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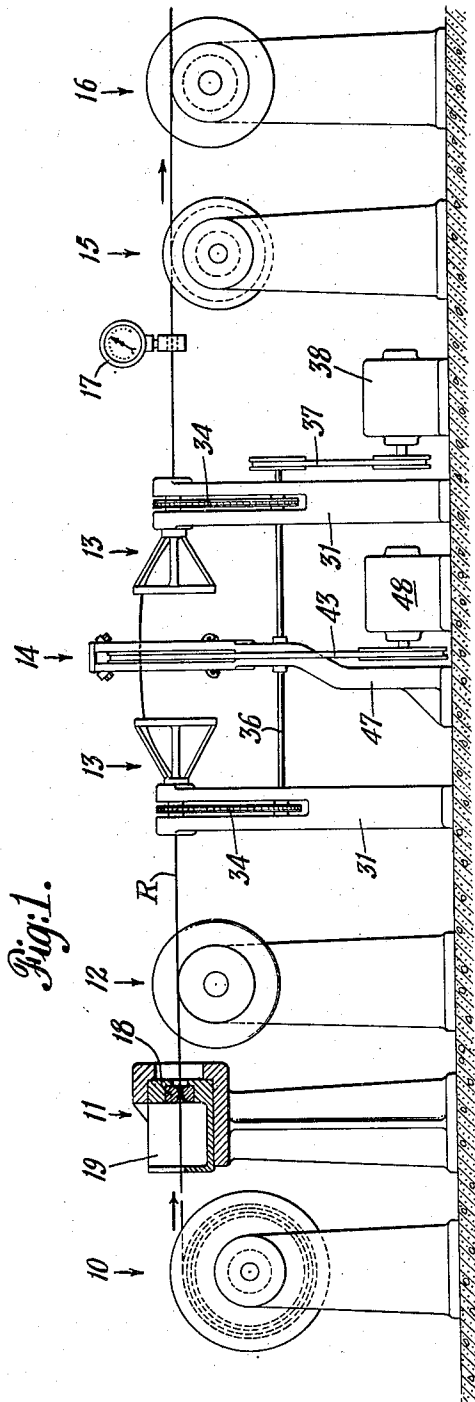
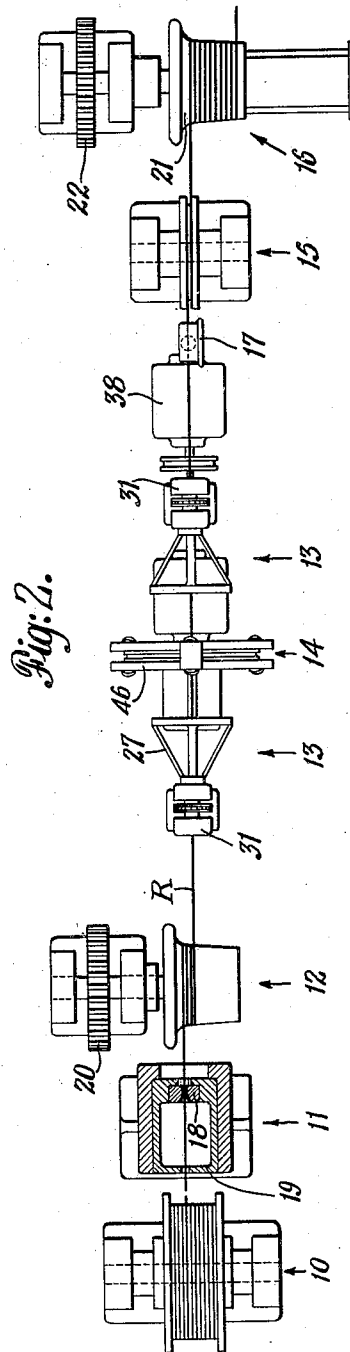
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2,497,407

METHOD AND APPARATUS FOR GRINDING ROD AND WIRE

Filed April 29, 1947

3 Sheets-Sheet 1



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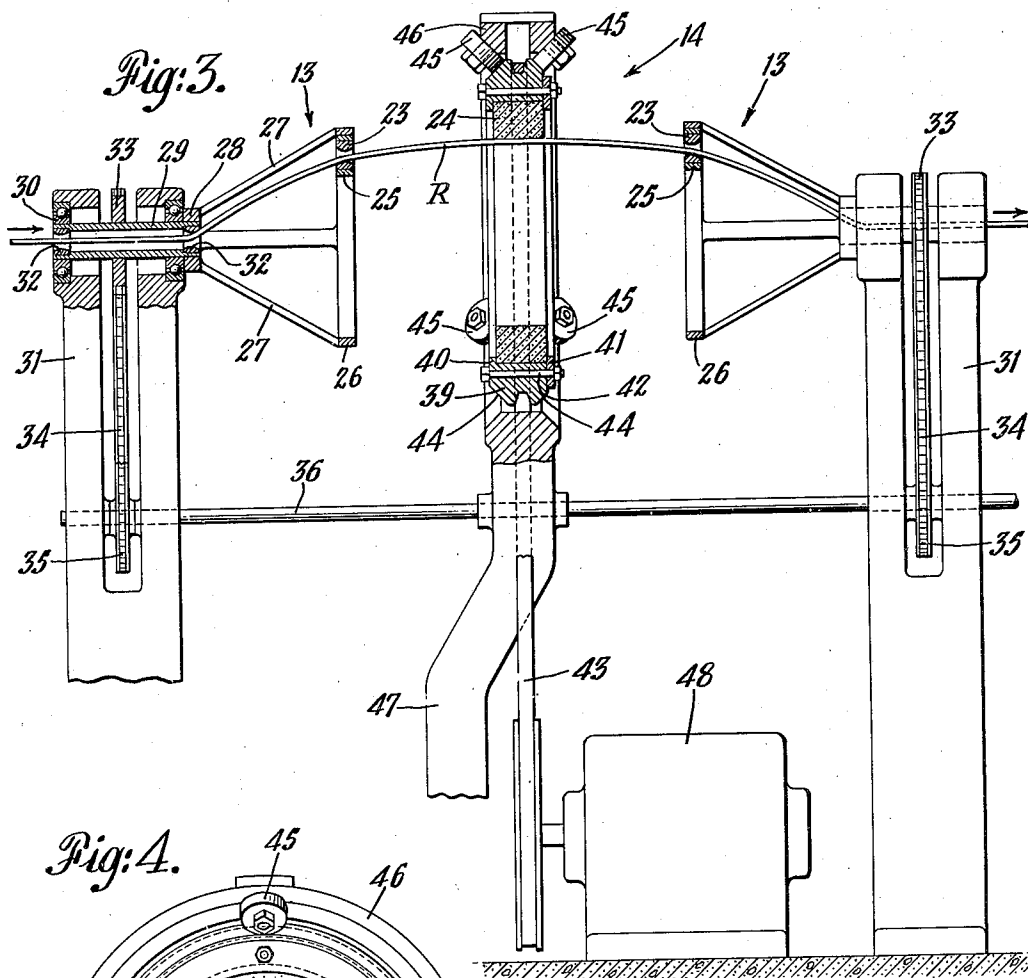
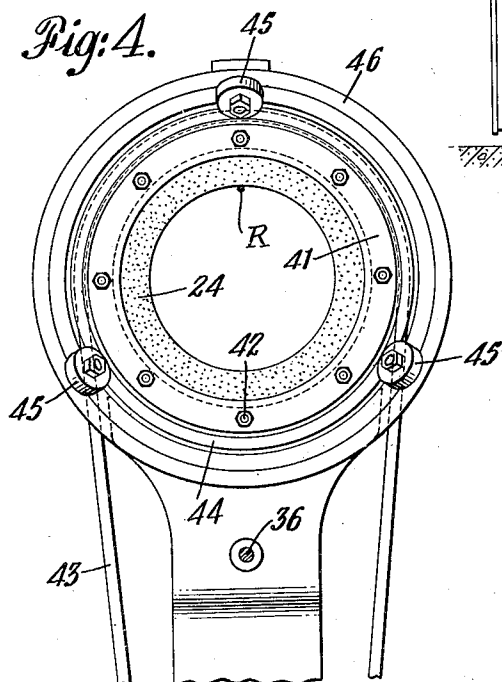
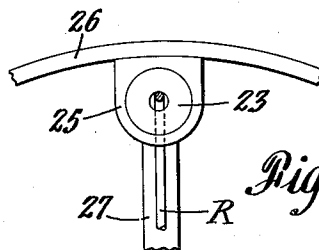
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3 Sheets-Sheet 2



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Fig. 7.

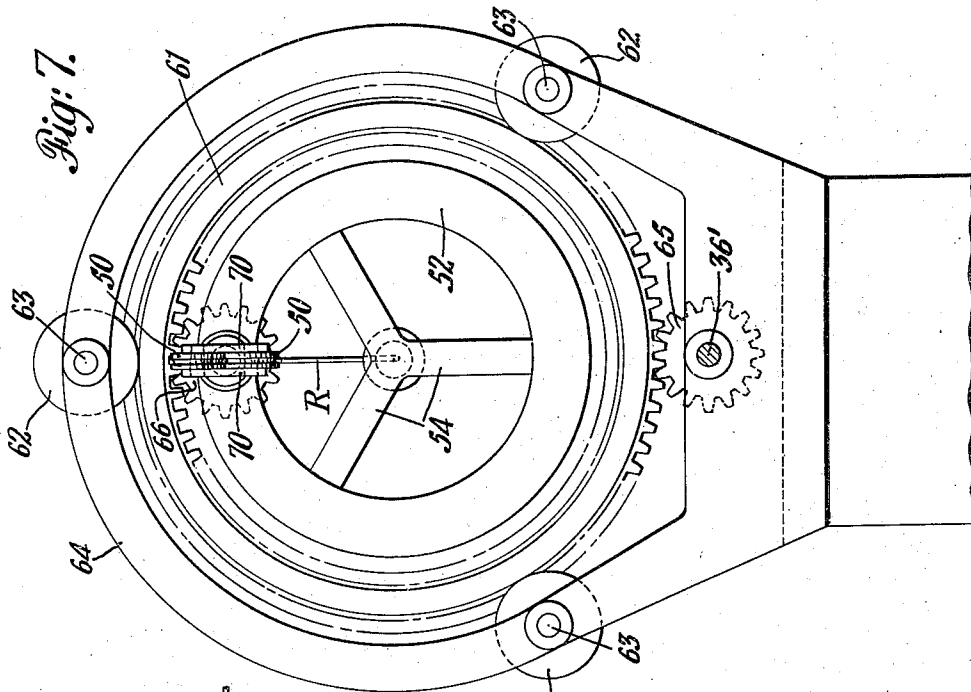
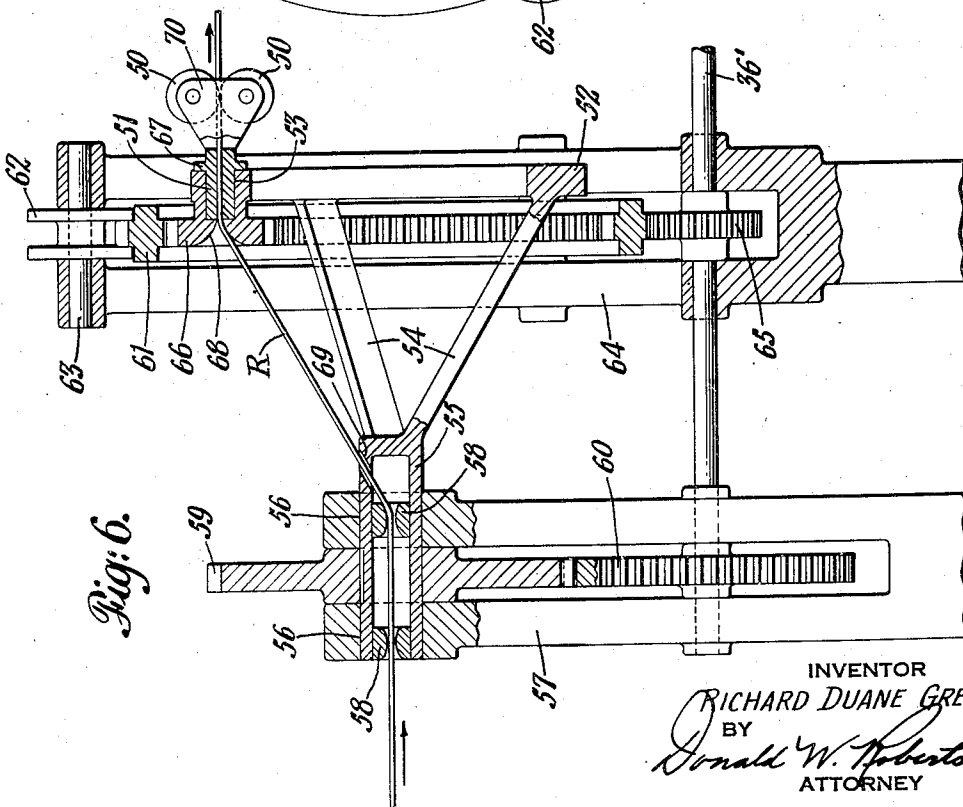


Fig. 6.



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METHOD AND APPARATUS FOR GRINDING
ROD AND WIRE

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9 Claims. (Cl. 51-73)

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This invention relates to the grinding of metal wire or rod to remove surface imperfections, as for example in preparing steel rod for wire drawing.

A leading object of my invention is to provide a method and apparatus for grinding rod and the like in continuous lengths wherewith uniform grinding to true circular form can be performed without rotating or oscillating either the rod or the grinding apparatus. Other objects and advantages will appear as the description proceeds.

According to my invention the rod or wire is whipped around the inside of an annular grinding wheel while it is pulled through the grinding wheel and restrained against turning about its own axis. The rod is moved in a substantially circular orbit within and in contact with the annular grinding wheel, thus having what might be described as a planetary movement about the center of the grinding annulus without substantial turning about the rod axis. This movement is accomplished by the use of offset or eccentric rod guides at either or both sides of the grinder, with driving mechanism for moving these guides in a circular path. Meanwhile the rod is transported through the grinding annulus in a generally axial direction, and is prevented from or restrained against turning by the use of drawing dies, drawheads, sheaves, take-up blocks, or the like, disposed at either side of the grinding annulus. Also, I have devised a construction in which sheaves and a planetary drive associated with the aforesaid offset rod guides exert a positive restraining action against turning of the rod by maintaining a fixed orientation of the sheaves.

In the drawings:

Fig. 1 is a side elevational view, somewhat diagrammatic and partly in vertical longitudinal cross-section, illustrating the general arrangement of apparatus for practicing my improved method, and embodying my invention in a preferred form.

Fig. 2 is a plan view of the same apparatus.

Figs. 3 and 4 are enlarged detail views of the grinding unit comprising the annular grinding wheel and rotary eccentric rod guides. Fig. 3 is principally a central vertical longitudinal cross-sectional view, but is shown partly in side elevation. Fig. 4 is an end elevational view of the grinding wheel and its mounting.

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Fig. 5 is a detail view of one of the eccentric rod guides.

Figs. 6 and 7 show a modified construction in which sheaves and a planetary drive associated with the offset or eccentric rod guides exert a positive restraining action against turning of the rod by maintaining a fixed orientation of the sheaves. Fig. 6 is a central vertical longitudinal cross-sectional view corresponding to the left-hand end of Fig. 3. Fig. 7 is an end elevational view of the planetary mechanism of Fig. 6.

In the general arrangement shown, the rod or wire R unwinds continuously from the pay-off reel 10 (or other suitable wire feeding mechanism such as a wire "flipper"), is pulled through the wire drawing unit 11 by a drawhead 12, passes through or over a rotary eccentric guide 13, thence through annular grinder 14, and a second rotary eccentric guide 13, takes a turn about an idler sheave 15 to be wrapped about a take-up block 16. A gauge 17 may be employed to determine the thickness of the ground wire and indicate necessary adjustments in the rate of grinding which is dependent upon the speed of the grinding wheel, rate of travel of the wire through the wheel and pressure between the wire and the wheel. This pressure in turn is governed by (1) speed of rotation of the rotary guides 13, (2) distance between these guides, and (3) the wire tension.

The pay-off reel 10 (or other wire feeding mechanism), wire drawing unit 11, drawhead 12, sheave 15 and take-up block 16 all may be of conventional construction, and since such apparatus is well known to those conversant with wire drawing and analogous arts, detailed description will be avoided here. However it may be mentioned that the wire drawing unit 11, if used, may comprise a die 18 and lubricant box 19. The drawhead 12 is driven through suitable gearing 20 from a source of power not shown, and serves to draw the wire through the die or to reduce the tension in the wire occasioned by the drawing operation. The tension at the grinder will depend upon the number of turns of wire taken around the drawhead, and as we have seen is one of the factors involved in control of the pressure between the wire and the grinding wheel.

The take-up mechanism 16 comprises a take-up block 21 which is driven through suitable gear-

ing 22 from a source of power not shown, and serves to pull the wire through the grinder and associated guide mechanism.

With more particular reference to Figs. 3, 4, and 5, I shall now describe the construction of the rotary guide units 13 and grinder 14. The two guide units are synchronized and cooperate to whip the rod or wire around the inside of the annular grinding wheel. In my preferred construction apertured guides 23 are eccentrically mounted in offset relation to the main path of travel of the wire through the machine so that the wire in the region of the guides 23 moves in a substantially circular orbit about equal to or a little less than the inside diameter of the grinding annulus 24. The rotary mounting for the guides 23 may be of any suitable construction. In the preferred construction which I have shown for illustration, these guides are mounted by means of brackets 25 (Figs. 3 and 5) to the interior of a ring 26 joined, as by arms 27, to a collar 28 fixed to a sleeve 29 rotatably mounted, as by bearing elements 30, in a frame 31. Apertured guide members 32 may be set into counterbores in the ends of sleeve 29. Fixed to the sleeve 29 of each rotary guide unit is a sprocket 33 with chain 34 driven from a sprocket 35 fixed to a common drive shaft 36 driven by a belt 37 (Fig. 1) from a variable speed motor 38.

Grinding annulus 24, of "carborundum" or the like, is carried by a metal ring 39 which may be flanged at one side, as at 40, for retention of the annulus. An annular plate or ring 41 held by a series of bolts 42 extending through ring 39 serves to clamp the grinding annulus in the wheel. The grinding wheel is suitably mounted for rotation around the imaginary axis of the inner or grinding surface of annulus 24. In the construction specifically illustrated, the outside of ring 39 is grooved to receive a belt drive 43 and beveled as at 44 for guiding engagement with a series of rollers 45 mounted for rotation about spindles or stud bolts arranged in parallelism with the beveled surfaces 44 of the ring and extending from a circular frame member 46. Three pairs of such guide rollers 45 are shown equally spaced about the grinding assembly. The frame 46 is bifurcated to admit passage of the belt 43 as shown in Fig. 1. Circular frame member 46 is carried by a suitable supporting base 47 through which the shaft 36 of the drive mechanism for the rotary guides may extend. The grinding wheel is driven from a suitable source of power such as the motor 48 which may be of either constant speed or variable speed type.

The permissible speed of rotation of the grinding wheel is subject to wide variations according to the particular circumstances of use involved. For example, the equipment will operate to grind the surface of the rod with a stationary grinding wheel or at any speed up to a speed limited by the strength of the supporting ring 39. It should be noted that this ring restrains the grinding wheel from bursting under centrifugal force and therefore permits higher grinding wheel speeds than are possible with grinding wheels not so supported. In practical operation the speed of revolution of the grinding wheel is chosen in relation to the physical construction of the wheel and the pressure of the rod against it to obtain the best relationship between rate of removal of material from the rod and wear on the grinding wheel. A satisfactory operating speed for the grinding wheel is 5,000 surface feet per minute.

We have seen that pressure between the wire

and grinding wheel is governed by (1) speed of rotation of the rotary guides 13, (2) distance between these guides, and (3) the wire tension. The pressure increases with increase in speed of rotation of the rotary guides, increase in distance between the guides, and decrease in wire tension. Thus an increase or decrease in any of these factors will bring about a change in pressure. Normally for a given wire grinding machine the spacing between the guides will remain fixed and changes in pressure will be governed by increasing or decreasing the wire tension and by increasing or decreasing the speed of rotation of the guides through control of the variable speed motor 38. At high rates of speed the wire will bend outwardly between the guides 23 as shown in Fig. 3 so as to be thrown by centrifugal force against the inside grinding surface of annulus 24. Where the bend in the wire at the grinding wheel is appreciable, the grinding surface of annulus 24 may be slightly concave laterally.

By placing the grinding wheel in close proximity to one of the eccentric guide units 13, it may be possible to eliminate the other eccentric guide unit. In this case the shape of the grinding surface of annulus 24 may be varied to suit the form of the bend in the wire as determined by centrifugal force and wire tension, the centrifugal force depending upon the speed of rotation of the guides, and the tension depending upon pull at the die 11, number of turns of the wire about drawhead 12, force applied at the take-up block 16, and friction in the guide units. As a practical matter, variation in the tension is accomplished simply by changing the number of turns of wire about the drawhead 12.

In some cases it may not be desired to use the wire drawing unit 11 and in this event the wire tension can be controlled by a brake or other friction device associated with the pay-off reel 10.

The speed of travel of the wire through the grinding unit is adjusted so that the guides will make at least one revolution during the interval that a given point of the wire travels across the face of the grinding surface of the wheel.

The wire is prevented from or restrained against turning by the drawing die 11, drawhead 12, sheave 15 and take-up block 16. With particular reference to Figs. 6 and 7, I shall now describe a modified construction for exerting a positive restraining action against turning of the wire at the offset guides. In this modified construction, a pair of idler sheaves, 50, 50, and a planetary drive to be described, are arranged in association with the offset or eccentric rod guide 51, the planetary drive being arranged to maintain a fixed orientation of the sheaves 50, 50 and thereby to exert a positive restraining action against turning of the rod R as it is carried around in its circular orbit by rotation of guide 51 about the main path of travel of the rod through the apparatus (and about the axis of grinding annulus 24). To maintain fixed orientation of the sheaves 50, 50, their supporting spindle (eccentric rod guide 51) must make one reverse revolution, relative to the rotary head 52 which carries it, for each revolution of the head 52. This fully compensates for revolution of the head, maintaining fixed orientation of the sheaves as aforesaid, i. e., maintaining the sheaves in a plane which does not rotate with the head.

To accomplish this reverse rotation of the sheaves, mounting relative to head 52, planetary gearing is provided as will now be described. In my preferred construction illustrated, guide 51 is

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formed as a spindle rotatably mounted in a bearing 53 in the head 52, the head comprising a ring joined, as by arms 54, to a hollow stub shaft 55 rotatably mounted in bearings 56 in frame 57 (corresponding to frame 31 of the Fig. 3 construction). Apertured guide members 58 may be fixed in the shaft 55. Fixed to the shaft 55 is a gear 59 meshing with gear 60 fixed to drive shaft 36' (corresponding to drive shaft 36 of the Fig. 3 construction).

A ring gear 61 having internal and external teeth surrounds head 52 and is mounted for rotation about the axis (projected) of the shaft 56, being carried by a series of flanged guide rollers 62 mounted for rotation about spindles 63 carried in bearings in a bifurcated frame 64 which may be of generally circular form appropriately to house the ring gear. The external teeth of gear 61 mesh with a pinion 65 fixed to drive shaft 36'. The internal teeth of said gear mesh with a pinion 66 fixed to the spindle 51. In the construction shown, the spindle is flanged, as at 67, and this flange together with the hub of pinion 66, provide suitable thrust bearings to hold the spindle 51 in position in the head 52.

The pinion 66 and spindle 51 are centrally apertured, with a flaring entrance portion 68, forming the eccentric guide through which rod R passes. Hollow shaft 55 has an opening 69 through which rod R passes as it leaves the guides 58 to be carried outwardly to the eccentric guide. The sheaves 50 are suitably mounted on the spindle 51 which, as shown, has a pair of extending flanges 70 carrying the pins on which the sheaves are supported.

Since the spindle 51 supporting sheaves 50, 50 is to make one reverse revolution, relative to the rotary head 52 which carries it, for each revolution of the head 52, the head must revolve a little faster than ring gear 61. The gear ratios are adjusted accordingly, the ratio of the number of teeth in gear 60 to the number of teeth in gear 59 being greater than the ratio of the number of teeth in pinion 65 to the number of exterior teeth in ring gear 61. For example, with a pinion 66 having 16 teeth, a ring gear having 70 internal and 86 external teeth, and a pinion 65 having 16 teeth, the gear 59 may have 43 teeth with 35 teeth in gear 60. Other gear and pinion sizes than these can be employed so long as the ratios are such as to maintain orientation of the sheaves. In the embodiment illustrated, the axes of the sheaves being horizontal they remain so at all times, regardless of the speed of rotation of the head 52.

It will be understood that one of the planetary rod guide units which I have described with reference to Figs. 6 and 7 can take the place of either of the rotary guide units 13 (Fig. 1), or that the planetary units may be substituted for both of the units 13 if desired.

The term "rod" as employed herein and in the appended claims is used in a relative sense and is defined as including what may be termed "wire" as well as "rod." Generally speaking, my method and apparatus as described are primarily applicable to the grinding of what the wire manufacturer may call either a rod or a wire and which usually ranges in diameter from $\frac{1}{2}$ inch to $\frac{3}{8}$ inch. However it may be applicable to other sizes of rod or wire. Also, while designed with more particular reference to the manufacture of steel wire such as used in springs, it may be used in connection with the manufacture of wire of copper, brass, and aluminum, as well as other metals and alloys.

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The terms and expressions which I have employed are used in a descriptive and not a limiting sense, and I have no intention of excluding such equivalents of the invention described, or of portions thereof, as fall within the purview of the claims.

I claim:

1. Apparatus for grinding rod and the like which comprises an annular grinding wheel, means for pulling the rod through the grinding wheel, means for restraining the rod from turning, and means for whipping the rod around the inside of the annular grinding wheel as it is pulled through it.

2. Apparatus for grinding rod and the like which comprises an annular grinding wheel, means for pulling the rod through the grinding wheel, means for restraining the rod from turning, and means for whipping the rod around the inside of the annular grinding wheel as it is pulled through it, said last-named means comprising an offset rod guide arranged to move in a substantially circular path.

3. Apparatus for grinding rod and the like which comprises an annular grinding wheel, means for pulling the rod through the grinding wheel, means for restraining the rod from turning, and means for whipping the rod around the inside of the annular grinding wheel as it is pulled through it, said last-named means comprising offset rod guides at each side of the grinding wheel, and driving mechanism for moving the guides in substantially circular paths.

4. Apparatus for grinding rod and the like which comprises a grinding annulus, rod transporting mechanism, and an offset rod guide with means for driving it in a substantially circular orbit to move the rod around and in contact with the grinding annulus as it is transported therethrough.

5. Apparatus for grinding rod and the like which comprises a grinding annulus, rod transporting mechanism, and an offset rod guide driven in a substantially circular orbit to move the rod around and in contact with the grinding annulus as it is transported therethrough, said rod guide comprising means for restraining the rod against turning about its own axis, and a planetary transmission arranged to maintain the guide in fixed orientation as it moves in its circular orbit.

6. Apparatus for grinding rod and the like which comprises a grinding annulus, rod transporting mechanism, and an offset rod guide driven in a substantially circular orbit to move the rod around and in contact with the grinding annulus as it is transported therethrough, said rod guide comprising a sheave to restrain the rod against turning about its own axis, and a planetary transmission arranged to maintain the sheave axis in fixed orientation as the guide moves in its circular orbit.

7. Apparatus for grinding rod and the like which comprises a grinding annulus, rod transporting mechanism and offset rod guide driven in a substantially circular orbit to move the rod around and in contact with the grinding annulus as it is transported therethrough and a variable speed drive for the offset rod guide to control the pressure between the rod and the grinding wheel.

8. In the method of grinding rod and the like, the concurrent steps which comprise moving the rod in a substantially circular orbit, feeding the rod longitudinally, continuously applying an

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abrasive to the surface of the rod, and restraining the rod against turning about its own axis.

9. In the method of grinding rod and the like, the concurrent steps of whipping the rod in a planetary movement about the center of a grinding annulus without substantial turning about the axis of the rod, continuously applying an abrasive to the surface of the rod, and pulling a continuous length of the rod through the annulus.

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REFERENCES CITED

The following references are of record in the file of this patent:

10

8

UNITED STATES PATENTS

Number	Name	Date
2,191,417	Woolley -----	Feb. 20, 1940
2,216,123	Magnolfi -----	Oct. 1, 1940
2,239,580	Statz -----	Apr. 22, 1941
2,260,314	Halin -----	Oct. 28, 1941
2,291,774	Taylor et al. -----	Aug. 4, 1942
2,293,923	Stewart et al. -----	Aug. 25, 1942
2,355,174	Nye et al. -----	Aug. 8, 1944

5