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WIRE GRINDING MACHINE

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Fig. 2

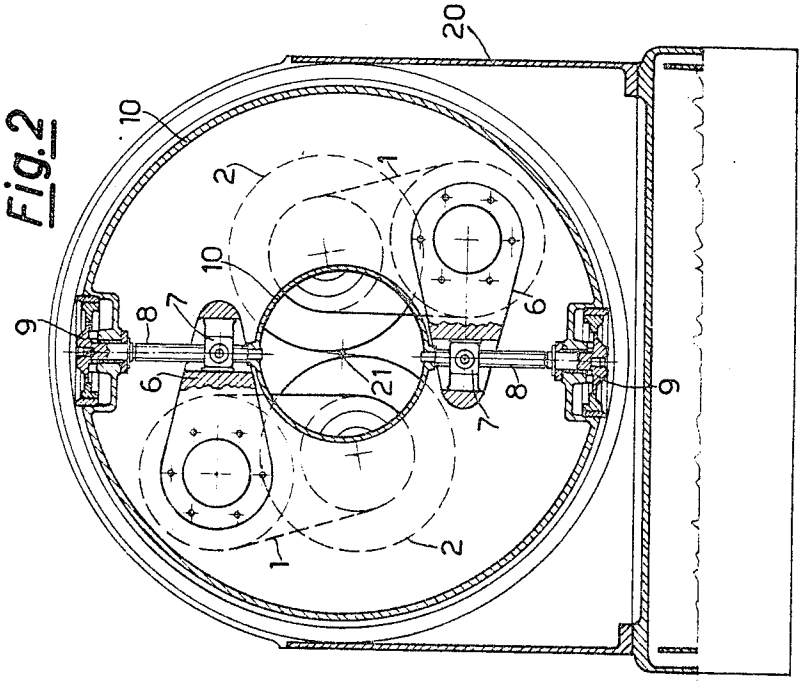
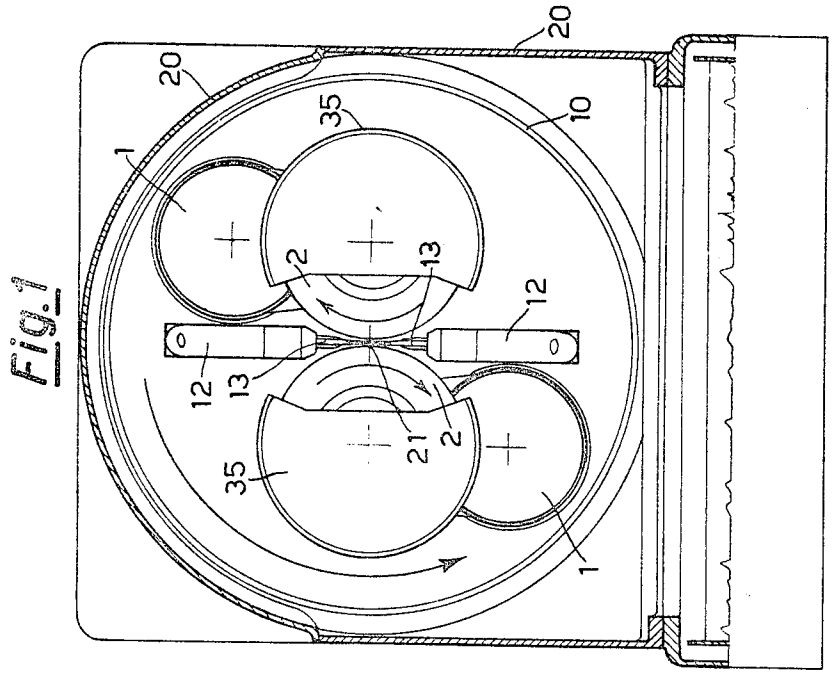



Fig. 1



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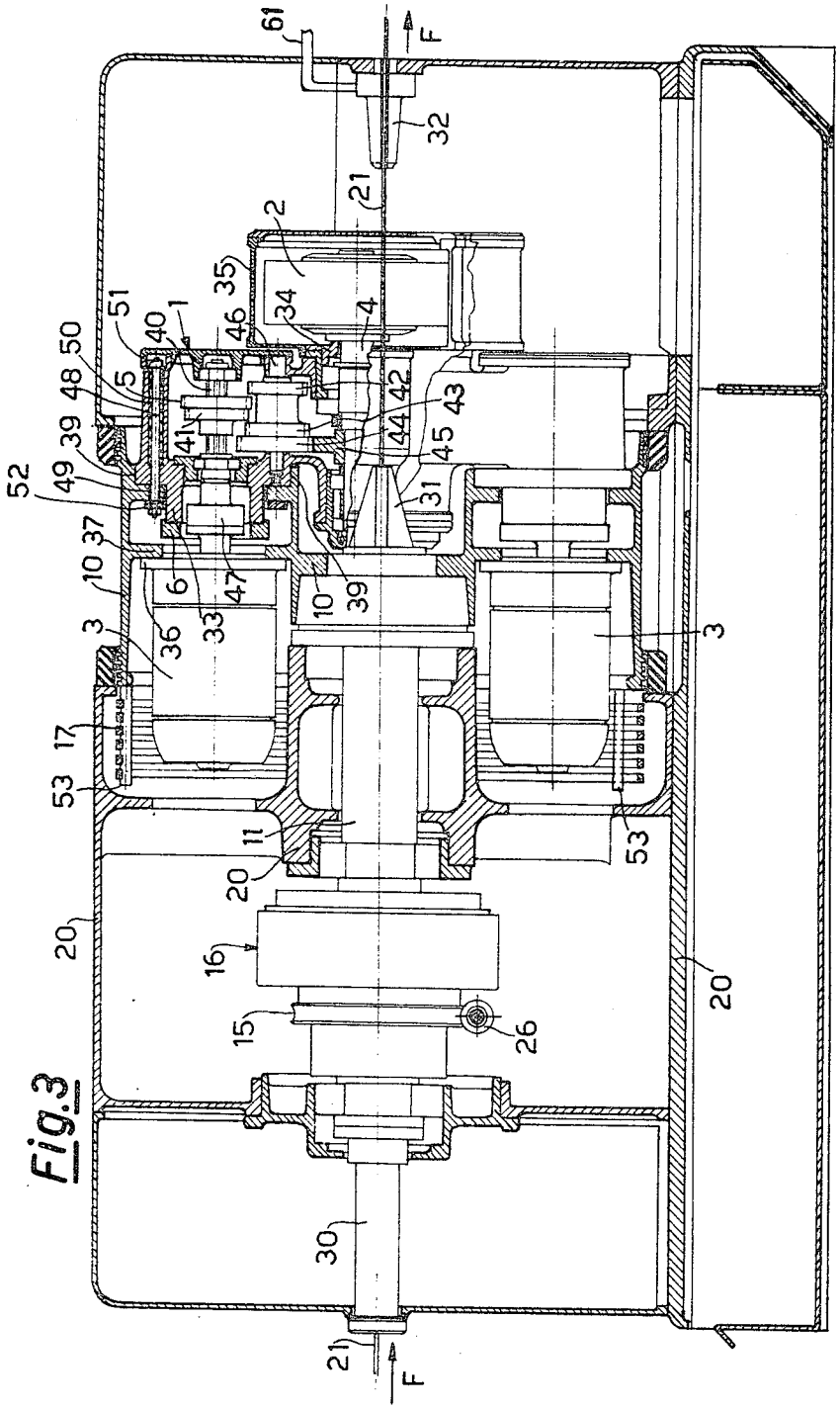



Fig. 3

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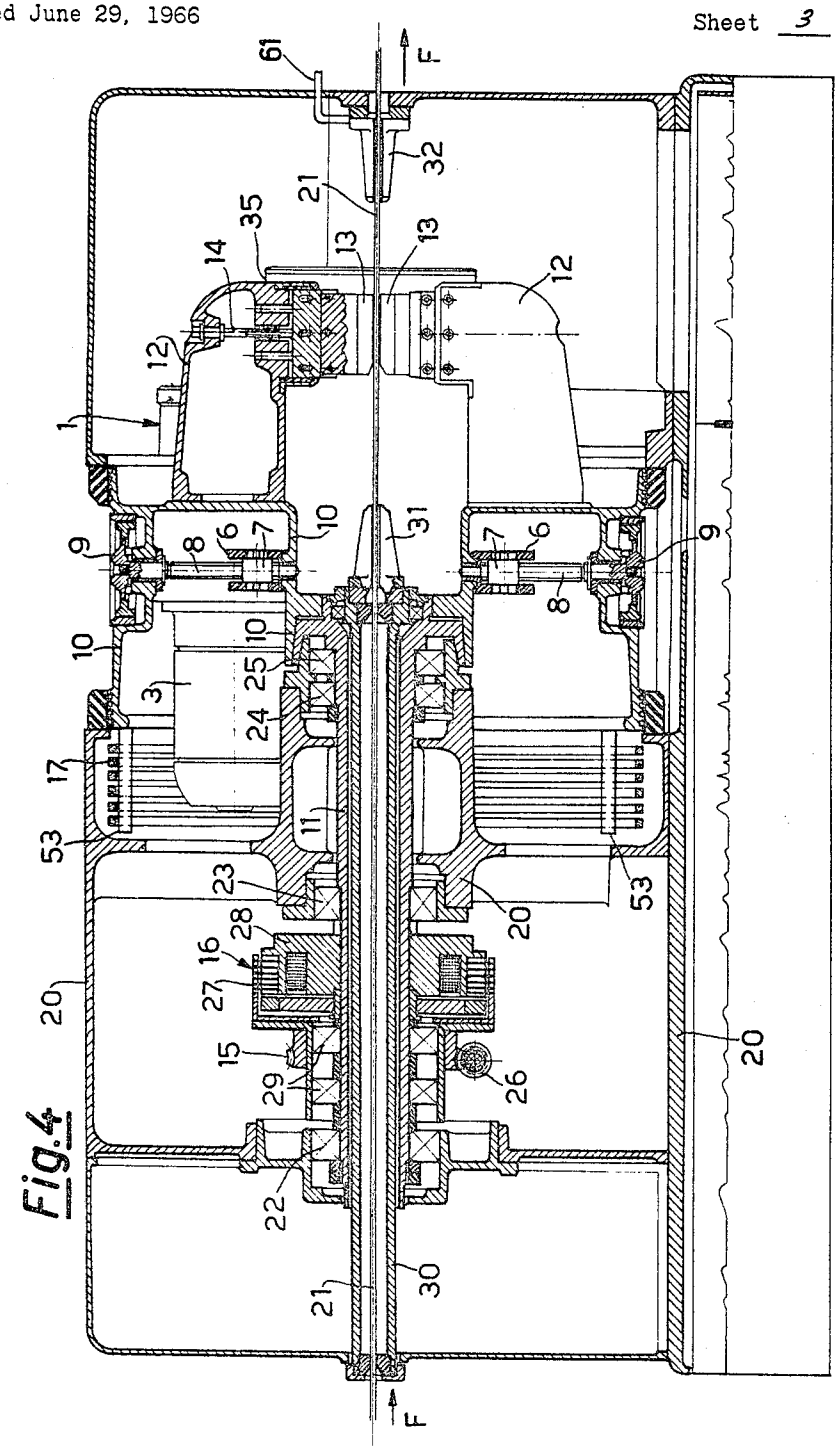



Fig. 4

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3,432,971

# WIRE GRINDING MACHINE

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U.S. Cl. 51—80 11 Claims
Int. Cl. B24b 7/02, 9/00

## ABSTRACT OF THE DISCLOSURE

A metal wire grinding machine in which a drum is driven in rotation about its axis and supports on one side of a radial wall therein, a pair of grinding wheels arranged symmetrically and adjustably, with respect to the axis of rotation of the drum, and on the opposite side of the wall a driving means for rotating the wheels about their respective axes which are offset from the axis of rotation of the drum. The wheels are supported in heads which in turn are supported in the drum and resiliently urged against the wall therein, said heads containing a transmission for the drive between the wheels and the drive means therefor.

This invention relates to a machine for grinding metal wires and the like.

It is known that in modern industry the use of hot-rolled wire rods of special or alloyed steels is ever increasing for the production of tools and of rollers and balls for roller-bearings and ball-bearings, respectively.

It is also known to those skilled in the art that hot-rolled wire rod exhibits superficial defects with inclusions of oxidized layers at variable depths, decarburized spots and the like. The use of modern high-speed rolling machines has further contributed to impairing the superficial condition of the wire rod thus giving rise to superficial ridges and creases which, though of restricted depths, are still very objectionable to the utilizing of the wire rod.

There are industries which utilize the wire rod and which necessitate, to the end of a subsequent processing of the metal wire, an absolutely pure rod devoid of any superficial defects and having a sufficiently smooth surface within the requested tolerances.

In order that these requirements may be fulfilled, two different modes are currently employed. For example, in one the wire rod is cold-drawn but, inasmuch as it is not possible to do away in this manner with all the defects aforementioned, the industries which utilize the drawn wire are compelled to use a wire having a diameter greater than that which would be theoretically required, that is, they are required to resort to an increase of the machining allowance so as to remove all the superficial defects by a subsequent machining. To this end, it is necessary to cut the continuous-length wire rod or wire into bars of a limited length which are ground on the so-called "centerless" machines; these have the great drawback that they are not enabled to operate on a whole wire coil with continuity. The machines which utilize the ground wire thus cannot work automatically or continuously because



they cannot be fed with a ground wire having a considerable length and forwarded continuously.

A novel machine has been recently adopted in which the continuous wire is caused to pass into a drum which rotates about its own axis and the latter coincides with the axis of the wire, special steel tools being provided within the drum for removing from the wire rod surface a thin superficial layer: this operative step, however, is such as to produce a noticeable waste of wire material since the tip of the tool must always work below the superficial oxidized or decarburized layer of the wire, said layer being very hard and, furthermore, this step cannot be regarded as anything more than a roughing operation which does not provide a smooth surfaced wire within the required tolerance limits.

An object of the present invention is therefore to provide a machine capable of operating on the common hot-rolled wire rod of alloyed or special steel, to produce a wire exempt from any superficial defect, exhibiting a smooth surface and within very close tolerances relative to the diameter of the obtained wire.

Another object is to provide a machine capable of being continuously fed by a coil of wire rod or continuous wire and capable of producing ground wire continuously and in infinite lengths.

A further object is to provide a machine capable of machining wires having different diameters, made of steels of different qualities.

Still another object is to provide a machine for grinding a wire by removing a minimum amount of wire from the surface of the wire being machined.

The foregoing and other objects are achieved with a wire grinder which comprises a bedplate, a drum mounted on said bedplate and rotatably about its own axis, members for guiding a metal wire coaxially with said drum, two grinding wheels arranged symmetrically with respect to the drum axis and borne by carriers mounted thereon, moving means for rotating said drum about its own axis, means for rotating said grinding wheels about their respective axes, and driving means for driving the metal wire along the axis of said drum.

The structural features of said machine and the advantages stemming from its use will become fully apparent from a consideration of the ensuing disclosure which describes, by way of example only and without any limitation, an embodiment of said machine, reference being had to the accompanying drawing, wherein:

FIGURES 1 and 2 are radial cross-sectional views of the machine with its rotatable drum somewhat angularly shifted in one figure with respect to the other one,

FIGURES 3 and 4 are two diagrammatical axial sections of the machine, which also show the drum somewhat angularly displaced in one figure with respect to the other figure.

As can be seen in the drawings, the machine comprises a bedplate **20** which, through bearings diagrammatically designated by the numerals **22**, **23**, **24** and **25** (see particularly FIG. 4) carries in a freely rotatable way a hollow shaft **11**. At the free end of the shaft **11**, on the right side as viewed in FIGS. 3 and 4, is overhangingly affixed a drum **10** coaxial with said shaft **11**. At the opposite end of the shaft **11** (on the left as viewed on FIGS. 3 and 4) is mounted, freely rotatable on bearings **29**, a

portion **27** of an electromagnetic clutch **16**, the other portion of which, indicated by the reference numeral **28**, is rigidly affixed to the shaft **11**. On the portion **27** of the electromagnetic clutch is affixed a worm gear **15** having helical teeth, meshing with a worm **26** driven in rotation by a motor (not shown in the drawings to simplify the same). When the electromagnetic clutch is de-energized, the portion **27** thereof rotates idly on the bearings **29** and thus on the shaft **11**. When, conversely, the clutch is energized and coupled, the rotary motion of the worm **26** is transferred from the portion **27** to the portion **28** of the electromagnetic clutch **16** thus driving in rotation the shaft **11** and therewith the drum **10**: the use of the electromagnetic clutch also permits to obtaining a gradual drive in rotation of the drum **10**.

The drum **10** comprises a radial wall having two holes with circular housings **39** (FIG. 3) diametrically opposite to one another: in each of said holes is threaded and housed a cylindrical shank **33** of a grinding-wheel-carrying head **1** which, as viewed from the side, has the shape of a large Z as can be seen in FIG. 3. One of said grinding-wheel-carrying heads will be described in greater detail hereinafter. At its end remote from shank **33**, the grinding-wheel-carrying head supports, by ball- and roller-bearings, a grinding wheel carrier chuck **4** which, through a flanged hub, carries a grinding wheel **2**: the grinding-wheel-carrying chuck is fixedly held by a screw-threaded sleeve **34** screwed onto the wheel-carrying head. The wheel-carrying head **1** comprises a plurality of housings in which are housed (FIG. 3) rods **48** having an enlarged head **51** at one end: between said head **51** and the body of the wheel-carrying head **1**, a spring **50** is interposed, which is in the compressed condition. The end of each rod **48**, remote from head **51**, protrudes out of the body of the wheel-carrying head **1**, and is screw-threaded and inserted into an elongated perforation **49** formed in the radial wall adjacent housing **39**. A nut **52**, screwed onto the screw-threaded end of the rod **48** acts in such a way that the spring **50** urges the wheel-carrying head against the radial wall of the drum thus impeding, by friction, free movement of the cylindrical portion **33** and thus of the wheel-carrying head **1** itself in housing **39**. On the shaft of the wheel-carrying chuck **4** is keyed a gear **45** (FIG. 3) which engages another gear **44** keyed, in turn, on an idle arbor **46** borne in the wheel-carrying head **1** and on which are also keyed two gears **42** and **43**. On a splined arbor **40**, also supported by the wheel-carrying head **1**, is mounted a pair of gears **5** and **41** which cannot rotate with respect to the arbor **40** but can be axially shifted thereon. Said operation can be effected when the machine is at standstill by removing, from the wheel-carrying head, a front lid, then causing the wheel **5** to mesh with the gear **42**, or, alternatively, the gear **41** with the gear **43**, by fixing the gears on the arbor **40** in the desired position and then replacing the front lid on the wheel-carrying head. In consideration of the fact that the arbor **40** is the driver shaft which transfers the rotational drive to the wheel **2**, as will be explained hereinafter, it can be appreciated that the assemblage of gears described above is such as to constitute a speed-change gear with two speeds, shown in its neutral condition in FIG. 3 and capable of transmitting to the wheel **2** a rotary drive at two different speeds, from a constant r.p.m. of the arbor **40**.

The arbor **40** is driven by an electric motor **3** via a clutch **47**, said motor **3** being secured to a flange **36** which is affixed to a radial wall **37** of the drum **10**. The two electric motors **3** which actuate the two grinding wheels **2**, receive their feeding current from a set of collector rings **17** which are rigidly borne by the drum **10** by a set of supporting brackets **53**. The motors are connected by cables to the collector rings **17** on which brushes, (not shown in the drawing), are allowed to slide and carry to said rings the feeding current.

The wheels **2** are partially enclosed and protected, each by an apron **35** affixed to the attendant wheel-carrier head and having the shape which can be seen in FIGS. 1 and 3.

To the cylindrical portion **33** of each wheel-carrying head **1** is affixed, by bolts, an end of a lever **6** (FIGS. 2 and 3), which, at its other end, has a longitudinally extending spline (FIG. 2) in which is housed freely slidable and rotatable a pivot rigid with a nut **7** having a cylindrical screw-threaded hole in which a screw-threaded arbor **8**. borne by the drum **10**, is inserted (FIGS. 2 and 4), to whose outermost end closest the drum **10**, is rigidly attached a hand-wheel **9** having a pointer (not shown in the drawings) which, in cooperation with a graduated scale solid with the drum **10** permits reading the angular position of the screw-threaded arbor **8**. By manipulating the hand-wheel **9** (when the machine is stationary), a sliding movement of the nut **7** along the screw-threaded arbor **8** is obtained, thus giving rise to a rotation of the lever **6** and consequently also of the wheel-carrying head **1** about the axis of the cylindrical portion **33**, against the friction existing between the contacting surfaces of the wheel-carrying head **1** and the radial wall of the drum **10** wherein the housing **39** have been formed. The rotation of the two wheel-carrying heads causes an approaching or retracting movement of the two grinding wheels **2**, one with respect to the other, the rotation taking place in such a way that the plane passing through the axes of the two wheels **2** is caused to pass, irrespective of the angular positions of the wheel-carrying heads, through the same ideal line which coincides with the axis of the metal wire **21** which will be discussed hereinafter (FIGS. 1 and 2).

To the same radial wall of the drum **10** through which the housings **39** are formed, are affixed, in a position diametrically opposite one another, two brackets **12** each supporting a blade **13** extending towards the axis of rotation of the drum and lying in the common plane of tangency of the two grinding wheels (FIGS. 1 and 4). As can be seen particularly in FIG. 1, the confronting ends of the two blades **13** are spaced from one another by a distance equal to the diameter of the wire **21** to be ground, so that the wire cannot undergo any transversal movements inasmuch as the confronting ends of the blades **13** and the confronting surfaces of the grinding wheels **2** prevent this movement. As can be readily appreciated, the blades **13** are contained in a plane which is substantially perpendicular to the plane containing the axes of the grinding wheels **2**. Each blade **13** is rigid (FIG. 4) with a blade-carrier which, via a screw **14**, and can be radially displaced when the machine is stationary, so as to cause the free end of the blade to approach or be separated from the axis of the drum **10**.

Internally and coaxially with the hollow shaft **11** is fixedly carried, with respect to the machine framing, a tubular member **30** which, at the inner end of the machine, carries members **31** capable of carrying and guiding the metal wire **21** which passes through the tubular member **30** and comes out of the machine by being displaced in the direction of the arrows F, by the action of suitable means (not shown in the drawings to simplify the showing), the wire being also carried and guided between the blades **13** and a supporting and guiding member **32** affixed to the machine bedplate at the right in FIGS. 3 and 4. Member **32** acts as a nozzle through which water is injected to cool the ground wire and dispose of the material and debris ground by the wheels **2**, said material being collected at the bottom of the machine in a specially provided tub (not shown). Water is delivered to the member **32** through a conduit **61** by a conventional delivery pump.

During the operation of the machine, the metal wire **21** which is advanced in a rectilinear and continuous way along the axis of the drum **10**, is rapidly and evenly ground by the grinding wheels **2** which are endowed with a rapid rotary motion about their own axes and also with

a revolution movement about the axis about the drum **10**, and thus, of the wire **21**. In practice, it has shown that it is possible to easily grind wires of special and alloyed steels by changing, as necessity demands, and according to the procedure outlined above, the speed of rotation of the wheels. Obviously, once a wire has been ground, if another wire having a considerably different diameter is to be ground, it is necessary to manipulate the handwheels **9** and the screws **14** so as to bring both the grinding wheels **2** and the blades **13** to a suitable mutual spacing. It should also be noted that, with coarse grit wheels and wire **21** fed at a high speed to the machine, the hot-rolled wire rod fed into the machine undergoes an operation which could be considered a peeling and in this case the machine could be properly employed in steel mills and drawing mills.

If, on the contrary, fine grit wheels are used and the wire rod to be ground is caused to advance at a speed lower than that of the preceding case, which can be measured experimentally, the wire is in reality ground and all the superficial defects are eliminated: under these conditions the machine finds its more appropriate application in the wire drawing mills and in industries which use ground wire, and these can have at hand a ground wire of infinitive length, produced by a continous process.

It is also important to note that the machine advantageously exploits what generally is considered a drawback of the materials used in machine constructions, that is the flexibility of said materials. During the operation of the machine, the rotation of the drum **10** about its own axis induces a resilient bending of the grinding-wheel carrying heads **1** due to the effect of the centrifugal force which is especially due to the mass of the wheels **2**. The higher the rotational speed of the drum, the greater the sag of the wheel-carrying heads and thus the greater the stroke of the wheels towards the outside with respect to the position occupied by the wheels at standstill; the position of the wheels during the operation of the machine is obviously constant if the rotational speed of the drum is constant along with the other conditions of the machine. It is apparent now that during the grinding operation of the wire, the grinding wheels wear out and their diameters are decreased: until such time as the decrease in diameter is confined within narrow limits of the order of hundreths or a few tenths of one millimeter, it is possible to obtain from the machine a ground wire of constant diameter without having to stop the machine and act on the handwheels **9** so as to readjust the machine. As a matter of fact, when it is noticed that the ground wire coming out of the machine increases in diameter to the tolerance limits (a consequence of the fact that the diameters of the grinding wheels have been decreased), it is sufficient to decrease the speed of rotation of the drum **10** so as to diminish the sag of the wheel-carrier heads **1**, whereupon a ground wire of the desired diameter is thus obtained again.

As an example of the mode of operation of the machine, let us assume it is desired to grind a hot-rolled wire rod, 7 mms. in diameter to obtain a wire of a diameter of 6.7 mms. With the machine at standstill, a section of previously ground wire having a diameter of 6.7 mms. is introduced between the grinding wheels **2** and the blades **13**, and then, by acting on the handwheel **9** and the screws **14**, the grinding wheels **2** and the blades **13** are brought into contact with the surface of said wire which is then removed from the machine. If the maximum speed of rotation of the drum during the operation of the machine is, say, 400 r.p.m., the centrifugal force will give rise, at this speed, to a sag of the wheel-carrying heads and thus will cause the wheels **2** to be pushed outwardly through a distance which has been determined by trial and error during the construction of the machine. Let us assume, for example, that at 400 r.p.m. of the drum, the wheels are thrust outward by 1 mm. each, with respect to the rest condition. Then, after having removed the section of ground wire as suggested above, the graduated handwheels **9** are manipulated so as to give rise to an approaching movement of the grinding wheels to the axis of the drum by 1 mm. The machine is now started at 400 r.p.m. and the grinding wheels are automatically shifted 6.7 mms. apart from one another. At this stage the wire rod to be ground is fed into the machine between the grinding wheels and the machining proceeds as detailed above.

I claim:

**1.** A metal wire grinding machine comprising a bedplate, a drum supported in said bedplate for rotation about an axis, means for driving said drum in rotation about said axis, means for guidably advancing a metal wire, to be ground, coaxially through said drum, said drum including a radial partition wall, a pair of grinding wheels, a head carrying each wheel, the heads being supported in diametrically opposed relation in said drum for rotation about respective axes which are offset from said axis of rotation of said drum, means urgng each head against said wall to resist rotation of said head relative to said drum, said heads supporting said wheels on one side of said wall for rotation about respective axes offset from those of the heads in the drum and in symmertical disposition relative to the axis of rotation of said drum and in a common plane therewith, means for angularly adjusting the heads in said drum to vary the position of said wheels in said plane relative to the axis of said drum, and means in said drum supported on the other side of said wall for driving said wheels in rotation about their respective axes.

**2.** A machine as claimed in claim **1** wherein said means for angularly adjusting the heads in said drum comprises a lever for each head, each lever having one end coupled to its associated head and an opposite end which is displaceable in said drum to produce rotation of the associated head, in opposition to the means which urges each head against the wall, and consequent displacement of the wheel suported by said head.

**3.** A machine as claimed in claim **2** wherein said means for angularly adjusting the heads in said drum further comprises for each head a rotatable threaded arbor radially disposed in said drum and a nut threadably engaged with said arbor and secured to the associated lever at the opposite end thereof.

**4.** A machine as claimed in claim **1** comprising transmission means in said head between the wheels and the driving means therefor.

**5.** A machine as claimed in claim **4** wherein said driving means is a prime mover and said transmission means comprises a drive shaft in said head driven in rotation by said prime mover, each said wheel having a driven shaft and gear means coupling said drive and driven shafts for transmitting drive therebetween.

**6.** A machine as claimed in claim **5** wherein said gear means comprises a speed-change gear assembly for varying the drive to said wheels.

**7.** A machine as claimed in claim **5** wherein said prime mover is an electric motor, said driving means comprising collector rings coaxial with said drum, sliding brushes on said rings adapted for connection with an electrical cource and electrical connection means between the collector rings and said motor.

**8.** A machine as claimed in claim **1** wherein said means which guidably advances the metal wire comprises two blades supported from said drum in a longitudinal plane of the drum passing through the axis of rotation thereof, and means for varying the position of the blade relative to the axis of rotation of said drum.

**9.** A machine as claimed in claim **1** wherein said means for driving said drum comprises a shaft coaxially mounted within said drum and drivingly coupled thereto, bearings in said bedplate supporting said shaft and means for driving said shaft in rotation.

**10.** A machine as claimed in claim **9** wherein said means

for driving said shaft in rotation comprises a driven worm, a worm gear in mesh with said worm, and clutch means between said worm gear and said shaft.

11. A machine as claimed in claim 1 comprising means adjacent said wheels on a side thereof opposite said wall for supplying a coolant, wash, liquid to said wire as it exists from said wheels.


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