Jan. 18, 1949. D. LEWIS 2,459,707

METHOD AND APPARATUS FOR GRINDING ROD AND WIRE

Filed April 21, 1947 2 Sheets-Sheet 1

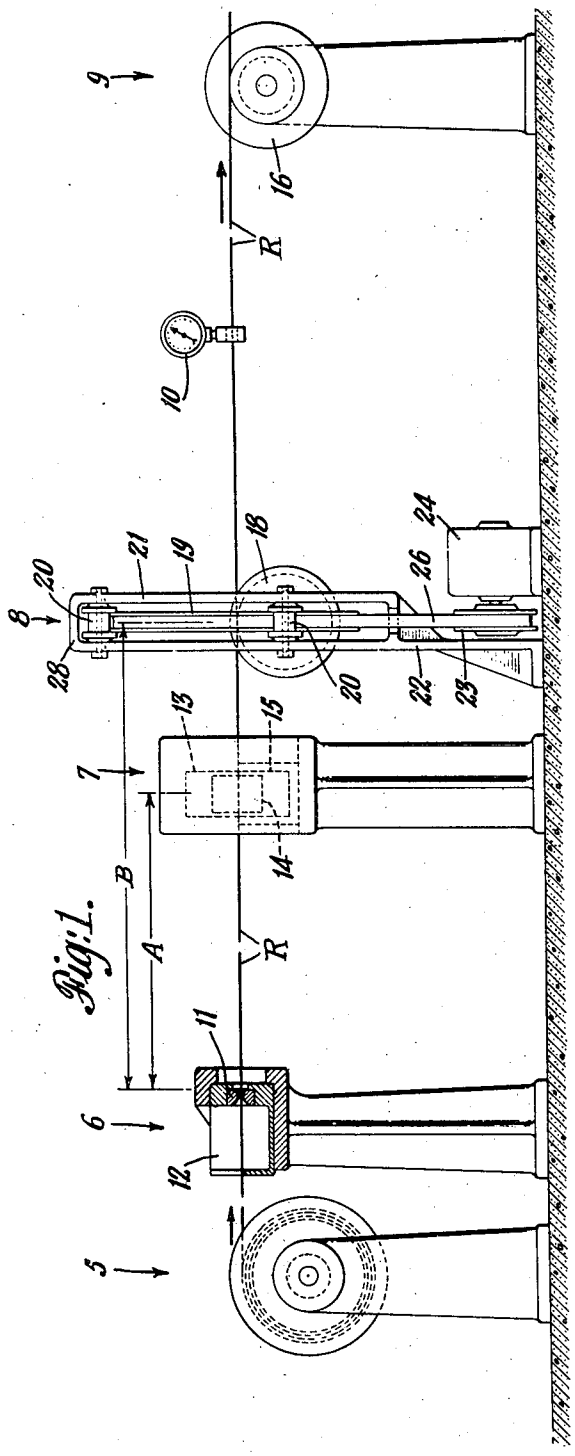


Fig. 1.

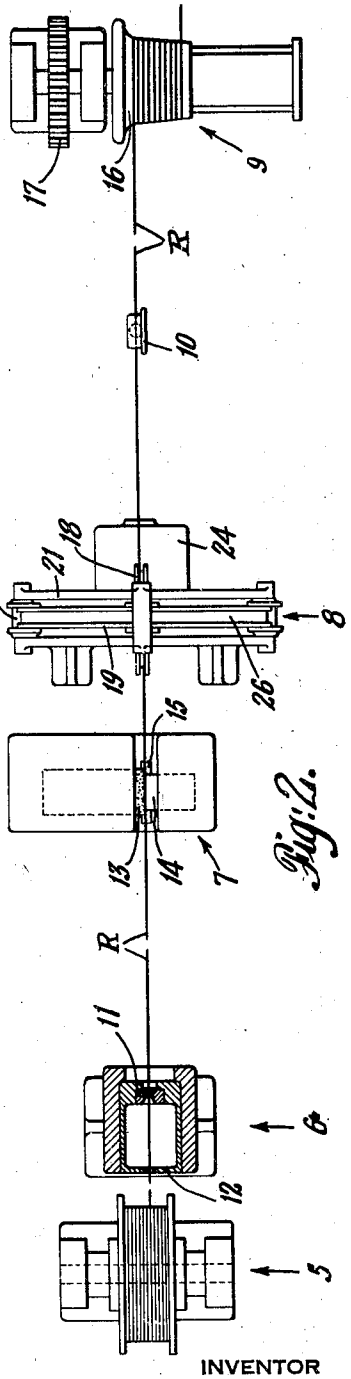


Fig. 2.

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Fig:3.

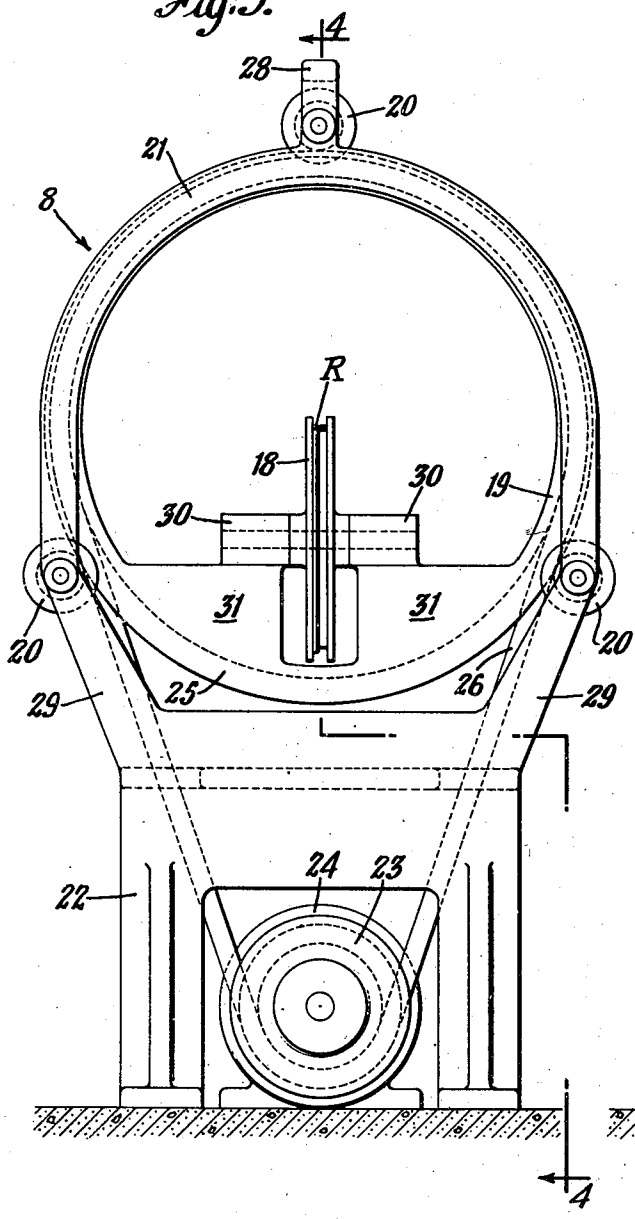
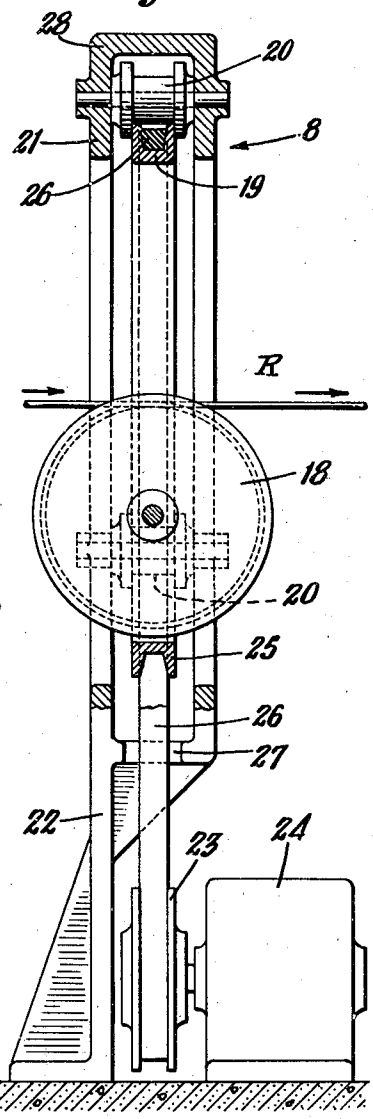


Fig:4.



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METHOD AND APPARATUS FOR GRINDING ROD AND WIRE

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6 Claims. (Cl. 51—75)

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The invention relates to the grinding of metal rod and wire to remove surface defects before drawing.

Rods employed in the manufacture of wire, e. g. steel wire, may have various surface defects such as minute cracks or other faults. Wire drawn from such rods will have microscopic defects which destroy its uniformity and which may even result in failure at points in the wire which are weakened by defects of this character.

It has been proposed to remove surface imperfections by grinding, but the methods and machines heretofore devised for this purpose have been subject to serious disadvantages. One machine which has been devised grinds the rod as it is drawn between the flat surfaces of two overlapping grinding wheels. As the rod passes between these grinding wheels it is rotated a part turn in one direction and then a part turn in the other direction, so as to have an oscillating motion. This has the disadvantage of producing a rod which is slightly out of round, having its sides somewhat flattened, or which has a cross-section that is slightly elliptical in contour.

Another machine which has been devised heretofore rotates about the axis of the rod as the rod is drawn between grinding wheels turning about fixed axes. This arrangement is very cumbersome, for it requires mounting the pay-off reel, capstan or drawhead, and take-up reel, in rotating frames, and the drawing die is mounted for rotation. Thus the whole apparatus rotates around a fixed grinder, requiring a complicated driving mechanism, increased power consumption, and entailing greater maintenance costs.

It is a primary object of my invention to provide a method and apparatus for grinding rod and the like which is not subject to any of the disadvantages enumerated in the two preceding paragraphs. A particular object is to accomplish the surface grinding of continuous lengths of rod or wire as it is drawn through a conventional centerless grinder mounted in a fixed position.

Other objects and advantages of my invention will appear as the description proceeds.

I have found that it is possible to accomplish the foregoing objects by twisting the rod continuously in one direction as it passes through a centerless grinder. The rod is likewise untwisted continuously in the same direction, so that in my preferred operation the rod is continuously twisted and untwisted in the same direction as it passes through the grinder. The portion of the

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rod which is in contact with the grinding wheels is either twisting or untwisting continuously, depending upon the position of the grinder relative to the component parts of the twist-untwist mechanism. There are means for restraining the rod from twisting at fixed points on each side of the grinder, and means for continuously applying a unidirectional twist to the rod at a point adjacent the grinder and between said fixed points. The last-named means comprises a sheave about which the rod is wrapped as it issues from the grinder, this sheave being mounted in a rotary frame for rotation about an axis tangent to the periphery of the sheave and substantially in line with the run of the rod through the grinder, and also about an axis normal to the first axis.

In the drawings, Fig. 1 is a somewhat diagrammatic elevational view (partly in section) of apparatus designed to operate in accordance with my improved method and embodying the invention in its preferred form.

Fig. 2 is a plan view of the same (also partly in section).

Figs. 3 and 4 show, to an enlarged scale, the twisting head of Figs. 1 and 2, Fig. 3 being a front elevational view, and Fig. 4 a sectional view taken as indicated at 4—4 in Fig. 3.

In the general arrangement shown, the rod or wire R unwinds continuously from the pay-off reel 5, is drawn through the wire drawing die 6, and passes through the grinder 7 and twisting head 8 to be wound on a take-up block 9. A gauge 10 may be employed to determine the thickness of the ground rod and indicate necessary adjustments of the grinder.

The pay-off reel 5 (or other suitable wire feeding mechanism such as a wire "flipper"), wire drawing die 6, grinder 7 and take-up block 9 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 6, if used, may comprise a die 11 and lubricant box 12. The grinding mechanism 7 may consist of a conventional centerless grinder having a grinding wheel 13, regulating wheel 14, and positioning blade 15. The positioning blade supports the rod from below and is thin enough to come up between the wheels 13 and 14 which rotate in the same direction. The take-up mechanism 9 comprises a take-up block 16 which is driven through suitable gearing 17 from a source of power not

shown and serves to pull the rod through the several units of the apparatus.

With reference to Figs. 3 and 4, I shall now describe the construction of the twisting head 8. It comprises an idler sheave 18 about which the rod is wrapped as it issues from the grinder (a single turn about the sheave is sufficient), this sheave being mounted for free rotation in a rotary frame 19 carried by a series of flanged guide rollers 20 mounted in a stationary frame 21 which encircles the rotary frame 19 and is fixed to a suitable supporting base 22 which, in the specific construction shown, is integral with the frame 21. Also in the construction shown, the supporting base 22 is offset from the center line of the stationary frame 21 conveniently to admit the drive pulley 23 of a motor 24.

The rotary frame 19 preferably is formed with outwardly extending flanges 25 shaped to receive the drive belt 26 which passes through recesses 27 in the frame and clears between the rotary frame and the lower two guide rollers 20. The stationary frame 21 may consist of semicircular rings fastened together at the top by a bridging U-strap 28 forming bearings for the upper guide roller 20 and fastened at their lower ends to the supporting base 22 by inclined portions 29. Bearings 30 for sheave 18 are secured to the rotary frame 19 as by means of webs 31 which are formed as extensions of the circular part of the rotary frame in line with the outwardly extending flanges 25 thereof.

It will be observed that the sheave 18 is mounted for rotation about its own axis and about an axis normal to its own axis. Its periphery is at the center of the rotary frame 19 so the second axis of rotation is tangent to the periphery of the sheave and substantially in line with the run of the rod through the grinder. Thus rotation of the frame 19 of the twisting head continually twists the rod in one direction as it passes through the centerless grinder. As fast as it twists up the rod between die 11 and the twisting head, it untwists the rod between the twisting head and take-up block 9. My apparatus comprises, then, means for restraining the rod from twisting at fixed points on each side of the grinder and means for continuously applying a unidirectional twist to the rod at a point adjacent the grinder and between said fixed points. These fixed points in the arrangement specifically illustrated are the die unit 6 and the take-up block 9. If the die unit be omitted as sometimes may be desired, then the pay-off reel 5 becomes the fixed point on that side of the grinder which constitutes the means for restraining the rod from twisting. It will be observed further that the pay-off reel 5 and take-up block 9 constitute rotary elements mounted for rotation about a single axis and that the twisting head 8 constitutes a third rotary element arranged between the first two and mounted for rotation about two axes to impart a unidirectional twist and untwist to the rod between the first two rotary elements.

The spacing between the units 5, 6, 7, 8 and 9 may be varied in accordance with the nature of the work being performed, the speed of travel of the rod through the grinder, and the permissible twist which may be performed on the rod. Completely to grind the surface of the rod, it is necessary for it to twist through at least one revolution during the interval of its travel across the face of the grinding wheel. This establishes a lower speed limit for the twisting head in relation to the speed of travel of the rod through the machine. For maximum twisting at the grinder, the grinder should be as close to the twisting head as practicable. Since there is no twisting at the die 11, and since the rate of twist at the twisting head 8 equals the speed of rotation of the rotary frame 19, it will be appreciated that the rate of twisting at the grinder 7 is at some intermediate figure. Letting A equal the distance from the die to the grinder, B the distance from the die to the twisting head, and S the rate of twist at the twisting head, the rate of twist at the grinder can be expressed by the relationship:

$$\text{Rate of twist at grinder} = \frac{A}{B} \cdot S$$

Thus it will be seen that the closer the grinder is to the twisting head, the greater will be the rate of twist at the grinder for a given rate of twist at the twisting head. Proximity of the grinder to the twisting head is restricted by practical considerations and the distance A must therefore be regulated in accordance with the limiting conditions of operation. That is to say, the distance should be great enough so that the rate of twisting of the rod at the grinder is not too small a percentage of the rate of twisting at the twisting head. 90% is a satisfactory percentage.

For example, in grinding .218" diameter spring steel rod in which the rod as it issues from die 11 has a diameter of .192", and with a drawing speed of 100 feet per minute, the following relationships will be found to be within the practicable range:

Distance A	feet	45
Distance B	do	50
Width of grinding wheel	inches	8
Lineal speed of surface of grinding wheel	feet per minute	5000
Speed of rotation of twisting head	R. P. M.	200

In this example the rod revolves 1.8 times per foot of travel at the location of the grinding wheel. This equals 1.2 revolutions while moving across the face of the grinding wheel.

The maximum twisting of the rod occurs at the twisting head. In the example it twists twice per foot of travel at this location. The upper limit of twisting depends upon the material. For example, hard drawn high carbon steel such as would be involved in the example will stand comparatively few forward and reverse twists per foot compared with low carbon annealed steel which will stand many. Since there must be at least one twist during a forward motion of the rod equal to the width of the grinding wheel, it is an advantage to have as wide a wheel face as practicable. In some cases it may be desirable to have two or more grinding wheels in tandem in order to get the desired total width of wheel or the desired amount of grinding. The grinding wheels do not have to be all on one side of the twister. For example, it might be advantageous to have one or more grinding wheels at each side of the twister.

Other operating conditions may be desired but in each case by using the relationships I have described the conditions and the desirable spacing of the various units of the apparatus can be determined.

It is possible to arrange the twisting head on the other side of the grinder, i. e. between the grinder and the die 11. In this case the grinding is performed during untwisting as distinguished from twisting but the principle of operation re-

mains the same. In both cases there is twisting and untwisting and it is merely a question of whether the grinder be located in the twisting or untwisting section of the rod, or whether grinders be located on both sides of the twisting head as I have described.

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 ½ inch to $\frac{3}{16}$ 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.

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. The method of grinding rod and the like which comprises continuously twisting and untwisting the rod in the same direction as it passes through a centerless grinder, while restraining the rod from twisting at points located some distance to either side of the grinder and the point of twisting and untwisting.

2. The method of grinding rod and the like which comprises pulling the rod through a grinder while restraining the rod from twisting at fixed points on each side of the grinder and continuously applying a unidirectional twist to the rod at a point adjacent the grinder and between said fixed points.

3. Apparatus for grinding rod and the like which comprises a grinder, means for pulling the rod through the grinder, means for restraining the rod from twisting at fixed points on each side of the grinder, and means for continuously applying a unidirectional twist to the rod at a point adjacent the grinder and between said fixed points.

4. Apparatus for grinding rod and the like which comprises a centerless grinder, means for pulling the rod through the grinder, means for restraining the rod from twisting at fixed points on each side of the grinder, and means for continuously applying a unidirectional twist to the rod at a point adjacent the grinder and between said fixed points, said last-named means comprising a sheave mounted for rotation about its own axis and about an axis normal to its own axis.

5. Apparatus for grinding rod and the like which comprises a centerless grinder, means for pulling the rod through the grinder, means for restraining the rod from twisting at fixed points on each side of the grinder, and means for continuously applying a unidirectional twist to the rod at a point adjacent the grinder and between said fixed points, said last-named means comprising a sheave about which the rod is wrapped as it issues from the grinder, said sheave being mounted in a rotary frame for rotation about an axis tangent to the periphery of the sheave and substantially in line with the run of the rod through the grinder.

6. Apparatus for grinding rod and the like which comprises three spaced rotary elements about which the rod is wound in succession, two of the rotary elements being mounted for rotation about a single axis and the third being arranged between the first two and mounted for rotation about two axes to impart a unidirectional twist and untwist to the rod between the first two rotary elements, and a grinder arranged to machine the rod surface as the rod passes between two of said rotary elements.

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