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Galletti

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[54] **WINDING DEVICE FOR SHEET METAL STRIP**

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[52] **U.S. Cl.** **72/148;** 242/78.1

[51] **Int. Cl.²** **B21C 47/00**

[58] **Field of Search** 72/146, 148, 150; 242/78, 242/78.1, 78.3; 29/473.9, 474.1

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Primary Examiner—C. W. Lanham
Assistant Examiner—Robert M. Rogers
Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

A winding machine for winding sheet metal strip has at least one chain of rollers, interconnected by links, which can be moved into a position partly surrounding a spindle to form a guide for the leading edge of a sheet metal strip to be wound on the spindle. In order to enable the machine to wind coils on two different spindles having different diameters, the chain is provided with an end link including a roller which can be pivoted into an operating position where it forms an extension of the roller chain to accommodate the larger of the two spindles, or away from the operating position to a position where it does not interfere with a winding operation on a smaller spindle.

4 Claims, 4 Drawing Figures

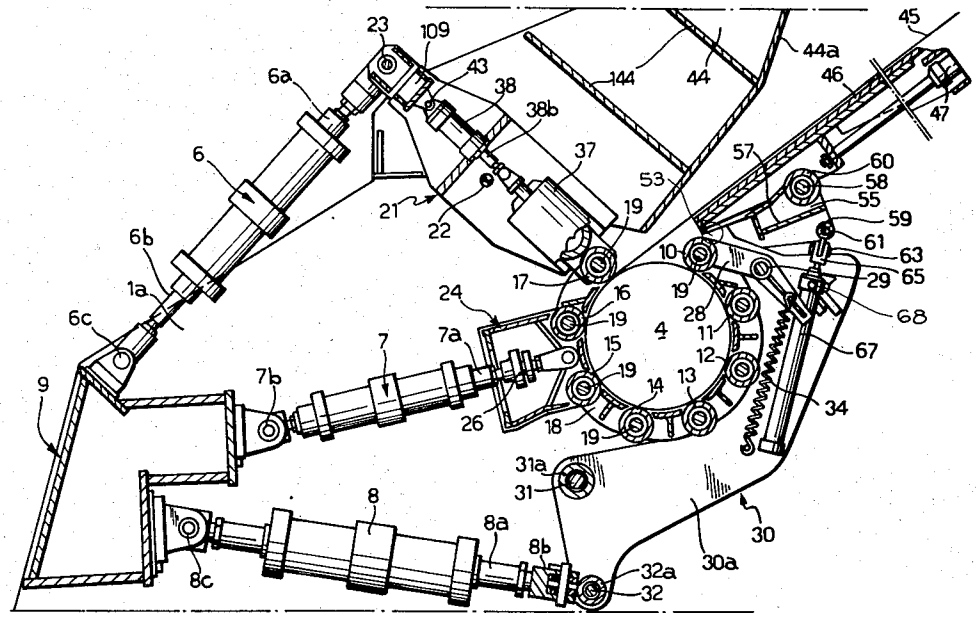
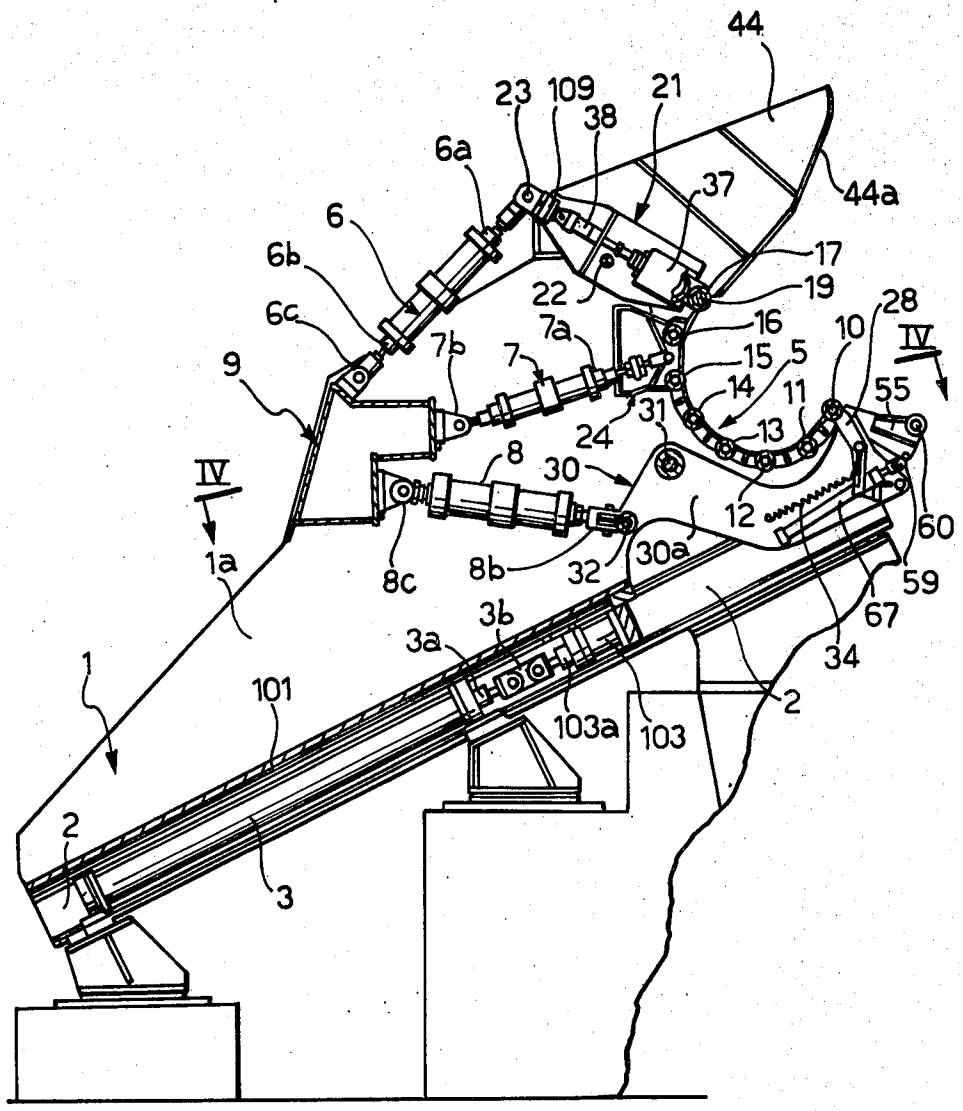


FIG. 1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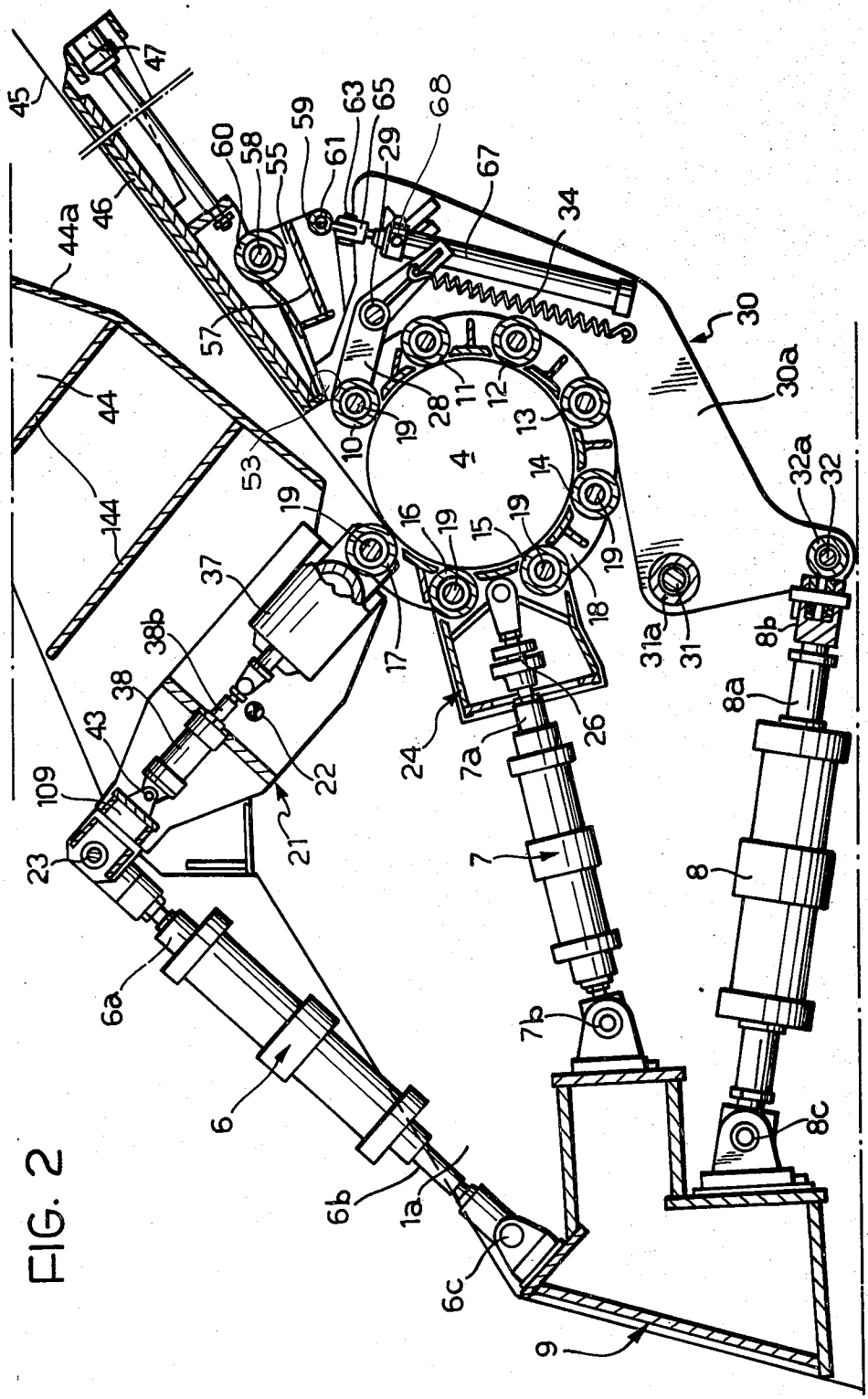
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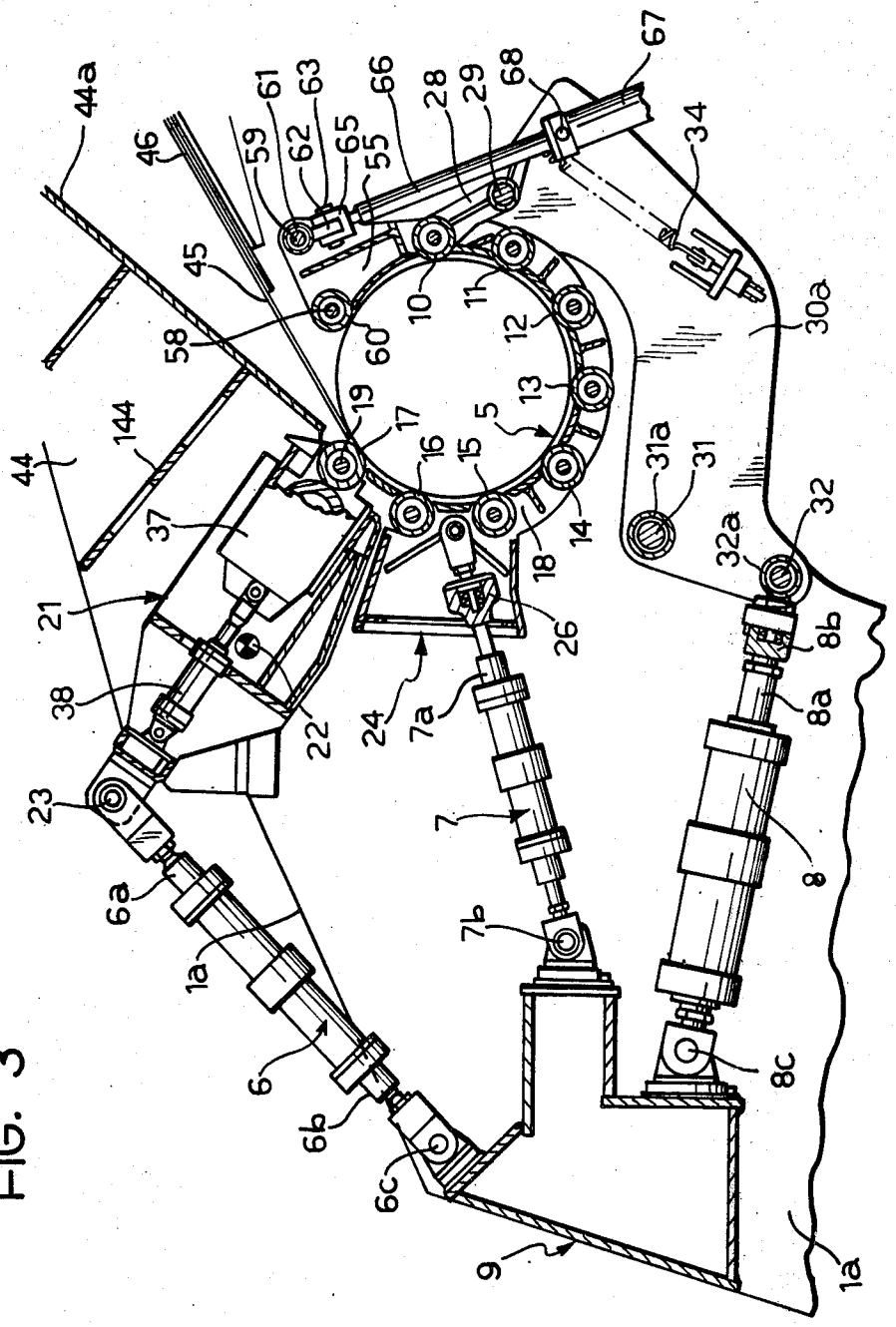
FIG. 2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1a
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6b
6c
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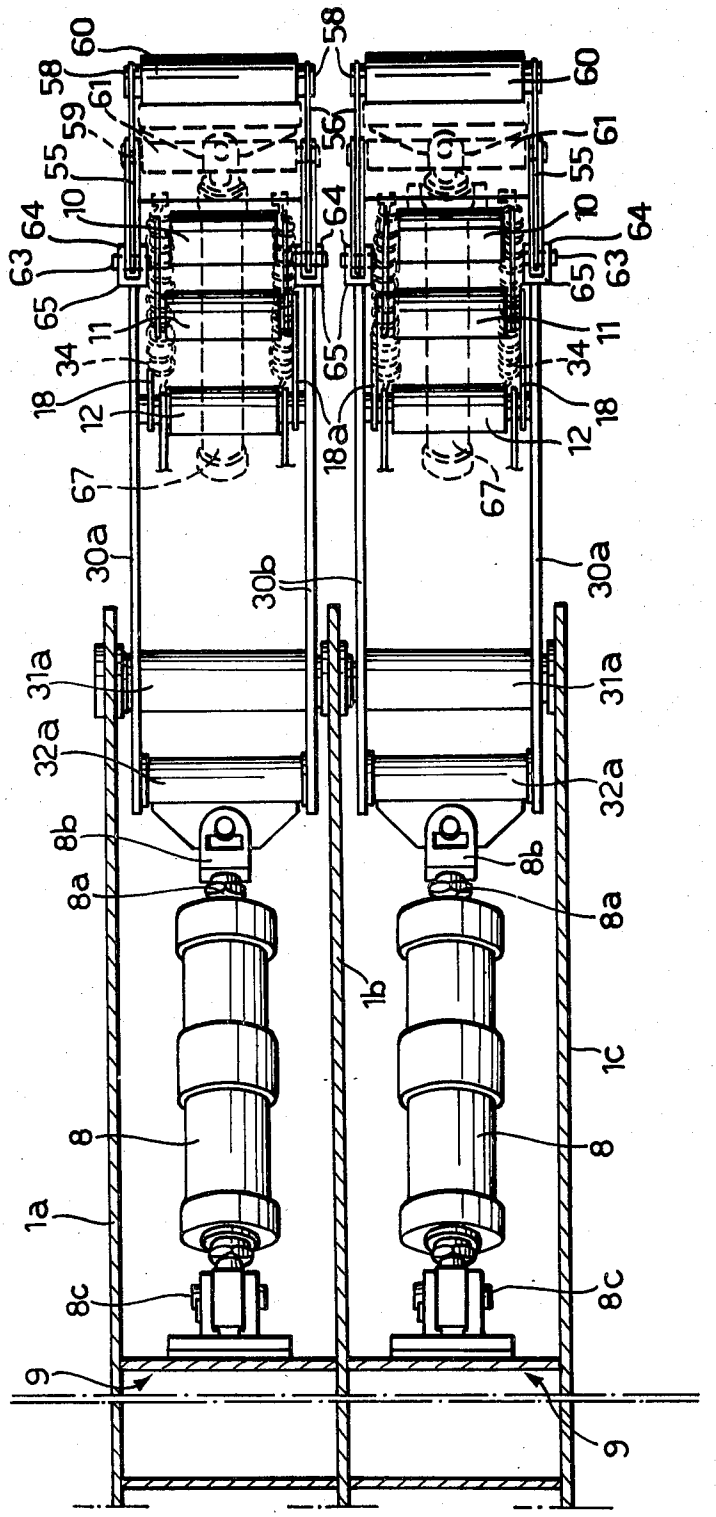
FIG. 3

FIG. 4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WINDING DEVICE FOR SHEET METAL STRIP

BACKGROUND OF THE INVENTION

This invention relates to a winding machine for making coils of sheet metal strip, of the type consisting of a rotatable winding spindle supported on a horizontal axis by a bearing structure, means for conveying the sheet metal strip towards the said spindle, a slide movable in a direction transverse to the axis of the said spindle, between a rest position spaced from the said spindle and a working position close to the said spindle, at least one chain of rotatable rollers positioned to one side of the said spindle with the axes of the rollers extending parallel to the axis of the said spindle, at least two jaw-like arms pivoted at one of their ends to the said slide (the pivot axes of the arms being parallel to the axis of the spindle), and supporting, at their other ends, respective end rollers of the said roller chain. Fluid pressure actuators are also provided for effecting angular movement of the said arms, around their respective pivot axes, from a position spaced from the said spindle to a position close to and partly surrounding the spindle.

For winding a sheet metal strip into a coil it is necessary first to form a few turns of the strip upon a rotating spindle by means of winding apparatus which produces the required curve of the strip, after which continued rotation of the spindle is sufficient to cause the winding to proceed until the coil is completed.

Winding apparatus at present in use consists essentially of a rotatably mounted winding spindle, located with its axis horizontal, carried by a bearing structure, and an endless belt which passes over rollers, which may be driven rollers, and which also passes over a part of the surface of the said spindle. In use of the apparatus a metal strip to be wound upon the spindle is fed to the apparatus in such a way that it passes between the spindle and the belt; the belt presses the plate against the spindle, strain relieving and bending it at the same time and thereby causing the required formation of the first turns of the coil.

In our copending patent application No. (Italy - 23095-A/73) filed in the name of the same Applicant and quoted here by way of reference, there is described and illustrated improved winding apparatus for winding sheet metal strip into coils, comprising a winding spindle, bearing structure rotatably supporting said spindle with its axis horizontal, means for conveyance of sheet-metal strip towards said spindle and means for forming the initial turns of a coil upon said spindle, wherein the improvement consists in the means for forming the initial turns of sheet-metal strip upon said spindle comprising: a slide movably mounted for movement in a direction transverse to the axis of said spindle; means for moving said slide between a rest position spaced from said spindle and an operating position close to said spindle; at least one chain of freely rotatable rollers positioned at one side of said spindle, the rollers of said chain extending parallel to the axis of the spindle; at least two jaw-like arms, pivoted at one of their ends to said slide with pivot axes parallel to the axis of said spindle and supporting at the other ends respective said rollers at the ends of said chain, and fluid pressure actuator means for effecting angular displacement of said arms around their respective pivot axes from a position spaced from said spindle to a position close to said spindle in which said arms partially surround said spindle.

In order to ensure satisfactory formation of the first few turns of sheet metal strip about the winding spindle the length of the roller chain, (or the belt, in the case of the prior art winding appliances) should be such that the chain (or the belt) extends around not less than three quarters of the whole outside of the said spindle when the apparatus is in operation.

Because of this requirement, and also because of the complicated structural and dimensional characteristics of the said winders, they are each made so as to cooperate, in the formation of the first turns of sheet metal strips, with spindles of a respective predetermined diameter. In other words, it is not, at present, generally possible to make use of one winder, the conformation of which is particularly adapted to form the first turns of a coil of sheet metal strip on a spindle of predetermined diameter, in order to form the first turns of a coil of sheet metal strip on a spindle of a different diameter, without the provision of complex and uneconomic replacements or modifications to the structure of the winder.

OBJECTS OF THE INVENTION

The primary object of the present invention is to provide a sheet metal strip winding machine for forming coils, which can be utilised for the formation of the first turns of a sheet metal strip on a winding spindle of predetermined diameter, or at least one winding spindle of greater diameter without having to modify the structural parts of the winder or to substitute any alternative components.

SUMMARY OF THE INVENTION

According to one aspect the present invention consists in a winding machine for winding sheet metal strip into coils, of the type comprising a winding spindle, a bearing structure rotatably supporting said spindle with its axis horizontal, means for conveying sheet-metal strip towards said spindle, a slide movably mounted for movement in a direction transverse to the axis of said spindle, means for moving said slide between a rest position spaced from said spindle and an operating position close to said spindle; at least one chain of freely rotatable rollers positioned at one side of said spindle, the rollers of said chain extending parallel to the axis of said spindle, at least two jaw-like arms, pivoted at one of their ends to said slide with pivot axes parallel to the axis of said spindle, means supporting at the other ends of said jaw-like arms respective said rollers at the ends of said chain, and fluid pressure actuator means for effecting angular displacement of said arms around their respective pivot axes from a position spaced from said spindle to a position close to and partially surrounding said spindle, in which there are provided support means at one end of said roller chain supporting at least one freely rotatable roller with its axis of rotation parallel to the axis of rotation of said spindle, said support means being carried by at least one of said jaw-like arms, fluid pressure actuators for moving said support means between a rest position in which said at least one roller is spaced away from said spindle when said jaw-like arms are in said working position, and an operating position in which said at least one roller is positioned adjacent said spindle as a further roller of said roller chain partly surrounding said spindle, whereby to enlarge said chain to accommodate a spindle of larger diameter than that of said spindle.

Preferably, said support means which support said at least one roller comprise a pair of spaced parallel levers, a stiffening cross piece linking said two parallel levers, pivot means pivoting said levers at one of their ends, said pivot means being supported coaxially by one of said jaw-like arms, pivot parallel to the axis of said spindle supported between the other ends of said levers and carrying said at least one roller, and an hydraulic actuator mechanically connected to said levers to effect angular movement thereof around the said pivot means between said rest position and the said operating position.

The main advantage of metal strip winding machines according to the invention is that, by simply turning over the said pair of levers supporting the said at least one roller, and by a simple adjustment of the control devices, it is possible quickly and automatically to adapt a winder of the roller chain type, made for winding metal strip on to a spindle of a given diameter, so as to be able to wind sheet metal strip on to a spindle of diameter larger than said given diameter.

Further advantages and features of the invention will become apparent during the course of the following description with reference to the accompanying drawings, which is provided purely by way of non-restrictive example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partly sectional side view of the winder of the present invention, illustrating the winder in its rest position;

FIG. **2** is a side view, on a larger scale than FIG. **1**, of a portion of the winder of FIG. **1**, illustrated in the working position for winding metal strip on to a spindle of a given diameter;

FIG. **3** is a side view, on a larger scale than FIG. **1**, of a portion of the winder of this invention shown in the operational position for winding metal strip on to a spindle of greater diameter than that shown in FIG. **2**; and

FIG. **4** is a section taken along the line IV—IV of FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings there is shown a sheet metal strip winder which is for the most part similar to that fully described in the copending patent application No. (Italy - **23095-A/73**) the disclosure of which is incorporated herein by reference and to which attention is directed for the constructional and functional details of the winder as a whole.

The winder shown herein comprises a winder spindle **4** of given diameter, rotatably carried, with its axis horizontal, by a bearing structure, not shown. A slide **1** assembled to slide on respective parallel guides **2**, is arranged to one side of the said spindle **4** and extends, from the bottom upwards, in a direction perpendicular to the axis of the said spindle. Located below the slide **1** and between the guides **2**, there is an hydraulic actuator **3**, of the piston and cylinder type, which is arranged with its axis parallel to the said guides. To the shaft **3***a* of the said hydraulic actuator **3** there is connected by means of a coupling **3***b*, the shaft **103***a* of a second hydraulic actuator **103**, the body of which is secured to a crosspiece **1***d* of the slide **1**, to effect movements of the said slide upon the guides **2**.

The slide **1** consists essentially of a plate-like base **101** which carries two upright plates **1***a* and **1***c* upstanding along its sides parallel to the guides **2**, and a third vertical plate **1***b*, parallel to the plates **1***a* and **1***c* and rigidly connected to the base **101** along its centre line. The said plates **1***a*, **1***b*, and **1***c*, are reinforced by a number of cross pieces, not illustrated, and also by a box-section crosspiece **9**. The medial vertical plate **1***b* of the slide **1** lies on a plane about which the winder of the invention is symmetrical and in order to simplify and clarify the following description reference will be made to one portion only of the winder, it being understood that the other portion is wholly similar to that which is described.

In FIG. **4**, in which both portions of the said winder are shown, the equivalent elements of the parts not specifically described are indicated with corresponding reference numbers. An hydraulic actuator **6** is pivotally mounted, at one end, to that portion of the box-section crosspiece **9** extending between the upright plates **1***a* and **1***b* of the slide **1**, the pivot axis being parallel to the axis of the spindle **4**; the axis of the actuator **6** lies in a vertical plane. The actuator shaft **6***a* of the actuator **6** is pivotally mounted, by means of a horizontal pin **23**, to one end **109** of a box-section support casing **21**. This box-section casing **21** is carried on a horizontal pivot **22**, supported by the vertical plates **1***a* and **1***b* of the slide **1**.

Advantageously the hydraulic actuator **6** is of the type known as a "double cylinder", that is to say, it consists of two coaxial cylinders connected end to end with their respective piston rods extending from opposite ends. In the box-section **21**, which is open towards the winder spindle **4**, there is slidably mounted, a slide **37** which supports a horizontal pivot **19**, upon which there is rotatably mounted the end roller **17** of a chain **5** of rollers described later. For the movements of the slide **37**, there is assembled inside the box-section casing **21** an hydraulic actuator **38** the shaft **38***b* of which is connected to the said slide **37** and the cylinder of which is pivoted to the said box-section casing **21** by a pivot **43** the axis of which lies parallel to the axis of the spindle **4**. The chain **5** comprises a number of parallel pivots **19** which are connected together in a spaced relationship by a corresponding number of links **18** and **18***a*; each of the pivots **19** carries a rotatable roller coaxially therewith. In the example illustrated, the chain **5** is formed of rollers **10, 11, 12, 13, 14, 15, 16** and **17**. The pivot **19** which carries the roller **17** at one end of the chain **5**, is supported on an axis parallel to the axis of the winder spindle **4**, by the slide **37** of the box-section casing **21**, as previously described. The pivot **19** carrying the roller **10** at the other end of the chain is itself supported on an axis parallel to the axis of the winder spindle **4** by a pair of levers **28** which are turnable about a pivot **29** parallel to the axis of the spindle **4** and transversely supported by the end portion of a support structure **30**.

This support structure **30** comprises two shaped flat jawlike arms **30***a* and **30***b* lying in vertical planes perpendicular to the axis of the spindle **4**. The ends of the shaped flat jaw-like arms **30***a* and **30***b* remote from the ends carrying the levers **28** are pivotally mounted on the plates **1***a* and **1***b* of the slide **1** by a pivot **31** stiffened by a sleeve **31***a*. The pivot **31** supported by the plates **1***a* and **1***b* of the slide **1** constitutes the fulcrum for both of the jaw-like arms **30***a* and **30***b*. A pivot **32**

having a surrounding sleeve 32*a* connects the levers 30*a*, 30*b* pivotally to a coupling 8*b* and the end of a shaft 8*a* of an hydraulic actuator 8. The cylinder of this actuator, which is advantageously a double cylinder as discussed above, is connected at the end remote from the arms 30*a* and 30*b* to the said box-section cross piece 9 by a pivot 8*c* extending between the vertical plates 1*a* and 1*b* of the slide 1.

The free end of the levers 30*a* and 30*b* which carry the horizontal pivot 29 on which the lever 28 is mounted are stiffened by means of a sleeve 29*a* over the pivot 29. The pivot 29 is located near the mid-point of the levers 28 and the ends of the levers 28 opposite to those which support the roller 10 are subject to the action of respective springs 34, each attached to a respective arm 30*a* and 30*b*.

The pivots 19 which carry the intermediate rollers 15 and 16 of the chain 5, are supported with their axes horizontal by a box-section casing 24 which is slidable in a direction perpendicular to the axis of the spindle 4 between the vertical plates 1*a* and 1*b* of the slide 1. The said box-section casing 24 is connected to the shaft of an hydraulic actuator 7 again advantageously a double cylinder by means of a coupling 26; the cylinder of the actuator is pivoted at its other end by a horizontal pivot 7*b* to the said box-section cross piece 9 between the vertical plates 1*a* and 1*b* of the slide 1.

The vertical plates 1*a* and 1*b* of the slide 1 extend upwardly forming large guide plates 44 (in the drawings only the guide plate of the upright plate 1*a* is visible) transversely stiffened by bars 144. The edges 44*a* facing the winder spindle 4 form guides acting to lead in the strip indicated 45, to be wound on to the said spindle 4. The sheet metal strip 45 is guided towards the spindle 4 by a chute 46, extending tangentially to the spindle 4 and supported by the structure (not shown) which supports the winder spindle 4. The chute 46 can be adjusted towards or away from the spindle 4 by means of an hydraulic actuator 47 (FIG. 2).

Referring now to FIGS. 3 and 4; to each of the said jaw-like arms 30*a* and 30*b* at the ends thereof close to the end roller 10 of the chain 5, there are attached U-bolt elements (not shown) which support pivots 53 and 54 (FIG. 2) parallel to the axis of the spindle 4, which carry the ends of flat levers 55 and 56 which are linked together at a predetermined spacing by a cross piece 57, so as to form practically a single arm movable angularly around the pivots 53 and 54. At their ends opposite the pivots 53 and 54 the levers 55 and 56 support pivots 58 and 59 which are parallel to the axis of the spindle 4.

A freely rotatable roller 60 is carried on the pivot 58, this roller is entirely similar to the rollers of the chain 5.

Assembled coaxially on the pivot 59 is a freely rotatable sleeve 61 which is provided with a radially extending bracket 62 to which are pivoted, by a pivot 63 perpendicular to the said bracket the arms 64 of a U-bolt 65 which is carried on the end of the shaft 66 of an hydraulic actuator 67. The casing of the hydraulic actuator 67 is supported by the arms 30*a* and 30*b* by means of horizontal pivots shown diagrammatically at 68 (FIG. 3) around which the cylinder 67 can move angularly in a vertical plane perpendicular to the axis of the spindle.

OPERATION

Operation of the winder described above is as follows. In the rest condition (FIG. 1) the slide 1 is spaced away from the spindle 4. The hydraulic actuators 6, 7 and 8 hold the respective box-section casings 21 and 24 and the jaw-like arm 30 in the "jaws open" position, so that the chain 5 is spaced away from the spindle 4; the levers 53 and 54 and the roller 60 supported by them are in the turned back position lying against the outside of the roller chain 5. The roller chain 5 has a length, from the roller 10 to the roller 17 strictly correlated to the circumference of a predetermined winder spindle 4 so that in the operational position, as shown in FIG. 2, the chain extends around the spindle 4 over three quarters of its circumference.

In order to form the first turns of a sheet metal strip 45 to be wound on the spindle 4, the slide 1 is moved, by means of the actuators 3 and 103, to a position close to the spindle 4 and then the actuators 6, 7 and 8 are extended to wrap the chain 5 partly around the spindle 4 (FIG. 2). The roller 60 is maintained in its initial position, turned back against the outer side of the chain 5. A sheet metal strip, such as that indicated 45 in the drawings, is fed into the gap between the spindle 4 and the roller chain 5 until the first few turns have been formed on the spindle 4. Then the actuators 6, 7 and 8 are retracted until the roller chain 5 is spaced away from the winder spindle 4, and the slide 1 is then returned to its rest position as shown in FIG. 1.

It is also possible to form the first turns of a coil of a sheet metal strip 45 on a spindle 104 of greater diameter than the above mentioned predetermined diameter of the winder spindle 4. In this case as shown in FIG. 3 after the slide 1 has been moved forward into the working position and the roller chain 5 has been wrapped around part of the circumference of the spindle 104, the hydraulic actuator 67 is extended to cause angular movement of the levers 55 and 56 around their respective pivots 53 and 54 so as to carry the roller 60, supported by the said levers, into contact with the circumference of the spindle 104 to form an extension of the chain 5. With the roller 60 in this position the effective length of the roller chain is increased to be three quarters of the circumference of the spindle 104. It will be appreciated that a spindle of any diameter between the two specifically mentioned could also be used.

After the first few turns of sheet metal strip have been wound on the spindle 104, the roller 60 is turned back by retracting the hydraulic actuator 67 into the position against the side of the chain 5 and subsequently or simultaneously the actuators 6, 7 and 8 are retracted to space the chain 5 away from the roller 104; the slide is then returned to its initial position as in FIG. 1 by means of the actuators 3 and 103.

I claim:

1. In a winding machine for winding sheet metal strip into coils, of the type comprising a winding spindle,

a bearing structure rotatably supporting said spindle with its axis horizontal,

means for conveying sheet-metal strip towards said spindle,

a slide movable mounted for movement in a direction transverse to the axis of said spindle,

means for moving said slide between a rest position spaced from said spindle and an operating position close to said spindle;

at least one chain of freely rotatable rollers positioned at one side of said spindle, the rollers of said chain extending parallel to the axis of said spindle,

at least two jaw-like arms, pivoted at one of their ends to said slide with pivot axes parallel to the axis of said spindle,

means supporting at the other ends of said jaw-like arms respectively said rollers at the ends of said chain, and

fluid pressure actuator means for effecting angular displacement of said arms around their respective pivot axes from a position spaced from said apindle to a position close to and partially surrounding said spindle, the improvement comprising:

support means at one end of said roller chain supporting at least one freely rotatable roller with its axis of rotation parallel to the axis of rotation of said spindle, said support means being pivotally mounted on one of said jaw-like arms adjacent the end roller of said chain supported thereby,

fluid pressure actuators for moving said support means between a rest position in which said at least one roller is spaced away from said spindle when said jaw-like arms are in said working position, and an operating position in which said at least one roller is positioned adjacent said spindle beyond the end of said one of said jaw-like arms as a further roller of said roller chain partly surrounding said spindle, whereby to effectively enlarge said chain to accommodate a spindle of larger diameter than that of said spindle.

2. The winding machine of claim **1,** wherein said support means which support said at least one roller comprise a pair of spaced parallel levers, a stiffening cross piece linking said two parallel levers, pivot means pivoting said levers at one of their ends, said pivot means being supported coaxially by one of said jaw-like arms, pivot parallel to the axis of said spindle supported between the other ends of said levers and carrying said at least one roller, and an hydraulic actuator mechanically connected to said levers to effect angular movement thereof around the said pivot means between said rest position and the said operating position.

3. The winding machine of claim **2** wherein one end of said roller chain is positioned to guide the sheet metal strip to be wound onto said spindle and said pair of levers is pivoted to respective pivots supported parallel to the axis of said spindle by the jaw-like arm of said pair which carries the roller at the other end of said chain.

4. The winding machine of claim **3,** wherein the cylinder of said hydraulic actuator is pivotally supported by said jaw-like arm about an axis parallel to the axis of said spindle.

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