United States Patent

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[33] **Bulgaria**
[31] **8279**

[54] AUTOMATIC MACHINE FOR MAKING STIRRUPS AND STRUCTURAL REINFORCEMENT

13 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **140/71,** 72/307, 72/387
[51] **Int. Cl.** **B21d 7/14**
[50] **Field of Search** 140/71, 105; 72/298, 384, 387, 307

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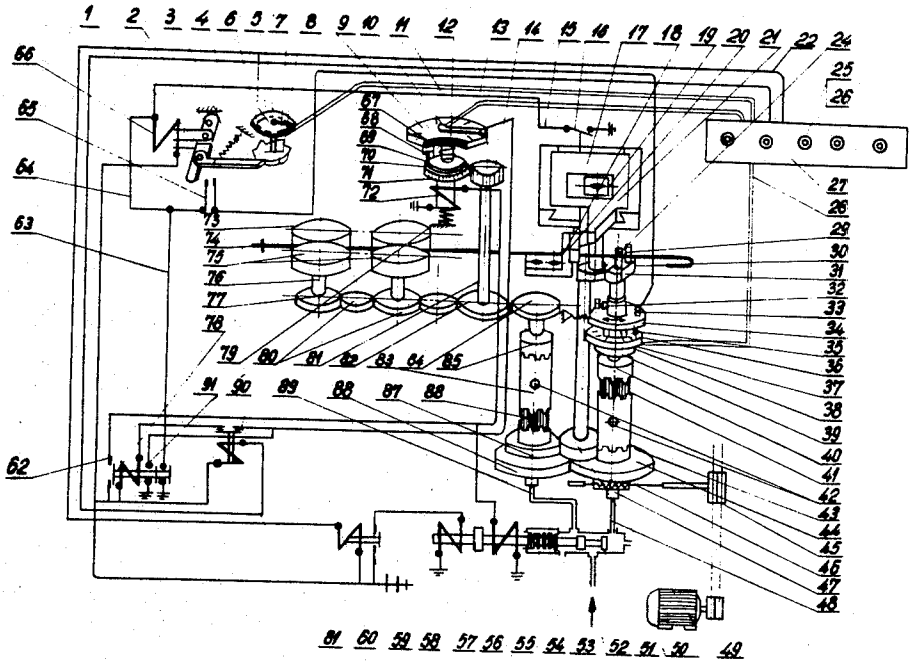
ABSTRACT: An electrically programmed automatic apparatus for bending stirrups and reinforcing rod for concrete, wherein pneumatic control is provided for the bending device and a clutch automatically cuts out the feed roller train for the rod and cuts in the bending device in a pneumatically energized state of the clutch system but connects the feed arrangement and disconnects the bender in a pneumatically deenergized state of the latter. Contactor arrangements control the measurement of the rod length and machine settings may be programmed by pushbuttons upon a panel.



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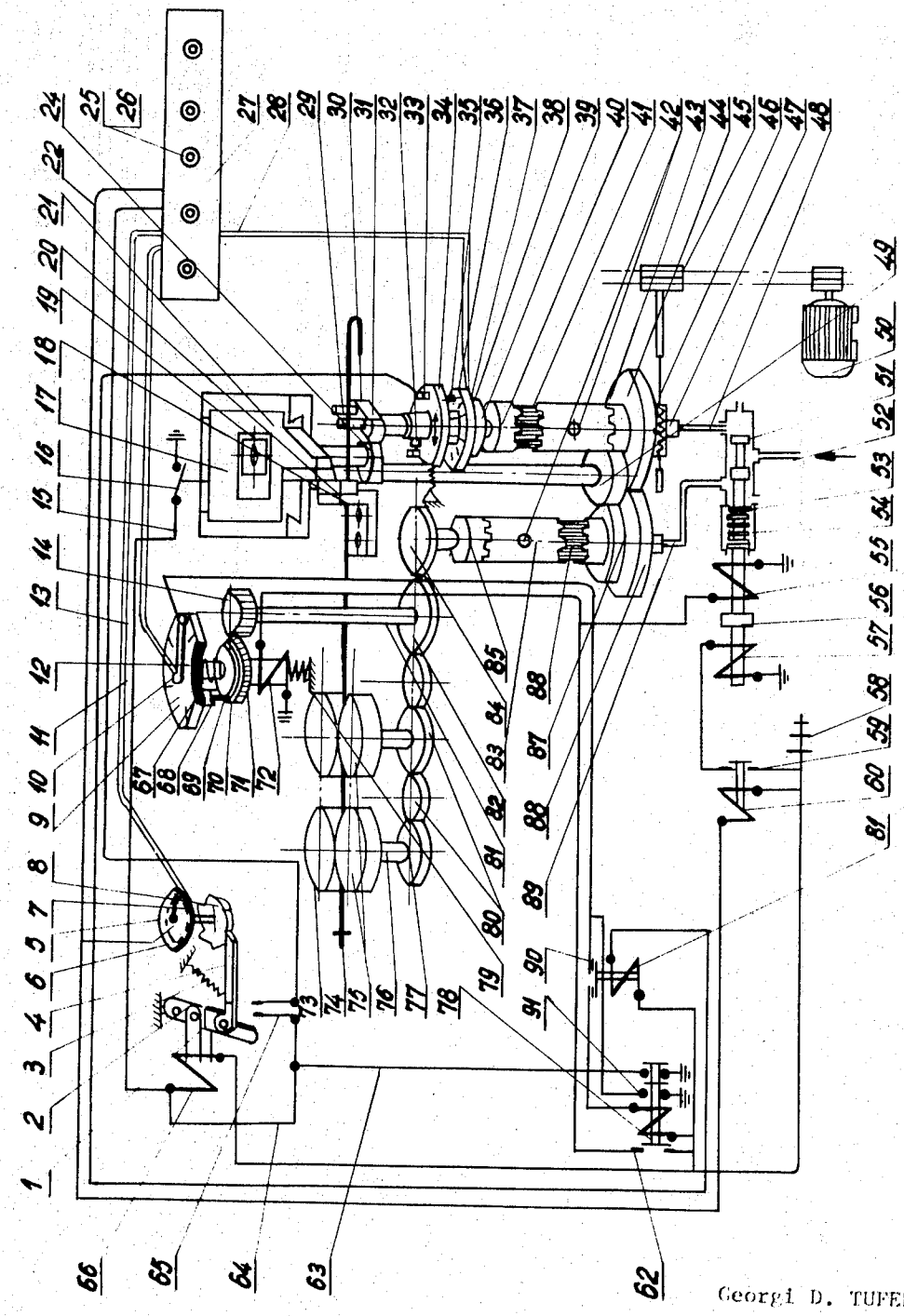

Fig. 1

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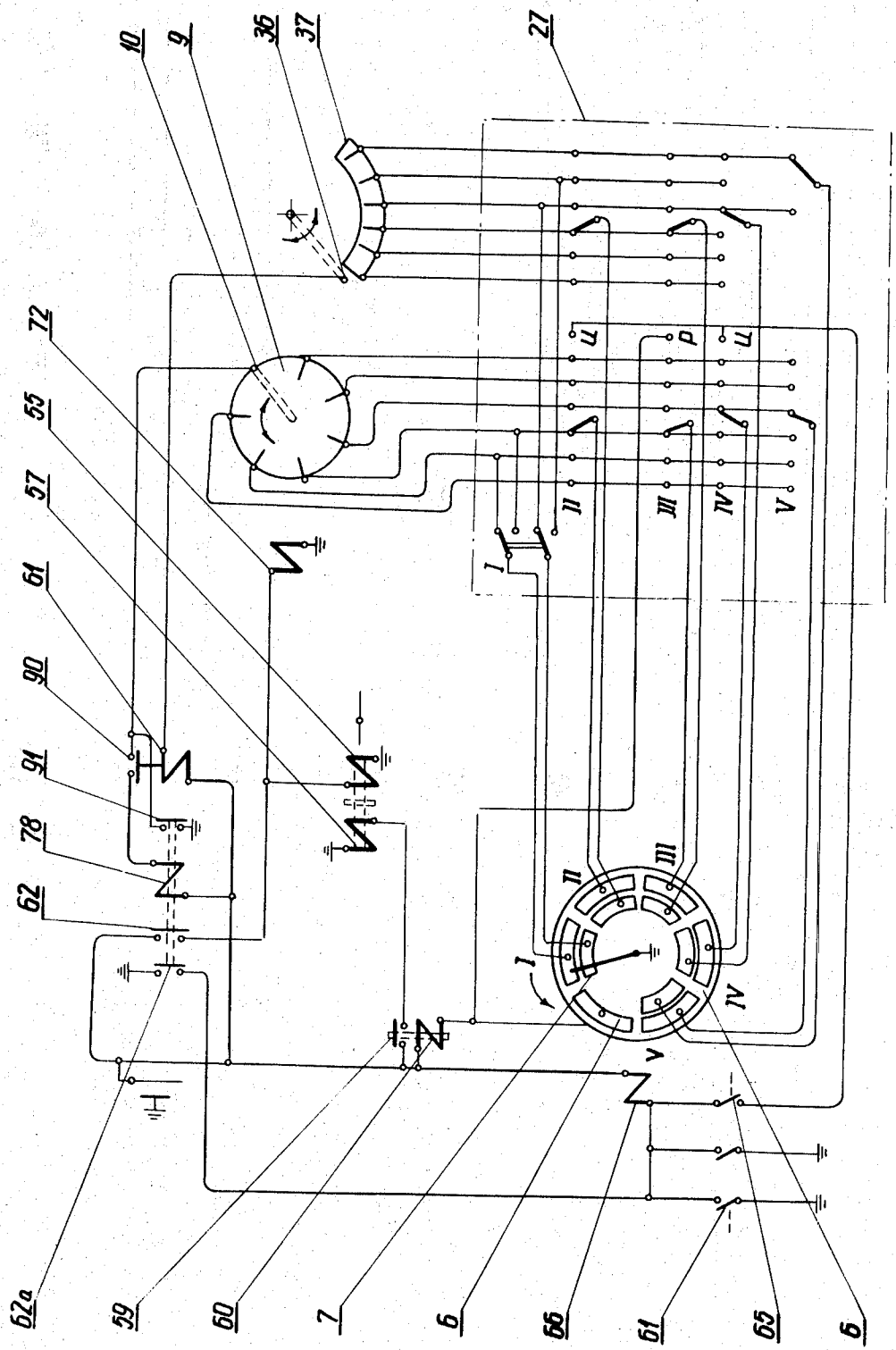

Fig. 2

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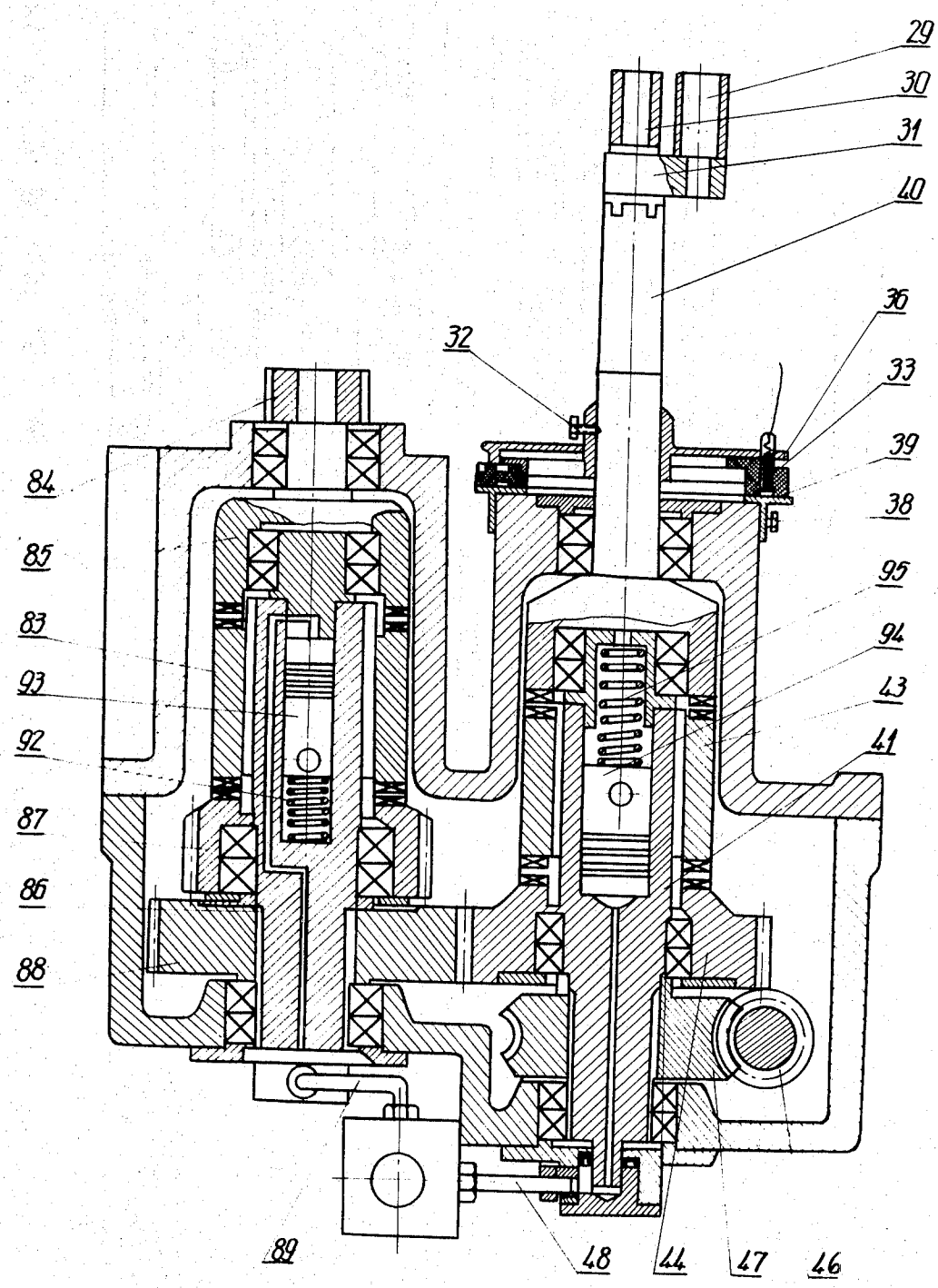

Fig. 3

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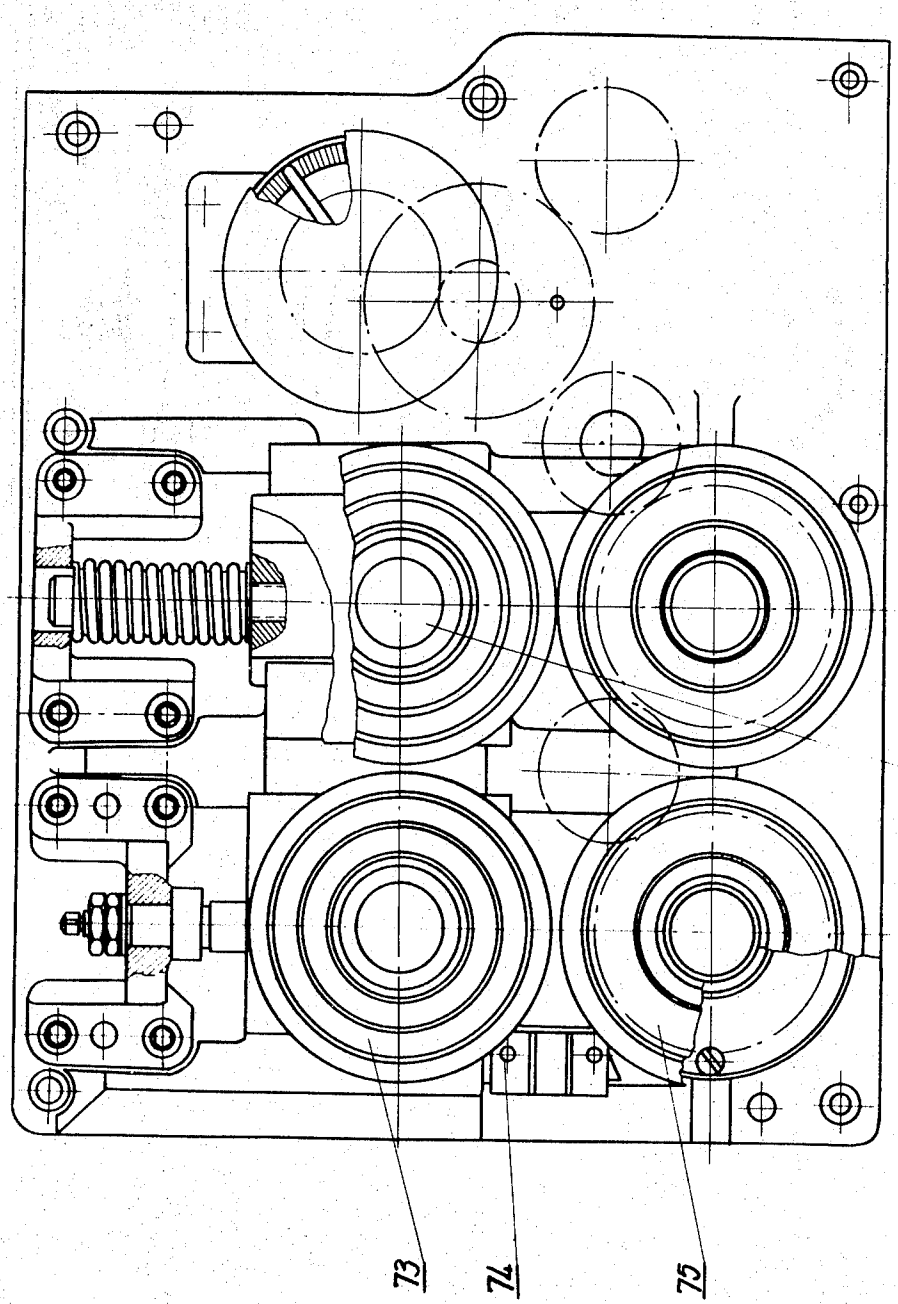

Fig. 4

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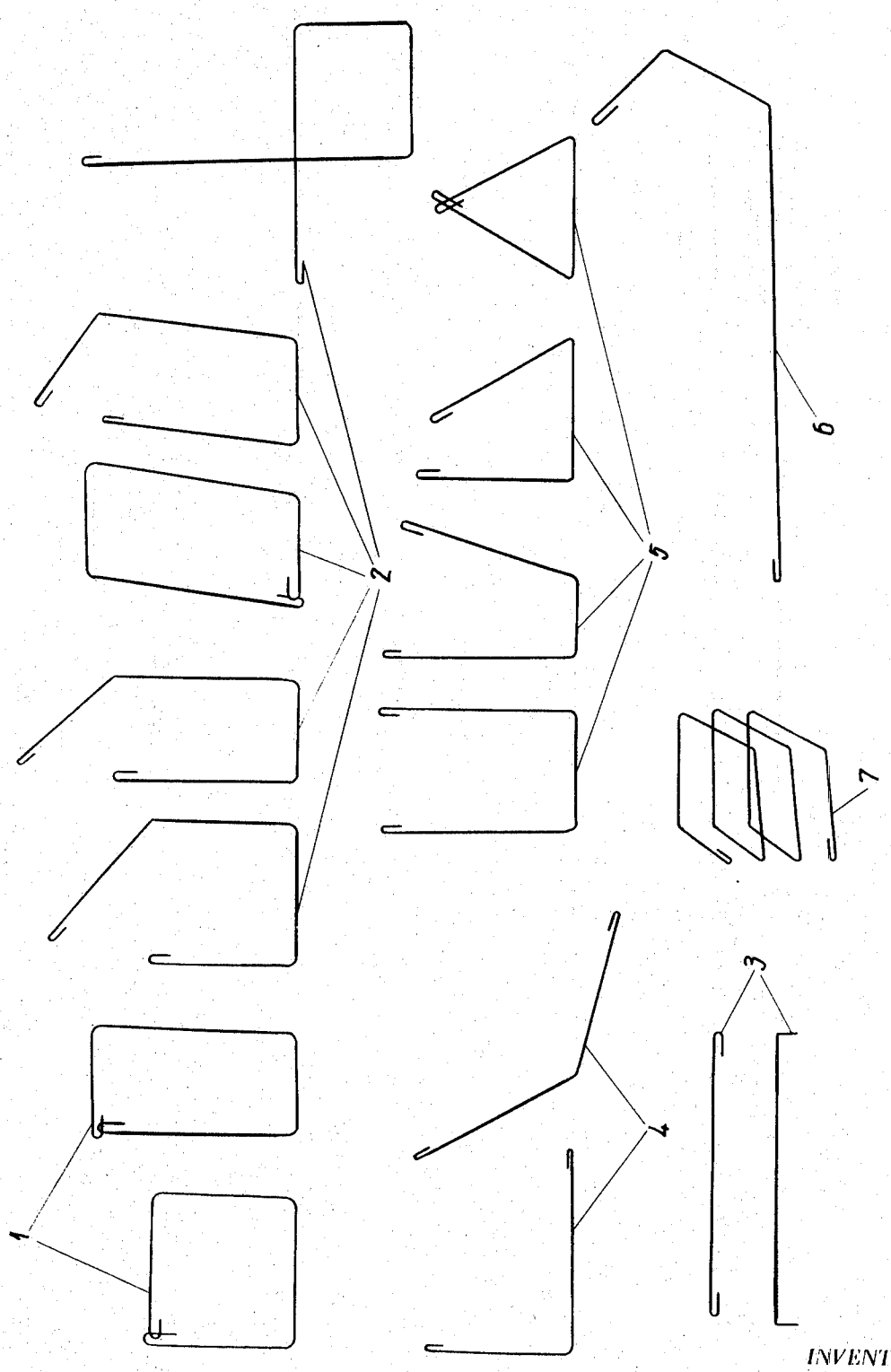

Fig. 5

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AUTOMATIC MACHINE FOR MAKING STIRRUPS AND STRUCTURAL REINFORCEMENT

This invention relates to the automatic production of cold-worked stirrups and structural reinforcement, comprising the operations of straightening the material, shaping the workpiece and cutting off the finished product. The setup for the desired configurations is carried out by an electroprogramming unit.

A stirrup-making machine is known which performs consecutively the operations of straightening, bending and cutting the wire rod. But the machine is designed such that it is able to bend only L-shaped angles. It is evident that the machine is not adapted for the production of stirrups with other than right angles so that only rectangular and square stirrups can be produced.

The unit measuring the length of the stirrup sides is very complex and the setting up of the machine for divers configurations is very complicated. The machine tends to stay perfectly adjusted for a short time so that the sides of the later-finished stirrups do not correspond to the initial setting. The machine has a complex structure and can be operated only by skilled personnel.

Another stirrup-making machine is known for producing stirrups with different degrees of bending, the bending operation being controlled and set up in a mechanical way, i.e. through a cam-lever mechanism. The setting accuracy for the desired angle is achieved through the displacement of the cam by means of adjusting screws, the cam eccentricity being increased by means of a linkage and a rod in order to be converted into a rotary motion of the bender. This is the weak point of the design, since a minor error at the adjusting screws can lead to a great angle deviation. The adjusting screws can be provided with indicia, but the corresponding angle values can not be engraved in degrees thereon, because a single turn of the screw is generally not adequate to the cam eccentricity required for bending angles between 5 and 180°. This is an obstacle for the prompt setting. This machine is able to produce stirrups only with five bends. Therefore reinforcements with four, three and two bends per unit cannot be produced.

Another machine with an electroprogrammed unit for measuring, bending and cutting of the finished stirrups is known. In practice no better results are obtained through this design, since the changeover of the gear controlling operations is carried out by large electromagnets, increasing the total electrical power consumption and in addition creating complications due to the large number of gear changes per minute, in order to reach the desired output.

The electroprogrammed automatic machine for stirrups and structural reinforcement in accordance with the present invention being fully automated, produces stirrups and reinforcements in the form of bent rods of different configurations and dimensions. In order to connect the adequate setup for the next problem, the setting is performed on a panel of the automatic machine by means of pushbuttons, thus making it possible to adjust the system in as little as 1 minute.

The machine makes it possible to encompass, without any structural change, a program including a great variety of ranges of standardized stirrup side lengths and bending angles.

An electromagnetic device for measuring the distance between the adjacent successive bendings, is actuated by the feed rollers and switches on the bend or cutoff operations. An angle meter disc with a brush moving thereon, switches off the bending operation for the next stirrup side, by means of a contactor and an electromagnetic air distributor, and ensures the accuracy of the set bend angle.

After each operation an electromagnetic distributor switches in the program of the next setup unit, so that the operations take turns in order. The electromagnetic distributor allows the elimination of a consecutive operation, whenever this operation is not required for the desired stirrup type, or the substitution, for instance, of a bending operation for a cutoff operation. The possibility to set up and to produce stirrups and reinforcement bent rods with less than five bends per configuration is evident. The program also ensures the possibility of making continuous spirals with different winding forms i.e. square, rectangular, polygonal and other spirals.

The invention will be better understood from the following detailed description of an electroprogrammed automatic machine with reference to the accompanying drawing, wherein:

FIG. 1 is an exploded kinematic diagram of the devices and the connections of the electroprogramming unit, in accordance with the present invention;

FIG. 2 is a wiring diagram of the electroprogramming panel and the electrical wiring connections, with the mechanism measuring the length of the stirrup sides, the terminal disc for dimensioning the angles, the distributor for the consecutive operation cycles, the electromagnetic air distributor, the contactors and the control switches of the programmer;

FIG. 3 is a vertical (axial) cross section of the changeover clutches;

FIG. 4 is an elevational view, partly broken away of the material-feeding means; and

FIG. 5 represents some typical configurations of stirrups and heat reinforcing rod.

The automatic machine of the present invention consists of a material-feeding device, a device for measuring the stirrup and reinforcement bent rod sides, a device for dimensioning the bending angles, a device for alternating continuously the setup cycles (the distributor), a guillotine shear for cutting off the finished product, and an electroprogramming panel for setting up the machine in order to produce various ranges (different stirrups with respect to side (leg) length, bending angle and number of bends per configuration).

Referring to FIG. 1 and FIG. 4 the wire rod, unwound from a coil not shown, moves forward through a wire-straightening device (not shown), and thereafter passes through a guide ring 74 upstream of two feeding-roller pairs 73 and 75.

Both adjacent rollers, identified at 75, are able only to rotate and the rollers 73 are forced against them, so that as result of the rotary movement of the rollers 75 the wire rod is fed through. In order to avoid a sliding of the wire rod relative to the rollers, the first (upstream) roller pair, in the direction of the wire rod movement, is a rolling pair able to plastically deform the rod and reduce its cross section, so that this roller pair calibrates the wire rod diameter to predetermined value. Thus, when the automatic machine is fed with several wire rods, any small diameter differences between them are removed and the second roller pair downstream in the direction of the wire rods movement, squeeze the rod similarly, since the shaft 76 of the roller 73 is under the action of a spring (i.e. spring loaded). Therefore a delay in the movement of some wire rods, due to the absence of pressure because of smaller diameter, is avoided. The straightened wire rod passes through the apertures 18 of the stationary guillotine shear and thereafter between the fixed stud 30 and the mobile stud 29, the latter being rigidly secured to the disc 31; the studs form the bender device used to bend the stirrups. When it is necessary to decrease the distance between the final bending of the stirrup and the cutoff point, the cutters 20 can be removed and replaced.

The feeding rollers 75 are driven by the shafts 76 through the transmission gears 77 and 80 rotated by the gear 82, which also drives the mechanism measuring the length and is moved by the gear 84, fixed on the toothed (jaw) clutch shaft 85.

Referring now to FIG. 3, it can be seen that the piston 93, under the action of the helical spring 92, is normally urged into its upper end position. By the locking stud 42, the piston 93 holds the jaw-clutch member 83 in engagement with the jaw-clutch shaft 85. The jaw-clutch member 83 is continuously in mesh and driven by the splined shaft 86. The splined shaft 86 is driven by the gear 88 and the jaw-clutch integral with the gear 44.

The jaw-clutch member 43 is held in engagement with the clutch gear 44, through the locking stud 42, when the piston 94 is in the lower end position, under the action of the helical spring 95. The jaw-clutch member 43 is continuously in mesh with and driven by the splined shaft 41.

The worm wheel 47 is rigidly secured to the splined shaft 41; the former is moved by the worm 46 coupled by the belt transmission 45 to the electric motor 50 (FIG. 1).

When the electric motor 50 is started, the jaw-clutch member 43 driven by the belt transmission 45, the worm 46, the worm wheel 47 and the splined shaft 41, rotates continuously. FIG. 1 illustrates positions of parts in the automatic machine when performing the feeding operation.

When the connection between the piping (ducts) 52, which supplies compressed air, and the ducts 48 is opened, the compressed air enters the cylindrical space of the splined shaft 41 and displaces the piston 94 upwardly, loading the helical spring 95. In this manner, the jaw-clutch member 43 is pushed upwardly, the unit 44 is disconnected, and the clutch engages the jaw-clutch shaft 40.

The jaw-clutch shaft 40 moves the bender device fixed thereon, so that the arrangement bends the wire rod to the corresponding setup angle. When the solenoid 55 is deenergized by the electrogramming unit, the piston 51 returns to its initial position, opening a vent, so that the compressed air escapes to the ambient atmosphere. After the pressure behind the piston 94 is released, the piston is shifted downwardly by the helical spring 95, so that the jaw-clutch member 43 disengages from the jaw-clutch shaft 40 and engages the jaw-clutch gear 44; in this manner the feeding operation for the next leg or side of the stirrup commences.

When the solenoid 57 of the electromagnetic air distributor 53 is energized by the programming unit, it pulls the armature 56 together with the piston 51, so that the duct 52 is connected with the duct 89, the latter communicating with the cylindrical space or the splined shaft 86 (FIG. 3). The compressed air actuates the piston 93, the spring 92 is loaded and simultaneously the jaw-clutch member 83 is moved by means of the stud 42 into its lower position and into engagement with the jaw-clutch gear 87. In this manner the movement transmitted by the jaw-clutch member 83 to the gear 87 is applied to the gear 49, which moves the cam 24.

The sliding block 19 of the guillotine shear (FIG. 1), being secured on the upper end of the cam 24, actuates the guillotine runner 17 in a reciprocative movement along the guideways 21 of the bed, thereby cutting the material between the cutter of the runner 17 and the fixed cutter 20 of the guillotine.

The mechanism (FIG. 1) for measuring the rod length comprises a terminal disc 9 (also seen in FIG. 4 and shown diagrammatically in FIG. 2) with terminals disposed with predetermined spacing between one another, corresponding to the units of material feed and in accordance with the diameter of the feeding rollers 73 and 75 and the ratio of the gears of a contact finger 10.

The contact finger 10 is secured on the axle or shaft 12, a disc 70 being fixed on the lower end side thereof. By means of the spring 79, the disc 71 integral with a guide serving also as an armature for the solenoid 72, is forced against the lower side surface of the disc 70. Both discs 70 and 71, forced each against the other by means of the spring 79, form a friction clutch.

In the disengaged position of this clutch, the movement of the feeding rollers 73 and 75 is transmitted to the axle 81 and through the gear 14 to the toothed circumference of the disc 71 integral with armature 72. The disc 77, when frictionally engaged with the disc 70, turns the contact finger 10 and, simultaneously winds up the spiral (torsion) spring 67 since one end of the spring is fixed while the other is secured to the disc 70.

When the programming unit energizes the solenoid 72, it pulls downwardly the armature integral with the disc 71 and the disc 70 is released, so that under the action of the torsion spring 67 it turns back until a stop or catch 69 thereon strikes against the fixed slop 68. Hence the contact finger 10, upon being actuated by the axle 12, comes always back the same initial position after the electromagnetic disengagement of the friction clutch of the mechanism.

When the bender device performs a bending operation, the disc 34 (FIGS. 1 and 3) secured in the jaw-clutch shaft 40 by means of the catch bolt 32, is driven by the shaft. After the jaw-clutch member 43 has been disengaged, the disc 34 together with the jaw-clutch shaft 40 and the bender device secured thereon, are returned to an initial position by means of a spring located in a groove formed along the circumference of the disc 34. The brushholder 33 with the brush 36, being secured on the disc 34, slides upon the contacts of the terminal disc 37, the latter being rigidly secured on the machine body by means of the binding ring 39, fixed in a predetermined location by means of the bolt 38. The contacts on the disc 37 are covered by the disc 34, so that the terminals and the collecting brush 36 are kept always clean. This mechanism, forming part of the programming unit, is provided for dimensioning the setup bending angle for the consecutive bending of the wire rod.

As is evident from FIGS. 1 and 2, another mechanism essential to alternating the program operations in accordance with the invention, is the distributor. It comprises the terminal disc 5 with six contacts and the contact finger or wiper 7. The terminals of the corresponding circuits of the program are grounded in succession through the axle of the contact finger 7. The contact finger 7 is moved by means of the ratchet wheel 8, divided into six steps, so that it makes one full revolution after six transpositions of the contact finger 7. The ratchet wheel 8 together with the shaft swinging the contact finger 7, is actuated by the pulses energizing the solenoid 66, which pulls the armature 1 together with the lever 2 extending the spring 3 and drawing the ratchet lever 4, which actuates the ratchet wheel 8, so that the ratchet lever 4 engages in the next step of the ratchet wheel 8. When the solenoid 66 is energized, the armature 1 is released and the ratchet wheel 8 is actuated by the lever 2 and the ratchet lever 4, under the action of the backgoing spring 4, and moves in the direction of rotation, so that the contact finger 7 is transposed on the following terminal. During the oscillating movement of the lever 2, the contacts 65 are closed and opened and, consequently, switched on and off.

Referring now to FIG. 2, the panel 27 for setting up the program comprises basically five pairs of multipole switches. Each pair comprises a terminal disc with contacts corresponding in number to the contacts of the angle-meter disc 37 and a terminal disc with contacts corresponding in number to the contacts on length-measuring disc 9.

As shown in the wiring diagram of FIG. 2, the contacts of the five terminal discs are connected in parallel, each contact corresponding to one of the contacts of the angle-meter disc 37, the contacts of the other five terminal discs are connected in parallel, each contact corresponding to one of the contacts of the length-measuring disc 9.

Aside from the contacts of both terminal discs, the second and the fourth positions of the programming panel 27 are provided each with a terminal N. These terminals are used for the connection of a setting whenever a side or leg of the stirrup, treated as a maximum of five, is to be eliminated, i.e. for setting up the production of stirrups with less than five bends per stirrup. Furthermore a terminal P is provided in the third position and is connected when, in place of a feeding or bending operation, a cutting of operation is necessary.

Every disc pair for the corresponding position on the programming panel 27, is provided with contact fingers, which are actuated independently through the keys 25 and 26. Each contact finger pair for the corresponding position is connected in parallel and with an individual wire to the terminal disc 5 of the distributor. Therefore the contact finger 7 of the distributor grounds always one of the five contact pairs in contact with the corresponding contact pair. This is referred to the five contact pairs of the terminal disc 5 of the distributor, the contact 6 thereon being not connected to the panel 27. When the contact finger 7 engages the contact 6, the solenoid 60 is energized, thus clutching in the cutting device. The terminal P of the third position on the programming panel 27 is connected also with the coil 60 (FIG. 2).

The programs for the desired leg length to the corresponding bend and for the bending angle are set up by means of respective multipole switch pairs of the programming panel **27**. This is achieved through the provision of five multipole switch pairs, respectively associated with the five bends of a four-sided stirrup corresponding to the capacity of the machine. The material which remains after the last bend is provided as the setup length up to the first bend of the following stirrup. The setting up of the program consists in the connection of the six circuit of the disc rotor and therefore the corresponding contact fingers of the multipole switches, with the terminals of the disc **37** for each successive bend and in connection of the five circuits of the distributor with the disc **9** for measuring the length to the next bend.

When the electromotor **40** is set in motion, the jaw-clutch member **43**, which moves the clutch gear **44** is driven through the belt transmission **45** and the worm-wheel arrangement **47**, **46**. The splined shaft **86** is driven by the clutch **44** via the gear **88**; the jaw-clutch member **83** is thus also driven. The jaw-clutch member **83** transmits the motion to the rollers **75** feeding the wire rod and rotates the axle **81** carrying the contact finger **10**, since the frictional engagement between the disc **70** and member **71** is operating when the solenoid **72** is deenergized.

In this manner when material is fed, the contact finger **10** engages successively the different contacts of the terminal disc **9**, until the contact which closes the circuit of the finger of the multipole switch for dimensioning the length to the first bend, is closed. When this contact is connected, the solenoid **78** is energized through the closed contacts **90**, the contact finger **10**, the setup terminal of the finger of the multipole switch for the first bend and the contact finger **7** of the distributor which is grounded.

Furthermore the contacts **62** are switched on by the solenoid **78**, thus energizing the solenoid **55** of the electromagnetic air distributor **53**. The solenoid shifts the armature **56** together with the piston **51** loading the spring **54**, so that the communication for the compressed air through the piping **52** to the piping **48** and to the piston **94** is opened. In this manner the jaw-clutch member **43** is engaged with the jaw-clutch shaft **40**, loading the spring **95**.

When the jaw-clutch member **43** is engaged in the upper end position, the shaft **32** of the bending device is driven and the bending operation commences. When this shaft **32** is rotated the disc **34** is likewise driven, which extends the helical spring **35** located in its groove and moves the brushholder **33** with the brush **36**; the latter slides upon the contacts of the disc **37**, until the contact setup (grounded) for the first bend is engaged in turn, whereupon the solenoid **61** is grounded and when energized it disconnects the contacts **90**, which are normally closed, thereby deenergizing the solenoid **78**. When the contacts **90** are switched off the contacts **62** through which the solenoid **55** of the electromagnetic air distributor **53** is energized, are also switched off.

The piston **51** returns to its normal position under the action of the spring **54**, and the air in the cylinder in front of the piston **51** escapes to the atmosphere. As a result, the piston **94** is actuated by the spring **95** and the jaw-clutch member **43** is engaged for the feeding of the next length of rod. The operation of the mechanism measuring the lengths during this time is described from the moment when solenoid **78**, closing the contacts **62**, is energized.

Through the contacts **62**, the solenoid **72** connected in parallel with the solenoid **55** is energized. When the solenoid **72** is energized it shifts the armature together with the toothed disc **71** and withdraws it from the disc **70**, loading the restoring spring **79**. When the disc **70** with the axle **12** and the contact finger **10** secured thereon is disengaged, it remains only under the action of the torsion spring **67**, which returns the disc **70** angularly until the slop **69** strikes against the immobile abutment **68**, so that the contact finger **10** returns also in its initial position. This procedure is carried out instantaneously once the bending operation is initiated. During the bending operation, the solenoid **78** is energized by the contacts **91**, but not through the contact finger **10**, the contacts **91** being closed at the same moment when the contacts **62** are closed so that, when the circuit is disconnected during the return movement of the contact finger **10**, the solenoids **55** and **72** are energized through the contacts **62** until the solenoid **61** is energized and its contacts **90**, which are normally closed, are now opened; this deenergizes the solenoid **78** immediately after the commencement of the bending operation and until the desired setup angle is reached. At the same moment that the solenoid **78** is deenergized, because of the opening of the contacts **90**, the solenoids **66** of the distributor is deenergized, the solenoid **66** being grounded through the contacts **62***a* of the solenoid **78**, which remains energized through the contacts **90** and **91** until the bending is performed.

When the clutching from bending to feeding occurs, the contact finger **7** of the distributor contacts the following terminal, i.e. the contact fingers of the setup for the second bend are grounded. In this way a new portion of material is fed through the mechanism and two other terminals have been already grounded through the programming panel **27**, i.e. by the contact finger **7** on the disc **9** for measuring the length and by another on the disc **37** for dimensioning the bending angle.

When the following feeding of material occurs, the same operations as described for the first bending operation are repeated. After the five bendings with the respective setup lengths and angles are performed, the contact finger **7** of the distributor connects the terminal **6** of the terminal disc **5**. When the contact finger **7** is in contact with the terminal **7** the solenoid **60** is energized, thus switching solenoid **57** on through the contacts **59**. The solenoid **57** attracts the armature **56** and the piston **51**, loading the spring **54**. When the piston **51** is actuated in the direction of solenoid **57**, the communication between the ducts **52** and the duct **89** is opened and the air enters into the space above the piston **93**, the piston is actuated downwardly to disengage the jaw-clutch member **83** from its upper position (material feeding) and engaging it with the clutch gear **87** for the rotation of the camshaft **27** of the guillotine shear, while loading also the helical spring **92**. The jaw-clutch member **83**, engaged in the lower position, moves through the gear **87**, **49** the camshaft **24**; the runner **17** of the guillotine **17** is pushed out by the camshaft **24** through the sliding block **29**, thus cutting off the material. When the guillotine runner **27** returns in its rear end position it engages the contacts **15** which are normally off, and switches them on. In this manner the solenoid **66** of the distributor is energized and pulls the armature **1** and therewith the ratchet lever (panel) **4**, which engages the following tooth of the ratchet wheel **8**. When the guillotine **17** passes its rear end position, it opens the contacts **16**, which deenergize solenoid **66**; the latter releases the armature **1**, which returns under the action of the spring **3** and actuates, via the ratchet lever **4** and the ratchet wheel **8**, the contact finger **7**, which passes from the terminal **6** to the terminal of the first bend, thus deenergizing solenoid **60** connected to the terminal **6** and grounded through contact finger **7**.

The solenoid **60** switches off the contacts **59**, thus deenergizing the solenoid **57**, which releases the armature **56** and therewith the piston **51**; the latter returns to its next position under the action of the spring **54**, thus opening the outlet for the compressed air.

The spring **92** (FIG. 3) shifts the piston **93** together with the jaw-clutch member **83** into the upper position of engagement, so that the movement of the guillotine is stopped and the feeding operation for the following stirrup commences. At this point, the contact finger **7** of the distributor is on the contact for the first bend and the movement of the guillotine is suspended in a position in which the contacts **15** are broken off. Hence the operations cycle of the following stirrup can begin. The contact finger **10** returns in its initial position after the material up to the following bending operation is measured without disengagement of the gears **71**, **14**.

The design of the automatic machine ensures the clutching of the motor movement for the adequate operations, without

switching off the motor. Instead of the above described pneumatic actuation, one can use a hydraulic system without modifying the design of the automatic machine in principle, because of the fact that the electromagnetic distributor can be actuated also when interconnected longitudinally in a hydraulic system.

When setting up of a stirrup configuration, as shown in FIG. 4 with reference number 2 i.e. with four bendings, the contact finger of the multipole switch of the second consecutive bending operation should be adjusted on the terminal N. In fact it not necessary to set up this position at some bending angle, because when the contact finger 7 of the distributor grounds the second position, simultaneously the contacts 65 are closed by the lever 2, thus switching on the circuit, so that the solenoid 66 is immediately energized through the finger on the programming panel set to terminal N. The contact finger 7 of the distributor grounds this preliminarily adjusted position when it connects the respective terminal, i.e. the adequate operation should not be performed. Because of the energizing of the solenoid 66, the armature 1 is pulled, so that the lever 2 is actuated also, releasing the contacts 65. In such a way the solenoid 66 is deenergized. Under the action of the spring 3, the lever 2 together with the ratchet pawl 4 returns to its static position. Before the contacts 65 are closed once again the ratchet lever 4 transposites the contact finger 7 to the following terminal and thereafter closes the contacts 65, the circuit thereof being no longer set to the grounding contact finger 7. This procedure is followed when it is necessary to eliminate two bending operations in a single stirrup, i.e. to obtain a stirrup with three bendings, as shown at 3 in FIG. 5. In this case the fourth position is also adjusted to the terminal N.

When reinforcement of the type shown at 4 in FIG. 5 is to be manufactured the contact finger for the program for the length up to the third bending operation is set to the terminal P. When the contact finger 7 of the distributor grounds this position, the solenoid 60 is energized through the contact finger of the third position of the programming panel 27, said finger being in contact with the terminal P and therefore with the contact finger 7 of the distributor. The solenoid 60 then switches on the program control and the cutoff mechanism. Therefore the pending operation of the third position is eliminated.

I claim:

1. A machine for automatically making stirrups and like concrete reinforcements from rod, comprising:

feed means for advancing a wire rod along a predetermined transport path;

length-measuring means along said path displaceable in step with the displacement of said rod by said feed means for producing an output signal;

cutoff means along said path for severing a length of said rod determined by said signal;

bending means downstream of said cutoff means and actuatable to impart a selected degree of bend to said rod;

programming means including a panel provided with switch means for operating said feed means, said cutoff means and said bending means in a predetermined sequence at least in part under the control of said output signal; and

control means for automatically recycling said sequence.

2. The machine defined in claim 1 wherein said feed means comprises:

a pair of calibrating rollers engageable with said rod at an upstream position of said path for imparting predetermined dimensions to the rod as the rod passes through said calibrating rollers;

a pair of feed rollers frictionally engaging said rod downstream of said calibrating rollers along said transport path;

a gear transmission coupling said pairs of rollers for joint rotation to advance said rod therethrough;

a clutch having an input member connected with said transmission in one clutch position and disconnected from said transmission in another clutch position;

a worm/worm-wheel arrangement operatively connected to said input member; and

an electric motor connected to said arrangement;

programming means including:

a pneumatic control operatively connected to said clutch for shifting same between said position, and

an electromagnetic air distributor pneumatically connected to said control.

3. The machine defined in claim 2 wherein said length-measuring means includes a terminal disc rotatable about an axis and formed with a multiplicity of contacts spaced therearound; a friction member gear-coupled to said transmission and spring-biased into frictional engagement with said disc for rotation thereof; an electromagnetic solenoid operatively connected with said friction member for drawing same out of engagement with said disc; and a contact finger sweeping the contacts of said disc for generating said output signal, each of said contacts being connected with corresponding terminals of said switch means.

4. The machine defined in claim 3 wherein said finger is secured to the upper end of a shaft coaxial with said disc, said length-measuring means further comprising a second solenoid for energizing same.

5. The machine defined in claim 4, further comprising a torsion spring acting upon said disc for restoring same to an initial position relative to said finger upon energization of the first-mentioned solenoid.

6. The machine defined in claim 4, further comprising a third solenoid operatively connected with said air distributor for admitting compressed air to said control and connected in circuit with at least one contact energized by said second solenoid, said bending means comprising:

a bifurcated bending member rotatable about an axis generally transverse to said rod;

angle-metering means operatively connected to said bending member for producing a second output signal in response to the angle of bend of the rod and connected with said programming means; and

second clutch means operatively connected between said arrangement and said bending member for interconnecting said bending member and said arrangement in a first position of said second clutch means and disconnecting said arrangement from said bending member in a second position of said second clutch means, said second clutch means being energized at least in part by said third solenoid.

7. The machine defined in claim 6 wherein said angle-metering means comprises an angle-metering disc including a fixed ring having contacts at angularly spaced locations therealong corresponding to increments of bending of the rod; a brush carried by said member and adapted to wipe the contacts of said ring; and a helical spring bearing on said brush and of increasing extension as the relative angular displacement of said brush and said ring increases.

8. The machine defined in claim 7, further comprising means connecting each of the contacts of said ring with a respective terminal of said switch means.

9. The machine defined in claim 6 wherein said third solenoid upon deenergization, operates said electromagnetic air distributor to permit a member of at least one of said clutch means to slide downwardly and disengage the respective clutch while a corresponding member of the other clutch means is spring-biased into its position opposite that prior to deenergization of said third solenoid.

10. The machine defined in claim 8 wherein said distributor comprises six contact pairs arrayed along a circular path; a contact finger sweeping along said path and successively connecting the contacts of said pairs; a ratchet wheel operatively connected to said contact finger of said distributor; and means connecting one contact of each pair in circuit with said length-measuring means and another contact of each pair in circuit with said angle-measuring means.

11. The machine defined in claim 10 wherein said distributor further comprises a pawl cooperating with said ratchet for stepping same; a spring connected with said pawl for drawing same away from said ratchet; and a fourth solenoid operatively connected to said pawl for stepping said ratchet.

12. The machine defined in claim 3 wherein said cutoff means includes a guillotine-type shear for separating said rod; a cam shaft operatively connected with said shear for driving

same; and means connecting said cam shaft with said arrangement in said other position of said clutch means for operating said shear.

13. The machine defined in claim 12, further comprising contacts closed upon operation of said shear, for stepping said distributor.