

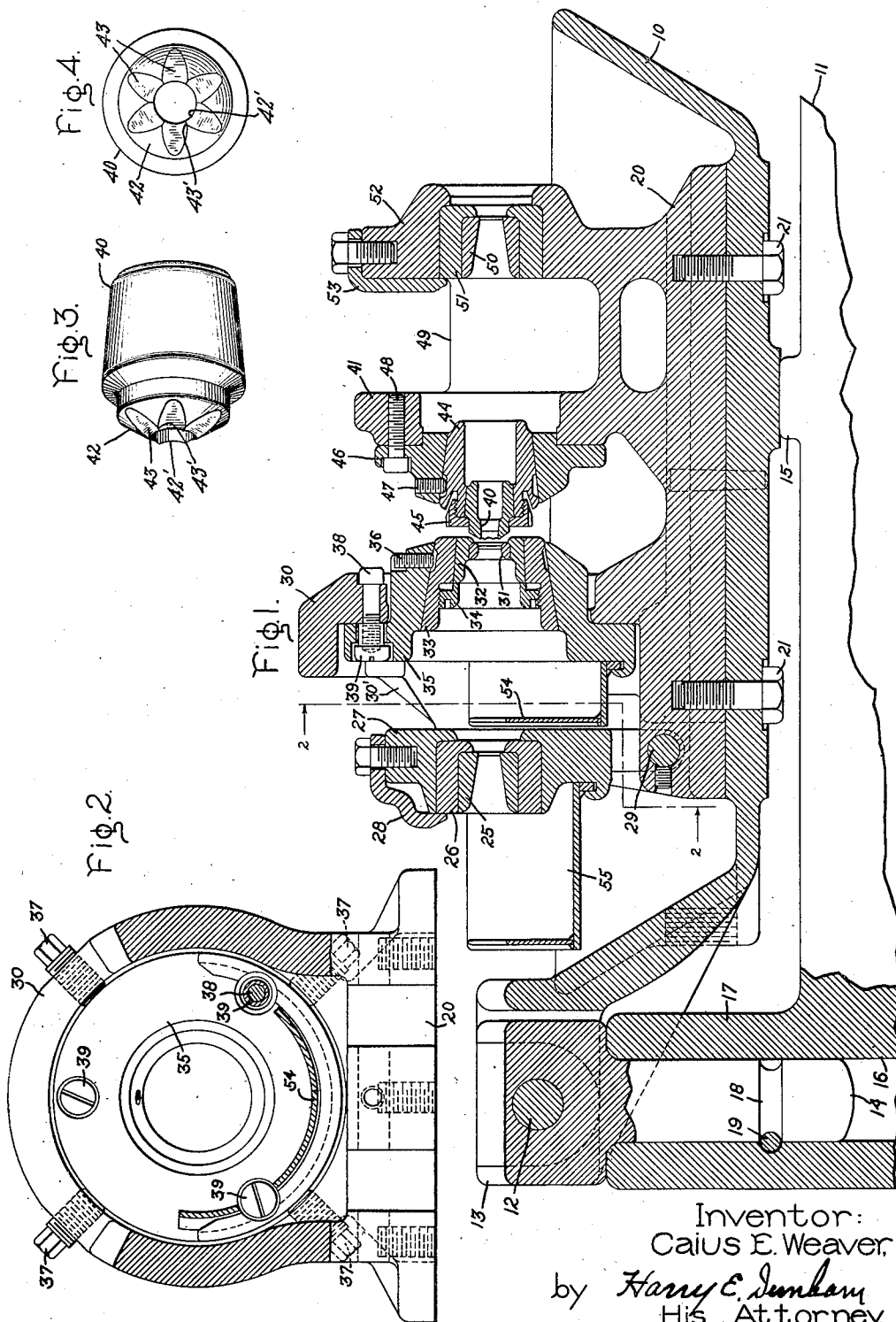
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C. E. WEAVER

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WIRE SHAVING PROCESS AND FIXTURE

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Inventor:
Caius E. Weaver,
by *Harry C. Dunham*
His Attorney.

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WIRE SHAVING PROCESS AND FIXTURE

Caius E. Weaver, Schenectady, N. Y., assignor to
General Electric Company, a corporation of
New York

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My invention relates to a wire finishing process and device, and more particularly to an improved process and fixture for shaving wire.

One object of my invention is to provide a fixture for shaving a uniform layer of metal off the surface of a wire so as to leave a smooth unbroken surface.

For a better understanding of my invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, Fig. 1 is a sectional elevation through the center of my improved fixture for carrying out my improved process; Fig. 2 is a view looking in the direction of the arrows along line 2—2; Fig. 3 is an enlarged perspective view of the wire shaving die; and Fig. 4 is a front view thereof.

In the production of copper rod and wire, an ingot of the metal is rolled to the desired dimensions in a large number of successive operations in which the ingot passes repeatedly through the mill rolls, the distance between which is gradually decreased until the proper sized rod is obtained. During these rolling operations, it frequently happens that layers of scale and iron particles become embedded in the metal, which layers of scale separate the metal, near the surface, from the main body of the rod. In the successive operations, this separated metal near the surface is gradually lengthened and reduced in thickness so that by the time the ingot has been reduced to a rod, or large sized wire, these portions of metal become mere slivers. When rod or wire is used in electric apparatus, it is insulated and bent into various shapes. During this bending process, the ends of the slivers, above-mentioned, may become separated from the wire, and pierce the insulation surrounding the wire. As a result, the entire coil of such wire may become useless.

It has also been found that when wire is drawn to very small dimensions from rod received from the mills, these slivers tend to stay in the wire through the successive reducing stages and finally may cause breaks in the wire. It is, therefore, of utmost importance to eliminate these slivers from the surface of the rod received from the rolling mills.

The method most commonly used heretofore to eliminate these surface irregularities included pickling and open fire oxidation of the wire surface. This method is wasteful. The black oxide

formed by firing in an open furnace is practically useless and the red oxide which goes into solution in the pickling process is also lost. The process and devices heretofore used for mechanically removing the surface metal from the rod have been unsuccessful and were discarded, for the reason that they would not produce a uniform and smooth surface on the wire. It was also impossible to remove continuously a uniform thickness of metal. There has been, therefore, a demand for a process and a fixture for carrying out such process at sufficiently high speeds to produce commercial quantities of the wire. The improved fixtures built to carry out the process in accordance with my invention are capable of continuously removing the surface of copper rod at high speed and produce a smooth surface thereon.

The process which is the subject of my invention and which is carried out by my improved apparatus includes as a first step a reduction of the wire area by about 10%. This step is not absolutely necessary, but when used, makes it practicable to remove less material from the wire surface than is necessary to remove when the wire is in its original state. This reduction in cross sectional area prepares the wire for shaving and the next operation is the actual shaving operation which may be divided into two steps. The first of these steps is the radial division of the surface layer into shreds or strips of equal width, and the second step is the separation of these strips from the wire surface. These two steps are performed successively upon any increment of the surface layer and are performed continuously as the wire is moved through the apparatus. The division of the surface layer into a number of narrow strips reduces the strain upon the wire surface caused by the separation of the surface layer from the wire, and the equal division of the layer results in an equally distributed force being applied about the axis of the wire whereby the wire is more easily held concentric with the cutting die.

The third step in the process is the removal of the strips from the cutting apparatus. It is necessary, as above mentioned, to use a minimum force in separating the strips from the wire so as to leave an unbroken surface on the wire. If in the removal of the strips from the wire, too great a resistance is encountered, such surface breakage occurs. In accordance with my invention, the strips are permitted to slide over smooth surfaces of a cutting die after separation from the wire in a direction radial to the wire, and

these surfaces over which the strips slide are substantially flat surfaces. This operation reduces the resistance to removal of the strips to a minimum and thereby substantially eliminates surface breakage.

A final step in my process is that of reducing the finished wire after the shaving operation. This last step hardens the newly shaved and, therefore, soft surface of the wire and protects it against abrasion or other injury during shipment and transfer to other machinery for further operations.

Referring to Fig. 1 in detail, the device illustrated comprises a cradle or pan 10 supported upon a suitable base 11 of which only a fragment is illustrated. The pan 10 is pivoted at one end, upon a horizontal pin 12, supported in the head 13 of a vertically supported pin 14. The other end of the pan merely rests upon a pad 15 which is integral with the base 10. The pin 14 projects into a hole 16 in the raised portion 17 of the base 11 and is provided with a groove 18 by means of which it is locked into the hole 16 by a pin 19. This cradle is, therefore, free to rotate horizontally as well as vertically. The wire finishing mechanism is supported in this cradle upon a suitable framework 20 bolted to the pan 10 by bolts 21.

The wire finishing mechanism includes a series of closely spaced drawing and guiding dies between which is arranged a cutting die. This arrangement of the dies is illustrated in detail in Fig. 1, this being a cross-sectional view taken through the axis of the die openings. The first of this series of dies is die 25. This is the first die through which the wire is drawn. The tapered opening through the die reduces the cross-sectional area of the wire by about 10%. The length and angle of taper in this die is governed by standard wire drawing practice. The die 25 is set into a reinforcing collar 26 and the collar in turn is supported in a holder 27 by a clamp 28. The holder is pivotally supported in the base 20 by a pivot pin 29. By means of this pivotal mounting this die assembly may be moved away from the supporting structure 30 of the succeeding die 31, so that this latter die may be removed from this structure. In operation, the die holder 27 is maintained in vertical position by being thrust against the structure 30; more specifically against the web 30'. This close spacing of the drawing dies and the cutting die is desirable to prevent a catenary sag of the wire between the drawing dies.

The second die in the series is the guide die 31. The function of this die is to guide the wire to the cutting die. The diameter of the hole through this die is made slightly smaller than the diameter of the wire emerging from the drawing die 25. This produces sufficient friction to grip firmly the wire and to hold it steadily while it passes to the cutting edge of the cutting die. The guide die is mounted in a reinforcing shroud 32. The shroud 32 is in turn mounted in an intermediate collar 33, being held therein by a screw-collar 34. The intermediate collar 33 is held in an adjustable collar 35 by a set screw 36. By means of this collar, this guide die is laterally adjustable relatively to the cutting die. It is necessary to provide for a slight adjustment between these two dies so as to produce a uniform thickness of the removed metal about the axis of the wire. This relative adjustment is preferably obtained by means of this collar on the guide die. The same mounting

may, of course, be used for the cutting die to obtain the necessary lateral adjustment.

The adjustable collar 35, better illustrated in Fig. 2, is held in the supporting structure 30 by four equally spaced adjusting screws 37, by means of which it may be adjusted laterally of the axis of the preceding drawing die and the succeeding cutting die. This collar 35 is also held against its seat in the supporting structure 30 by screws 38 which are rigidly mounted in the supporting structure 30 and by screw caps 39 which project through bores in the collar 35. These bores are of slightly greater diameter than the screw caps 39 and thereby, permit a slight movement of the collar 35 relatively to the supporting structure 30.

Immediately following the guide die 31, the cutting die 40 is mounted by various intermediate collars in a supporting structure 41. The distance between the guide die and the cutting edge of the cutting die is made as short as possible so that the relatively soft wire will not be moved laterally of the cutting die axis by the cutting action. In the present apparatus this distance is only sufficiently great to permit the removed metal to flow outwardly. In actual practice, it has been found that one-eighth of an inch is sufficient spacing for this purpose. The cutting die as illustrated enlarged in Fig. 3 is provided with a tapered front surface and a tapered inner diameter. In the illustrated example, it is intended to shave or remove metal from a circular wire, but the principles herein disclosed are applicable to bars or wire having rectangular or other cross-sections. The tapered outer surface and the tapered inner surface meet to form the cutting edge 42'. The angles of these two surfaces are ground in accordance with well established metal cutting practice and are slightly different for each metal that is cut. In the present die a three degree taper is used for the inner surface and a 35 degree taper is used for the outer surface.

To facilitate the removal of the metal that is cut by the cutting edge, I provide auxiliary cutting edges which separate the removed metal into narrow shreds. These auxiliary edges are clearly illustrated in Figs. 3 and 4. To provide these auxiliary cutting edges, the outer conical surface 42 of the die is provided, in accordance with my invention, with a series of equally spaced flat portions 43. These flat portions are ground into the conical surface and are at a slightly greater angle to the axis than the cone surface 42. These flat portions 43 intersect above the cutting edge of the die, and thereby produce radial cutting edges, or chisel edges 43' which extend radially from the circular cutting edge 42'. The length of these edges is calculated to be slightly greater than the thickness of the metal that is to be removed. These edges cut the metal removed from the wire radially, and thereby facilitate a movement of this metal in narrow strips over the flattened die surfaces. These flattened surfaces are preferably polished very smoothly, so as to reduce the friction of the removed metal against this surface to a minimum. It has been found in practice that reducing this friction is important because, if this friction is too great, the surface of the wire is torn or broken, and eventually causes breaks in the wire when it is later drawn down to the small diameters. In the illustrated dies, six of these flattened portions are illustrated. More may be used. Further-

more, these need not be true flat surfaces. They may be slightly concaved. The die 40 is supported in an intermediate collar, or collet, 44, being held therein by a screw collar 45. The intermediate collar 44 is held in a supporting collar 46 by a set screw 47, and the collar 46 is attached to the supporting structure 41 by screws 48.

As above described, the cutting die is provided with radial cutting edges or chisel edges 43'. These edges 43' are created by superposing, upon the conical outer surface of the cutting die, flat surfaces which are equally spaced about the axis of the die. They are therefore at an angular relationship to each other and intersect to form the edges 43'. These flat surfaces are necessarily formed by the removal of metal from the conical die surface, which removal of metal results in an alteration of the circular cutting edge 42'. This alteration consists of the formation of arcs between the chisel edges, each chisel edge being axially ahead of the center portion of each arc of the circular cutting edge extending between the radial cutting edges. This condition is clearly shown in Fig. 3. As a result of this relationship between the radial and circular cutting edges, every increment of the surface layer, which is to be removed, is first cut by the radial edge. Furthermore, this radial edge is necessarily at an angle to the axis so that each increment of the surface layer of the wire actually encounters a chisel point. As the wire progresses, the layer is cut radially by the radial cutting edge and is severed from the wire surface by the circular cutting edge, the complete separation of each strip, or section, of the layer being accomplished either simultaneously or slightly subsequent to the radial separation of the strip. The operation carried out by the cutting edge of this die can, therefore, be separated into two steps performed either simultaneously or successively upon each increment of the layer, the first of these steps being the radial separation of the layer into strips and the second being the separation of the strips from the wire surface by the circular cutting edge.

After each increment of the strips is separated from the wire, it slides over the flat surface, between the radial edges on the die, in a radial direction and at an angle to the axis which is determined by the flat surface. This removal of the strips is of importance, because as above stated in the specification, the resistance to removal must be at a minimum, otherwise, the surface of the wire is broken. This removal of the strips may, therefore, be considered as a third step performed by the cutting die, and a second function of the flat surfaces superposed upon the conical surface of the die.

The fourth die 50 in this assembly is another wire drawing die. Its function is to harden the surface of the wire after it leaves the cutting die, and in doing this, it also may be used to reduce the cross-sectional area by about 10%. The friction on the wire at the first drawing die of this device produces a tension on the wire so that the section of the wire between the two drawing dies remains straight. I have found that it is important to keep the wire sections, preceding and succeeding the cutting die, perfectly straight so that the metal removed from the wire by the cutting die will be of uniform thickness both longitudinally and annularly. The drawing die 50 is supported in a reinforcing shroud 51 and held in a supporting structure 52 by a clamp 53. The supporting structures 41 and 52 are connected by

webs 49 which strengthen the combined structure and simultaneously form a container, for lubricating material, between the cutting die and the final drawing die. Similar lubricating material containers 54 and 55 are provided before the guide die and the first drawing die, respectively.

In operation, the mechanism above described may be placed between two drums of a wire drawing machine. The wire is threaded there-through in the usual manner by reducing the diameter of an end of the wire sufficiently so that the wire will thread through the die without resistance, and is then drawn through by means of drums. The metal mostly used is copper, and in the illustrated arrangement the stresses and corresponding sizes of the dies are calculated for this material. When properly calculated, wire may be drawn through this mechanism continuously at a considerable speed, speeds up to 200 feet per minute having been obtained in practice.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a wire shaving apparatus the combination of an integral cutting die provided with an annular cutting edge, a drawing die preceding said cutting die, a guide die arranged between said drawing and cutting dies, said guide die being spaced from said cutting die by a distance only sufficient to permit a continuous egress of the material being removed from the wire, and means for adjusting said guide die about the axis of the cutting die to equalize the annular thickness of the material removed from the surface of the wire.

2. In a wire shaving apparatus the combination of a cutting die and a drawing die arranged in series for the passage of a wire therethrough, said drawing die being provided with a wire drawing surface for reducing the cross-sectional area of the wire passing therethrough and placing a tension upon the wire sufficient to straighten it, whereby the wire entering the cutting die is of sufficient uniformity to permit the cutting of a uniform layer of surface metal from said wire.

3. In a wire shaving apparatus the combination of an integral cutting die provided with a continuous annular cutting edge, a drawing die preceding said cutting die, a guide die arranged between said drawing and cutting dies and spaced from the cutting die by a distance sufficient only to permit free egress of the material being removed from the wire, and means for adjusting the axial relationship between said guide die and the cutting die to equalize the annular thickness of the material removed from the surface of the wire.

4. In a wire shaving apparatus, the combination of a cutting die, a drawing die immediately preceding said cutting die, and a second drawing die immediately following said cutting die, said drawing dies having drawing surfaces arranged to reduce the diameter of the wire passing through them and to place a predetermined tension upon the section of wire between them whereby the wire passing through the dies is held in a substantially straight line and the cutting die is enabled to cut a layer of annularly uniform thickness.

5. In a wire shaving die, the combination of a cylinder, an inner and an outer tapered surface on said cylinder intersecting at one end of said cylinder to form a continuous cutting edge, and means on said outer surface forming radial cut-

ting edges, said radial edges projecting from said continuous cutting edge and having a length greater than the thickness of metal intended to be removed by said continuous cutting edge,

5 whereby the layer of metal removed from a bar passing through said die is shredded.

6. A wire shaving die comprising a hollow cylinder, an inner and an outer conical surface on said cylinder, said surfaces intersecting at one
10 end of said cylinder to form a circular cutting edge, and radial cutting edges projecting from said circular cutting edge along said outer conical surface to shred the material cut by said circular cutting edge.

15 7. A wire shaving die comprising a cylinder having inner and outer conical surfaces intersecting to form a cutting edge having a diameter equal to the diameter to which the wire is to be reduced, a plurality of substantially flattened
20 portions upon said outer conical surface, said flattened portions intersecting each other above the cutting edge, thereby producing radial cutting edges extending from said circular cutting edge which break the material cut from the wire
25 into strips, said strips being removed by sliding on said flattened portions.

8. In a wire shaving apparatus the combination of a cutting die, a drawing die preceding said cutting die, a second drawing die succeeding
30 said cutting die and a guiding die immediately preceding the cutting edge of said cutting die, the diameters of said successive dies being arranged successively to reduce the diameter of said wire by amounts sufficient to cause a tension
35 in the sections of wire between said dies whereby the wire is straightened and maintained straight while passing through said cutting die.

9. In a wire shaving apparatus, the combination of a cutting die, a drawing die preceding
40 said cutting die, and a second drawing die succeeding said cutting die, said drawing dies being spaced from said cutting die and from each other a sufficiently short distance to prevent catenary sag of the wire between the dies.

45 10. The process of removing a layer of metal from a metallic rod which consists of cutting said complete layer radially into a plurality of strips and simultaneously cutting all of said strips from said rod.

50 11. The process of removing a layer of metal

from a metallic rod which consists of simultaneously cutting said layer radially into a plurality of strips and cutting each of said strips from said rod.

12. The process of removing a layer of metal 5 from a metallic rod which consists of cutting said layer radially into a plurality of strips having equal width and simultaneously cutting all of said strips from said rod.

13. The process of removing an annular layer 10 of metal having a radially uniform thickness from a round metallic rod which consists of simultaneously cutting said layer into a plurality of equally wide strips and cutting all of said strips from said rod.

14. The process of removing a layer of metal 15 from a round metallic rod which consists of cutting said layer radially into a plurality of strips of equal width, cutting said strips from said rod and thereafter removing said strips radially from 20 said rod.

15. The continuous process of shaving a metal rod having a surface containing defects to produce a rod having a smooth surface free from defects and suitable for drawing into wire which 25 consists in passing the rod through a cutting die thereby cutting the complete layer into a plurality of strips and simultaneously removing each of said strips.

16. The process of shaving a metal rod having 30 a surface containing defects to produce a rod having a smooth surface free from defects and suitable for drawing into wire which consists in passing the rod through a cutting die thereby cutting from the rod an outer layer of uniform 35 radial thickness and cutting said layer into strips before removing said layer from said rod.

17. The process of shaving a metal rod having a surface containing defects to produce a rod 40 having a smooth surface free from defects for drawing into wire which consists in passing the rod through a cutting die having a series of circularly arranged arcuate cutting edges and radial cutting edges projecting from the meeting points of said arcuate cutting edges, thereby cutting 45 from the rod a layer of substantially uniform radial thickness and separating the removed layer into a plurality of strips, said strips being removed radially from said rod.

CAIUS E. WEAVER. 50