leading edge to the trailing edge occurs while maintaining a uniform maximum line of contact between grinding wheel 11 and workpiece W.

I claim:

1. In a roll grinding machine, a bed, a grinding wheel, a work carriage on said bed, means for effecting relative longitudinal movement of said grinding wheel and said carriage including a reversing mechanism, a swivel table on said carriage, means on said swivel table for rotatably supporting a workpiece, means for swivelling said swivel table comprising an angularly adjustable guide member, a follower, a connection between said follower and said swivel table, means for supporting said follower eccentrically in said connection, and means operable at each end of said longitudinal movement for shifting said eccentric supporting means angularly to change the relation between said follower and said swivel table.

2. In a roll grinding machine, a bed, a grinding wheel, a work carriage on said bed, means for effecting relative longitudinal movement of said grinding wheel and said carriage including a reversing mechanism, a swivel table on said carriage, means on said swivel table for rotatably supporting a workpiece, means for swivelling said swivel table comprising an angularly adjustable guide member, a follower, a connection between said follower and said swivel table, means for supporting said follower eccentrically in said connection, and means operable by said reversing mechanism for shifting said eccentric supporting means angularly to change the relation between said follower and said swivel table.

3. In a roll grinding machine, a bed, a grinding wheel, a work carriage on said bed, means for effecting relative longitudinal movement of said grinding wheel and said carriage including a reversing mechanism, a swivel table on said carriage, means on said swivel table for rotatably supporting a workpiece, means for swivelling said swivel table comprising an angularly adjustable guide member, a follower, a bracket for supporting said follower on said swivel table, eccentric means for supporting said follower in said bracket, and means operable by said reversing mechanism for shifting said eccentric means to change the relation between said follower and said swivel table.

4. In a grinding machine, a bed, a grinding wheel, a work carriage on said bed, means for effecting relative longitudinal movement of said grinding wheel and said carriage including a reversing mechanism, a swivel table on said carriage, means on said swivel table for rotatably supporting a workpiece, means for swivelling said swivel table comprising an angularly adjustable guide member on said bed, a follower on said swivel table for engagement with said guide member, and means operable at each end of said longitudinal movement for changing the relation between said follower and said swivel table.

5. In a grinding machine, a bed, a grinding wheel, a work carriage on said bed, means for effecting relative longitudinal movement of said grinding wheel and said carriage including a reversing mechanism, a swivel table on said carriage, means on said swivel table for rotatably supporting a workpiece, means for swivelling said swivel table comprising an angularly adjustable guide member on said bed, a shaft rotatably supported on said swivel table, a roller follower mounted eccentrically on said shaft for engagement with said guide member, and means operable at each end of said longitudinal movement for turning said shaft for changing the relation between said follower and said swivel table.

6. In a grinding machine, a bed, a grinding wheel, a work carriage on said bed, means for effecting relative longitudinal movement of said grinding wheel and said carriage including a reversing mechanism, a swivel table on said carriage, means on said swivel table for rotatably supporting a workpiece, means for swivelling said swivel table comprising an angularly adjustable guide member on said bed, a follower on said swivel table for engagement with said guide member, and means operable by said reversing mechanism at each end of said longitudinal movement for changing the relation between said follower and said swivel table.

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