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(54) MACHINE FOR COILING METAL WIRE

- (71) I, ENRICO LAMPERTI, an Italian Citizen, of 4 Via Ercole Ferrario, Gallarate, Varese, Italy, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention concerns an automatic machine for coiling metal wire.
- In accordance with the present invention there is provided an automatic machine for coiling metal wires to form springs, comprising power driven means to advance wire to be coiled, means to coil the advancing wire, a pair of slides disposed on opposite sides of the path of advance of the wire, a tool for penetrating between coils of the wire thereby to open the coiled wire so as to determine the pitch of the coils, a cutter for severing a length of coiled wire, said cutter and tool being detachably inter-changeably mountable on respective ones of said slides, a first power-driven shaft having means for imparting to a said slide a wire cutting movement, and a second power-driven shaft having means to impart to a said slide a coil opening movement, each shaft being operable to impart movement to one or other of said shafts, whereby said machine can be selectively adapted for the formation of right-hand coils or left-hand coils.
- An arrangement embodying the invention will be described, by way of example, with reference to the accompanying drawings, in which:—
- Figure 1 is a diagrammatic front view, taken on the line 1-1 of Figure 2, showing the mechanism present at the upper part of a practical embodiment of the machine of the invention, which machine is shown to a smaller scale in Figure 11;
- Figure 2 is a diagrammatic part-sectional plan view taken on the line 2-2 of Figure 1, showing certain of the details of the mechanism of Figure 1;
- Figure 3 is fragmentary part-sectional view, taken on the line 3-3 of Figure 1, showing further details of the said mechanism;
- Figure 4 is another fragmentary part-sectional view, taken on the lines 4-4 of Figure 1, showing details of the mechanism;
- Figure 5 is yet another fragmentary part-sectional view, taken on the line 5-5 of Figure 1, showing further details of the mechanism;
- Figure 6 is another similar view, taken on the line 6-6 of Figure 1, showing more details of the mechanism;
- Figure 7 is a further similar view, taken on the line 7-7 of Figure 1, showing more of said details;
- Figure 8 is a detached elevation showing further details of the mechanism;
- Figure 9 is a schematic perspective view illustrating the mode of operation of the machine;
- Figure 10 is an enlarged detached view illustrating the relationship between the wire guides of the mechanism of the preceding figures; and
- Figure 11 is a perspective view illustrating the overall machine.
- As shown in the drawings, for instance in Figure 1, the preferred machine of the invention has a front face composed of three metal plates 1, 2 and 2' which, being suitably anchored and fixed together, create a hollow space 14 between the plates 2 and 2' accommodating the majority of the components necessary for the formation of springs, these being driven from a single drive shaft 23, through the agency of a train of gears 5, 6, 7, 8, 9 and 10, and three rotating hubs 11, 12, 13. The space contains an eccentric 22 controlled by a shaft 24 which actuates a link 15, the link being detachably connected by a pivot pin extending through pivot holes indicated at a lever 16. The lever 16 is loaded by a spring 21, and actuates a slide 33. When the eccentric 22 is thus connected with the lever 16 by the pivot pin, a lever 17 loaded by a spring 21' is connected through a window 18' to a device 26 (Figure 5) controlled by a cam-carrier 25, the lever 17 being operable to actuate a slide 34.
- This arrangement can be reversed by disconnecting the link 15 from the lever 16 which is instead connected through a window 18 to the movable device 26 which thereby actuates the slide 33, while coupling a link 15' to the lever 17 so that the eccentric 22 actuates the slide 34.
- Adjacent the plates 2, 2', the plate 1 has mounted thereon adjustable wire guides 3 and 3' disposed along the line of advance of a wire entrained by wire-drawing rollers. These adjustable wire-guides (shown in detail in Figure

10) are positioned upstream, between and after the wire-drawing rollers, and are each divided into two half guides registering with one another, one of which is the half guide 3' which is fixed by means of suitable screws to the plate 1 and the other of which is the half guide 3 which is adjustable vertically by means of suitable adjusting screws 4.

Figure 10 illustrates possible cross-sections for the adjustable guides 3 and 3', from which it will be seen that the half guides 3' are provided, in addition to fixing and registration holes, with triangular recesses 38 which are complementary to respective frusto-cones 39 formed on the movable half guides 3. When the cone frustum 39 of the half guide 3, upon adjustment with the screws 4, is engaged into the triangular recess 38 of the fixed half guide 3', there arises, between the plane of the tip of the cone frustum 39 and the exposed walls of the recess 38, a wire gliding space. This space is minimum with full registration of the frustum 39 into the recess 38; the more the half guides 3 are separated, by adjustment, from the fixed half guides 3', the greater is the wire gliding space so that the machine can be used so with metal wires of increasing diameter up to a maximum handleable by the winding machine.

Metal wire, passing between the adjustable guides, slides between the latter, being displaced by rollers 32 which, too, each have a triangular recess in which the metal wire engages. Gripping of the wire is achieved by means of a device 72 mounted on the plate 1 (Figure 1) which makes it possible to set exactly the pressure by which the rollers 32 press on the wire. A device 30, illustrated non-restrictively in Figure 3, actuates, through a worm gear, a carriage 28 which carries a counter-cutter blade, an actuating stub 29 of the device 30 protruding from the machine so as to be rotatable by means of a removable hand-wheel (shown at 49 in Figure 11).

Rotation of the shaft 23 (Figure 2) is transmitted by the gears 5, 6, 7, 8, 9 and 10 situated in the hollow space 14 to the hubs 11, 12 and 13 which carry respective cams, and the shaft 23 is provided with the rear cam-carrier 25 which, by means of the device 26 (Figure 5) controls a vertical coil opening tool 70 which can be mounted either on the slide 33 or on the slide 34. When a coil opening movement is imparted to the slide, the wedge shaped tool 70 is operable to penetrate between the coils so as to separate them by an amount determined by the amount of penetration.

Figure 4 shows the manner of location, within the hollow space 14, of the gear 10. The output of the latter is to the hub 13. The arrangement for the gear 9 and hub 12 is similar.

Figure 6 shows the arrangement of the intermediate gear 7. The arrangement of the gear 7 is similar.

Figure 7 shows how the control shaft 24 has the eccentric 22 mounted thereon so as to be disposed in the hollow space 14.

Figure 5 shows how the lever 16 is accommodated in the hollow space 14 and is connected, through the window 18, to the removable device 26 which is supported on the cam-carrier 25.

Figure 3 is a section to illustrate that the carriage 28 having the counter-cutter blade and the control device is located in a position behind the slides 33 and 34.

Figure 2 shows the plate 1 penetrated by roller-carrying shafts 40, the plates 2 and 2' which form the hollow space 14, and the gears 5 and 6 with their output to the central hub 11. In Figure 2 there is shown, also, a support panel 43 for the shafts 40 which are coupled to electric motors (not shown) by way of electromagnetic clutches (also not shown). This figure also shows drive shaft 41, the control shaft 24 and the shaft 23, and a partition 42 which separates the two operative parts of the machine and on which is mounted a horizontal retractor device 31.

Figure 8 shows how by means of the combined action of two of the three rotating hubs disposed at the front of the machine, it is possible to produce special coil springs like the conical torsion spring 37 shown in the figure.

Figure 9 shows diagrammatically the operation of the winding machine.

Figure 11 is a general overall view of the winding machine from which it will be observed that it comprises a cabinet 60 housing any necessary electrical and electronic components. Section 61 of the cabinet 60 houses the electric motors and the electromagnetic clutches, already mentioned, for providing the necessary drive. Housing 62 accommodates members for forming eyes or end loops on the wire springs being wound, as well as appropriate control equipment, associated, for example, with manually operable buttons of a push-button panel 63. The section 67 houses the devices 26 and 31, and a cleaning device for cleaning and lubricating the wire.

Figure 11 shows a plate 44, which carries slides 47 and 47' in turn carrying winding points 45 and 45'. The plate 44 is fixed to the front face of the casing by screws and has behind it a cavity capable of accommodating interengaging toothed sectors 46 which transmit drive from the slide 47 to the slide 47'. The position of the slide 47' relative to the toothed sectors 46 can be adjusted using a locking screw 58. The slides 47 and 47' and the toothed sectors 46 are actuated by a control lever 38 which is in turn actuated by the cam-carrying hub 12.

The plate 44 shown in Figure 11 is used in producing clockwise-wound springs; to produce anticlockwise-wound springs one substitutes an alternative plate 44 to obtain an inverted arrangement in which the cam-carrying hub 13

is used in place of the hub 12.

Because there is a plurality of cam-carrying hubs 11, 12 and 13, specially-shaped coils can be produced. By way of example, one can use the device 27 shown in Figure 8 which is pivoted on a bearing 35 and the pivotal movement of which is controlled by the cam-carrying hub 12. The hub 12, which uses an interposed lever device for regulating the time at which the movement caused thereby occurs, causes the device 27 to rotate, which allows the wire-drawing rollers to drive forward a section of straight wire, after which the device 27 returns to its normal position. In this position, the straight wire is pushed so that it projects past the blade carried by the carriage 28, the wire engaging a suitable winding point mounted on a retractable point-carrier 36, which is actuated by the cam-carrying hub 11 and the movement of which is thereby a function of the profile of the cam. The arrangement is such as to cause the spring to be wound conically, and when the winding cycle is finished, the cam carried by the hub 12 once again rotates the device 27, thereby thrusting forwards the wound spring, after which the spring is cut off and the cycle repeats from the start.

The operation of the machine, and the optical arrangement for control thereof, is illustrated diagrammatically in Figure 9, and is as follows: One firstly rotates hand-wheel 51 of the device 72 which causes a force to be exerted on the spring 20, (Figure 1) until the outer surface of a cone 64 encounters a graduated measurer 50. One then proceeds, on the basis of the nature of the spring to be constructed, to adjust optical detectors which control an electromagnetic clutch 57, combined with a brake, located on the shaft 41 thereby to control rotation of the roller-carrying shafts 40, this being done by actuating the graduated pulley 52 (Figure 11) which acts on a mobile optical head 53 which is swingable around the axis of the drive shaft 23. With the position of optical head 53 determined, a reader (or pick-up) 58 passing under the head 53 allows an electrical command to pass to the electromagnetic clutch 57 so as to cause rotation of the wire-drawing rollers 32, until the pick-up 58 encounters an optical head 54 which is in a fixed position. This disconnects the clutch 57, thereby stopping the wire-drawing rollers. Between the encounters with the cycle end head 54 and the productive cycle start head 53, a pick-up 59, in combination with an optical head 55, controls an electromagnetic clutch or electromagnet 56 which causes the cut-off shaft 24 to

carry out a complete revolution. This, in its turn, acts on the eccentric 22 connected by the link 15 to the lever 16 which controls the slide 33 carrying cutting knife 65.

Modification to convert the apparatus from producing right-hand springs to left-hand ones involves releasing the link 15 from the lever 16, rotating the shaft 24 by half a turn, connecting the shaft 24, by way of the link 15' and a pin in the pivot holes 19', to the lever 17 thereby to transfer control to the slide 34 which, as the cutting knife 65 and the tool 70 have been interchanged, effects cutting-off of the wound spring.

WHAT I CLAIM IS:—

1. An automatic machine for coiling metal wires to form springs, comprising power driven means to advance wire to be coiled, means to coil the advancing wire, a pair of slides disposed on opposite sides of the path of advance of the wire, a tool for penetrating between coils of the wire, thereby to open the coiled wire so as to determine the pitch of the coils, a cutter for severing a length of coiled wire, said cutter and tool being detachably inter-changeably mountable on respective ones of said slides, a first power-driven shaft having means for imparting to a said slide a wire cutting movement, and a second power-driven shaft having means to impart to a said slide a coil opening movement, each shaft being operable to impart movement to one or other of said shafts, whereby said machine can be selectively adapted for the formation of right-hand coils or left-hand coils.

2. A machine as claimed in claim 1, further comprising optical detector means responsive to the rotational position of said second shaft to control the operation of said wire advancing means.

3. A machine as claimed in claim 1 or 2, further comprising wire guides for guiding said wire in its advance toward said coiling means, said wire guides being movable toward and away from each other, and at least one of said wire guides having a V-groove therein to accommodate wires of different diameters.

4. An automatic machine for coiling metal wire to form springs, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

R.G.C. JENKINS & CO.,
Chartered Patent Agents,
Chancery House,
53/64 Chancery Lane,
London, WC2A 1QU.
Agents for the Applicants

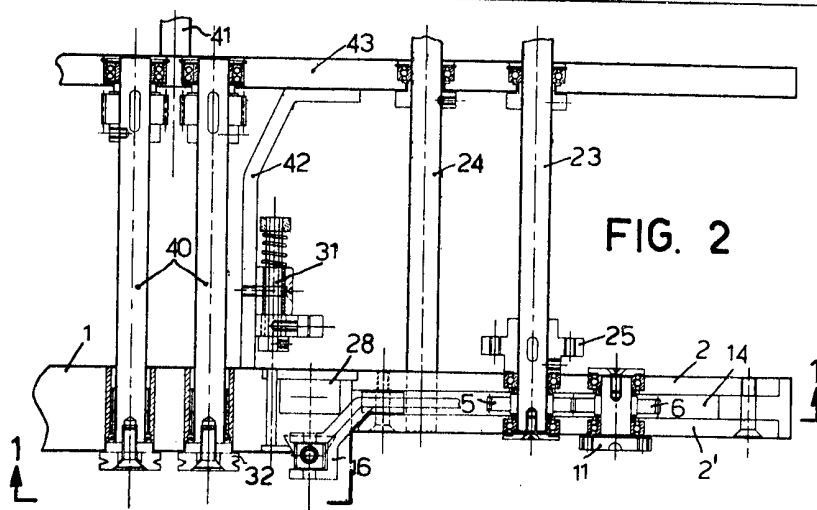
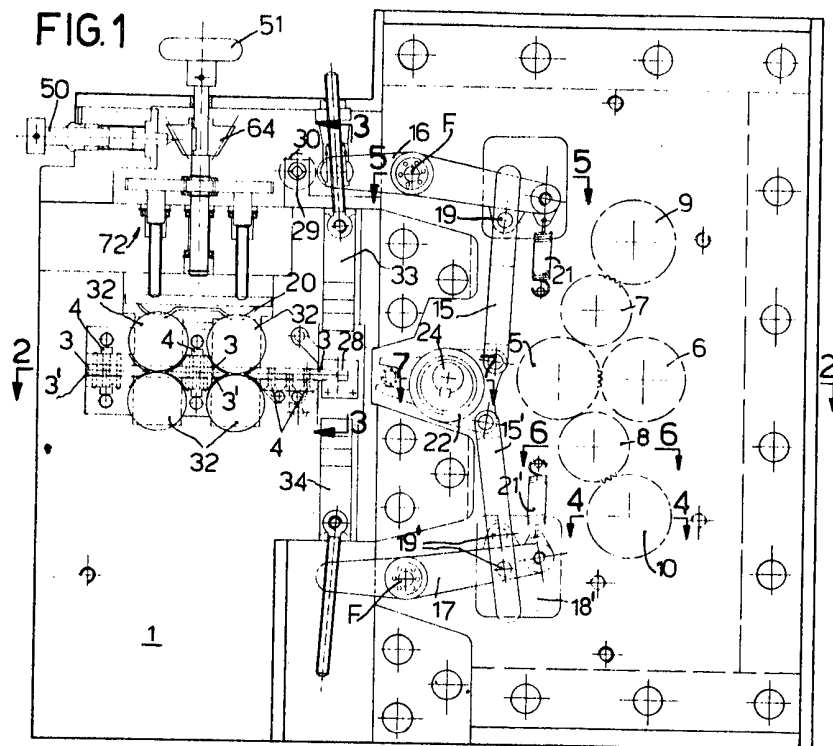
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COMPLETE SPECIFICATION

3 SHEETS

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the Original on a reduced scale

Sheet 1



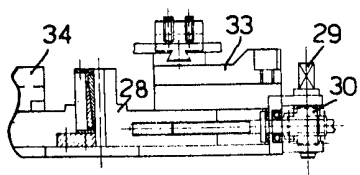


FIG. 3

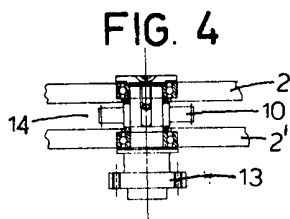


FIG. 4

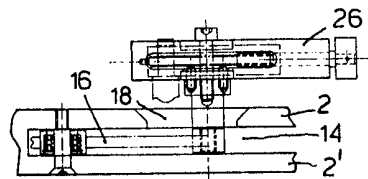


FIG. 5

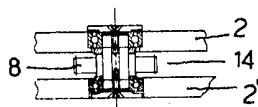


FIG. 6

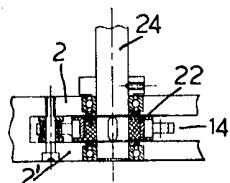


FIG. 7

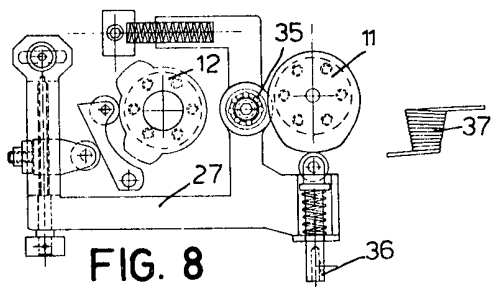


FIG. 8

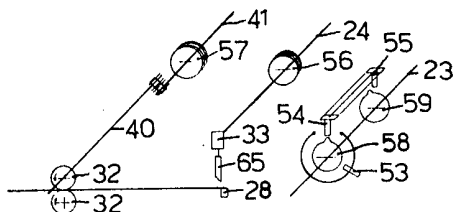


FIG. 9

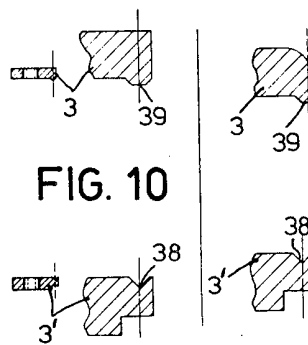


FIG. 10

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COMPLETE SPECIFICATION

3 SHEETS

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Sheet 3

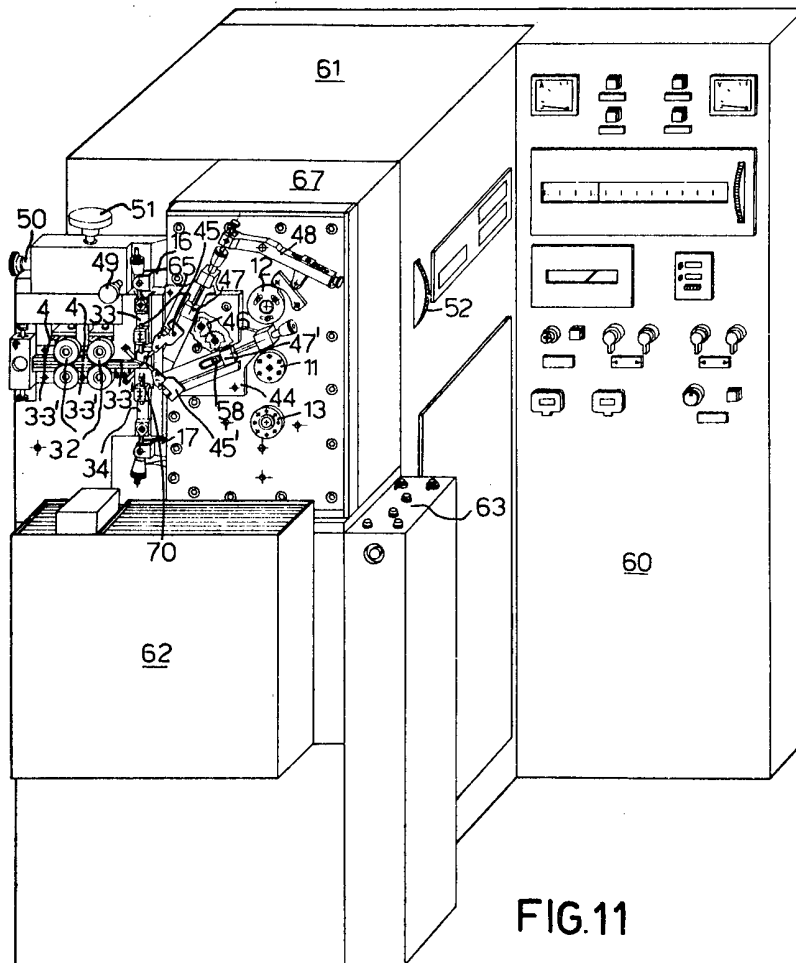


FIG. 11