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Ritter et al.

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[54] **MACHINE FOR STRAIGHTENING AND CUTTING METAL WIRE OR STRIP INTO PIECES**

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[52] **U.S. Cl.** **72/12,** 72/17, 72/131, 83/69

[51] **Int. Cl.** **B21f 11/00**

[58] **Field of Search** 72/131, 17, 12, 8; 83/369, 208, 242, 210, 69

[56] **References Cited**

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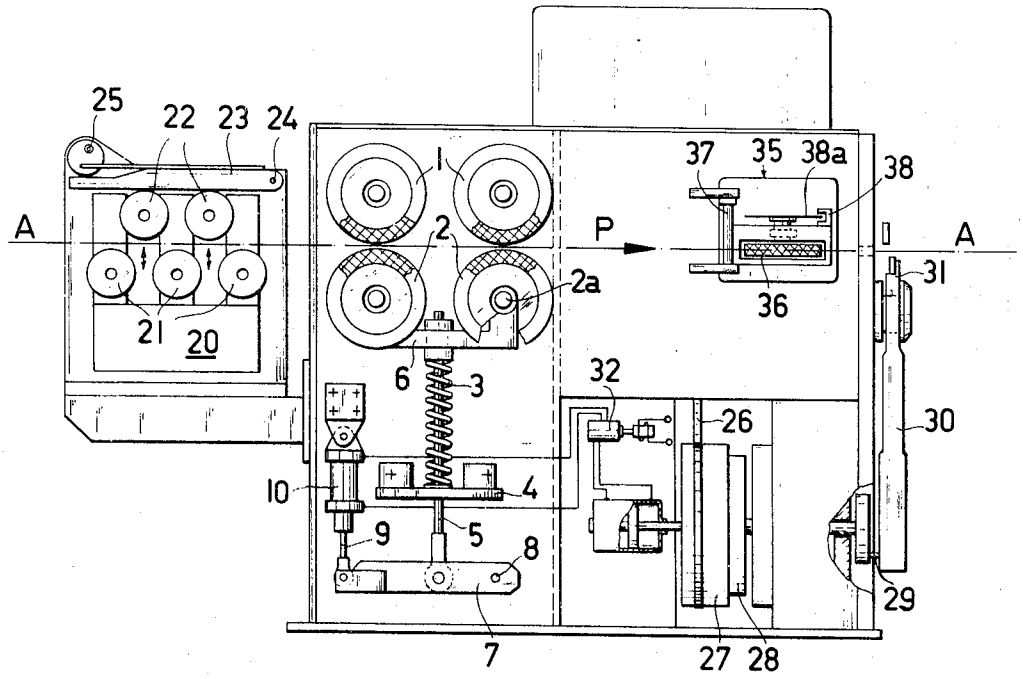
[57] **ABSTRACT**

A machine for straightening and cutting material in the form of metal wire or strip into lengths comprising a straightening device, a conveyor for conveying the material through the machine and a shearing device for cutting off lengths of the material. In this machine a measured length sensor for measuring the lengths of the material conveyed through the machine and an adjustable required length transmitter for controlling the length of material to be cut off are both connected to a comparison circuit which, as soon as the length sensed by the measured length sensor is equal to that to which the required length transmitter is adjusted brings the material to a standstill and operates the shearing device to cut off a length of the material. The machine is also provided with adjustable number-of-cuts counter which, after each cut has been made resets the measured length sensor and thus causes the cycle of operations of the machine to be repeated until the number of cuts to which the number-of-cuts counter is adjusted is reached.

6 Claims, 4 Drawing Figures



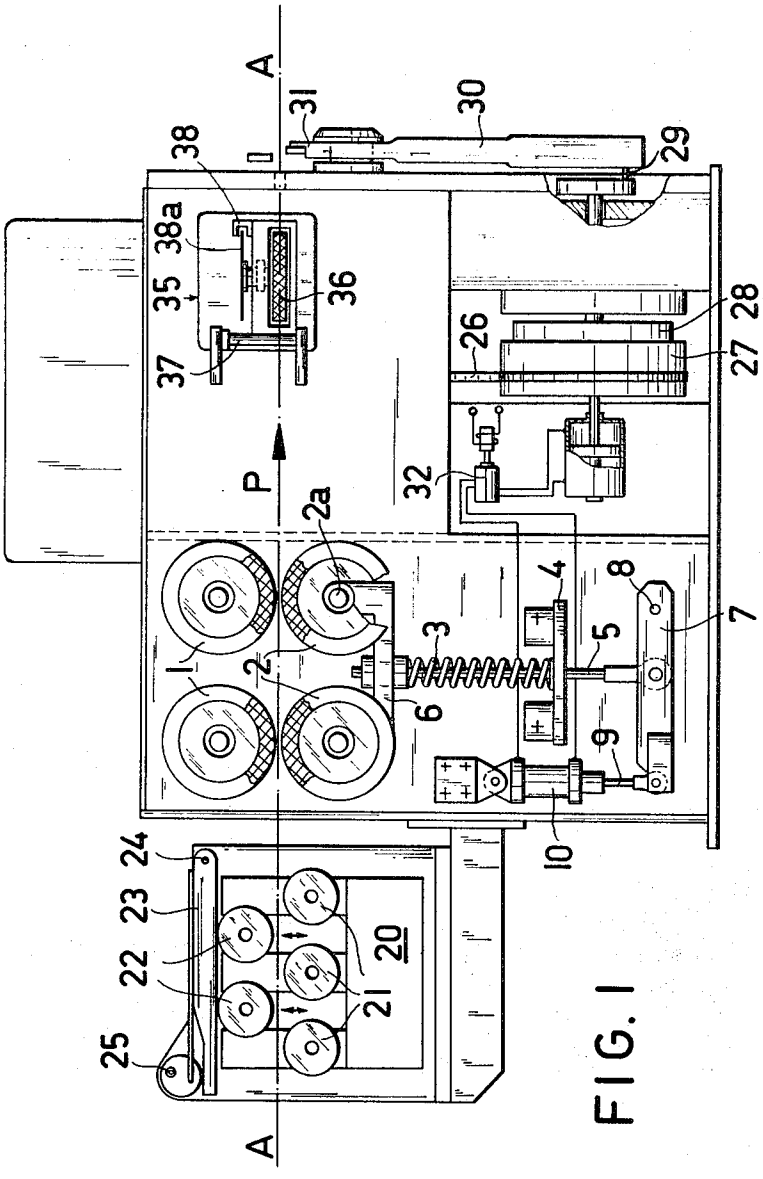

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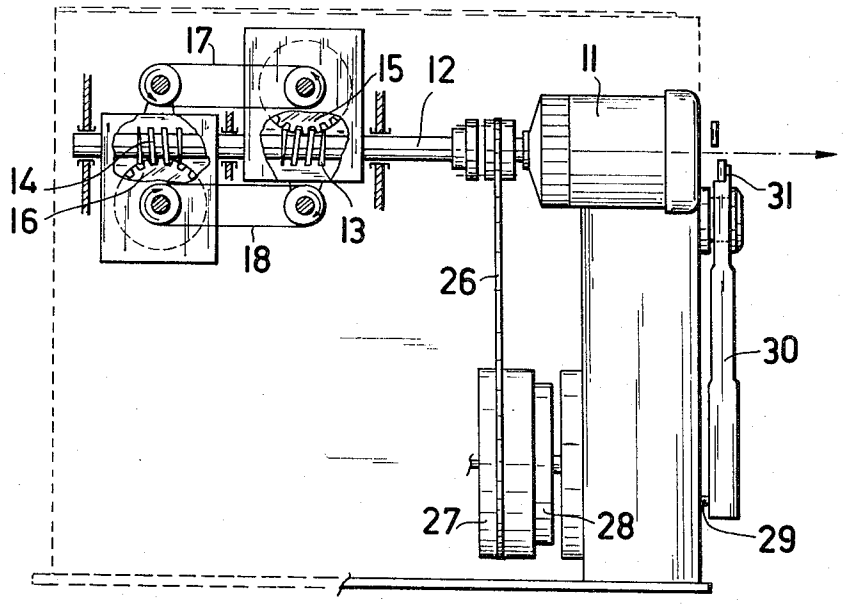
FIG. 1

FIG. 2



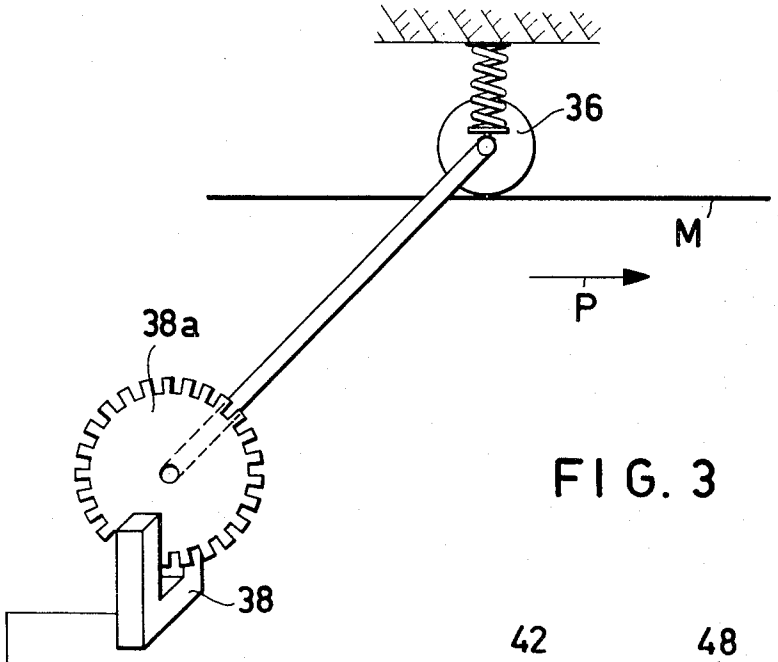
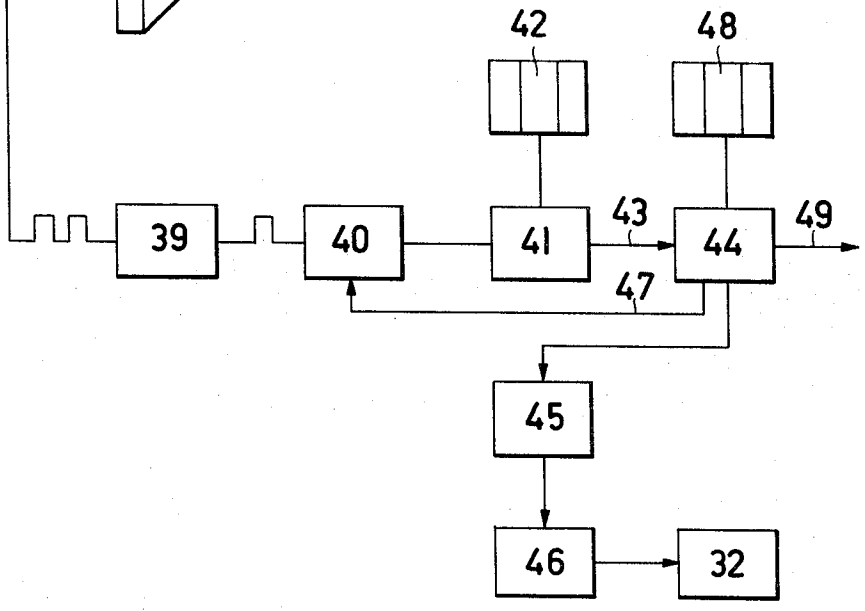


FIG. 3



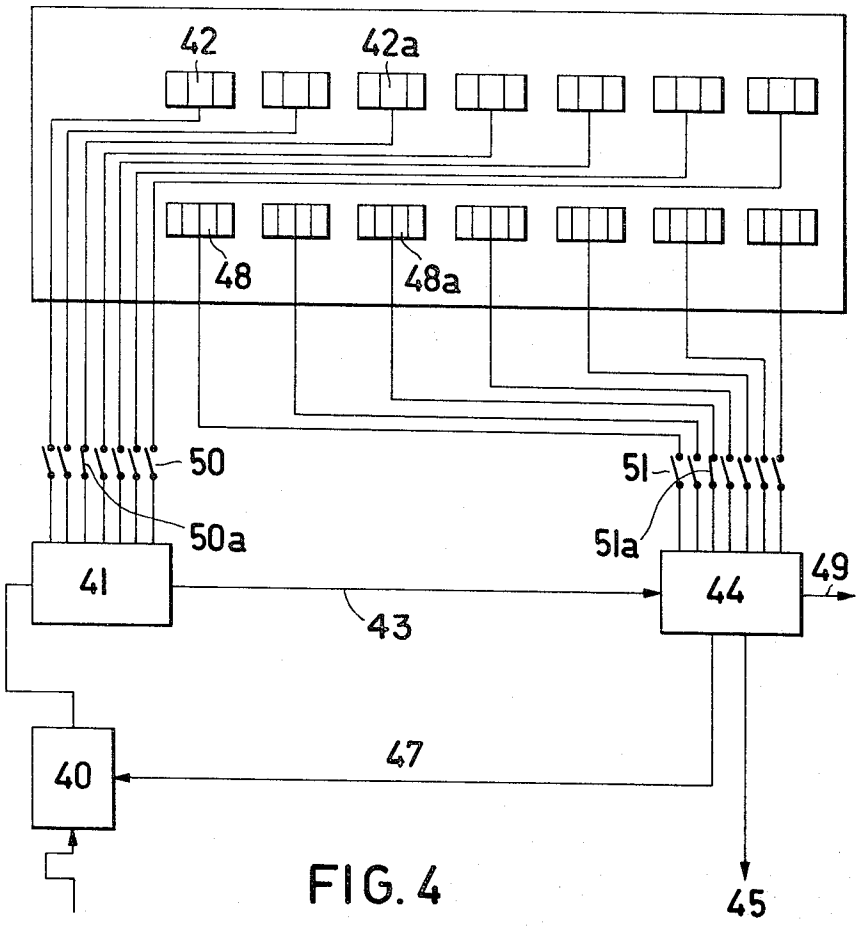


FIG. 4

MACHINE FOR STRAIGHTENING AND CUTTING METAL WIRE OR STRIP INTO PIECES

Conventional machines for straightening and cutting metal wire or strip into lengths usually have at least one set of straightening rollers through which the metal wire or strip, which will subsequently be called "the material"is conveyed by a conveyor. In those cases where the material is of a section which has essentially the same moment of inertia in all directions perpendicular to its longitudinal axis, for example in the case of circular wire, two or more sets of straightening rollers are required, and the straightening planes of these sets intersect. On the other hand in those cases in which the section of the material has greatly different moments of inertia in two directions perpendicular to its longitudinal axis and at right angles to each other, it is usually sufficient to provide a single set of straightening rollers, the straightening plane of which is perpendicular to the direction of the smaller moment of inertia of the section.

In addition to straightening the material it is necessary to be able to cut it off into lengths. For this purpose the conventional machines are provided, downstream of the straightening rollers, with mechanical stops which are adjustable in position longitudinally. When the leading end of the travelling material comes into contact with the mechanical stop, this brings the conveyor to a standstill and if desired automatically operates a shearing device.

A machine of this kind is described for example in the applicants' Austrian Patent Specification No. 237,410. However this conventional means for stopping the conveyor and for operating the shearing device with the aid of mechanical stops is not suitable for use in the production of comparatively small batches of material of particular length. A machine of this conventional kind is not capable, under these circumstances, of operating rapidly enough and reliably enough, because each time the cut-off length is changed the mechanical stop has to be readjusted in position and locked in place. This resetting of the machine often takes longer than the straightening and cutting off operation itself.

The object of the present invention is to provide a machine for straightening and cutting metal wire or metal strip into lengths, the machine being free from the disadvantages mentioned above and the adjustment necessary for cutting different lengths being able to be easily and rapidly effected.

According to this invention, in a machine for straightening and cutting material in the form of metal wire or strip into lengths, the machine comprising a straightening device, a conveyor for conveying the material through the machine and a shearing device for cutting off lengths of the material, a measured length sensor for measuring the length of the material conveyed through the machine and an adjustable required length transmitter for controlling the length of material to be cut off, are both connected to a comparison circuit which, as soon as the length sensed by the measured length sensor is equal to that to which the required length transmitter is adjusted, brings the material to a standstill and operates the shearing device which cuts off a length of the material, the machine also being provided with an adjustable number-of-cuts counter which, after each cut has been made, resets the measured length sensor, causing the cycle of operations to be repeated until the number of cuts to which the number-of-cuts counter is adjusted is reached.

Preferably, the machine further comprises a programming system including a number of independent required length transmitters and an equal number of independent number-of-cuts counters, the individual transmitter and counter pairs, each pair consisting of one required length transmitter and one number-of-cuts counter, being arranged to be energised one after the other, the programming system being arranged in such a way that as soon as the number of cuts made reaches that to which one number-of-cuts counter is adjusted, this counter and the transmitter in the pair are disconnected and the next pair are energised.

This form of the invention makes it possible to programme a production run in which a whole series of batches of different lengths are straightened and cut, each batch containing a required number of pieces all of the same length, the lengths being, however, different in the different batches.

Once the machine has been started it goes through the entire programme automatically without any further attention by the operator. It may pull the material off a storage reel and it then straightens and cuts, entirely automatically, the required series of batches of cut-off material the batches having different lengths from each other.

An example of a machine constructed in accordance with the invention is illustrated somewhat diagrammatically in the accompanying drawings, in which:

FIG. 1 is a front view of the machine;

FIG. 2 is a front view of further parts of the machine shown in FIG. 1, these parts not being visible in FIG. 1 because they are situated behind the front of the machine;

FIG. 3 is a circuit diagram of the control system of the machine; and,

FIG. 4 is a circuit diagram of a programming system for the machine.

As shown in FIG. 1, the material which is to be straightened and cut off into lengths advances through the machine in the direction of an arrow P along a horizontal path A-A. The material is conveyed by a conveyor formed by two pairs of motor-driven driving rollers 1, 2. The lower pair of driving rollers 2 can be raised and lowered, relative to the upper pair 1. When the machine is operating the lower pair of rollers 2 is thrust upwards towards the upper pair 1 by a thrust spring 3, so that the material is clamped firmly between the two pairs of driving rollers, a drive being applied to the material by friction. The spring 3 is mounted on a sliding pull rod 5. At its lower end the spring 3 thrusts against a guide plate 4 fixed to a frame of the machine. The upper end of the spring 3 thrusts against a cross beam 6 to which the upper end of the rod 5 is fixed.

The rod 5 slides up and down in a hole through the guide plate 4, raising and lowering the cross beam 6. Bearings 2*a* for the two driving rollers 2 are fixed to the two ends of the cross beam 6, the arrangement allowing the lower pair of driving rollers 2 to be adjusted in position vertically.

As shown in FIG. 2, the two pairs of driving rollers 1 and 2 are driven by an electric motor 11. Worms 13 and 14 are keyed to a driving shaft 12 of the motor and these worms mesh with the worm wheels 15, 16. One worm wheel 15 is coaxial with and fixed to one of the

upper driving rollers 1 and the other worm wheel 16 is coaxial with and fixed to one of the lower driving rollers 2. The other two driving rollers are driven through V-belts 17 and 18.

The mechanism for raising and lowering the lower pair of driving rollers 2 is arranged as follows. The lower end of the rod 5 is pivotally attached to a lever 7, which is itself pivotally mounted at one end 8 on the frame of the machine. The other end of the lever 7 is pivotally connected to the lower end of a piston rod 9 the piston of which slides in a pivotally mounted pneumatic cylinder 10. Compressed air supplied to the cylinder 10 moves the piston rod 9 downwards, rocking the lever 7 about its pivoted end 8 so that the sliding rod 5 is moved downwards against the action of the spring 3. This lowers the lower pair of driving rollers 2 away from the upper pair 1, releasing the material so that it ceases to be driven. The material is therefore brought to a standstill.

Just upstream of the driving rollers 1, 2 there is a straightening device 20. Lower rollers 21 of this device are rotatably mounted in bearings fixed to the frame of the machine. Upper rollers 22, on the other hand, are adjustable in position vertically. The bearings of the upper straightening rollers 22 are connected to a lever 23 pivoted at one end 24 to the frame of the machine. An eccentric 25 acts on the other end of the lever 23, to rock this lever up or down about its pivoted end 24. This arrangement allows the upper straightening rollers 22 to be adjusted in position vertically relative to the lower straightening rollers 21.

The system for cutting the material into lengths is arranged as follows: the electric motor 11 drives a flywheel 27 through a V-belt 26. The flywheel 27 is coupled by a pneumatic coupling 28 to an eccentric 29, which is merely indicated in FIGS. 1 and 2 of the drawings. The eccentric 29 drives a connecting rod 30 which actuates a shearing device 31.

An electro-pneumatic valve 32 (FIG. 1), controlled as will be described later, controls the admission of compressed air to the cylinder 10, for lowering the lower pair of driving rollers 2 and also controls the engagement of the coupling 28 for actuating the shears 31.

Downstream of the two pairs of driving rollers 1 and 2 there is a measured length sensor 35 which senses the advancing movement of the material. The sensor 35 has a measuring wheel 36 mounted on an arm which is pivoted about a vertical axis 37. A spring, not shown, thrusts the measuring wheel 36 against the surface of the travelling material so that the measuring wheel is rotated by the moving material. As indicated in FIG. 3, the measuring wheel 36 drives a pulse transmitter disc 38*a*. The rim of the disc 38*a* moves between the arms of a pulse transmitter fork 38. The rim of the disc 38*a* can for example have slots or teeth. The pulse transmitter fork 38 can be constructed, for example, as a photoelectric or a magnetic sensor.

The number of pulses sent out by the pulse transmitter fork 38 is proportional to the distance of advance of the material. The pulses from the pulse transmitter fork 38 are transmitted to a pulse divider 39. The mode of operation of the pulse divider 39 is as follows: let it be assumed that the material is to be cut off into lengths each of which is a whole number of centimetres and that the tolerated error in length is 0.25 cm. Under these circumstances the pulse transmitter fork 38 which forms a measured length transmitter, must deliver four pulses for each centimetre of advance. The pulse divider 39 divides the pulses in the ratio 4 : 1. The pulses delivered by the pulse transmitter fork 38 to the pulse divider 39 are therefore accurate within the tolerated 0.25 cm, four pulses being delivered for each 1 cm of advance of the material. The pulses delivered by the pulse divider 39 represent the specified distance of advance in centimetres.

The pulses delivered by the pulse divider 39 are transmitted to a pulse counter 40 which is connected to a comparison circuit 41 which is itself connected to a required length transmitter 42 which is adjustable. The adjustment of the required length transmitter 42 determines the length of the cut-off piece of material. The arrangement functions as follows. As soon as the material has advanced the desired distance, corresponding to the setting to which the required length transmitter 42 has been adjusted, the comparison circuit 41 delivers a signal, through a conductor 43, a cut counter 44 and a power stage 45, to a cut commander 46, which can for example take the form of an energising coil of the electro-pneumatic valve 32. On receiving this signal the cut commander 46 by sending a command to the compressed air cylinder 10, brings the material to a standstill and also, engaging the pneumatic coupling 28, operates the shears 31, cutting the material. The cut counter 44 also delivers, through a feedback conductor 47, a resetting signal to the pulse counter 40, starting a further operational cycle in which the material is advanced through a further measured distance. The cut counter 44 is connected to a number-of-cuts transmitter 48, which is adjustable by the operator. By adjusting the number-of-cuts transmitter 48 the operator determines the number of cut-off lengths of material he wishes the machine to produce in a given batch, the length of each piece of material being determined by the setting of the required length transmitter 42. That is to say, the number-of-cuts transmitter 48 determines the number of pieces cut, whereas the required length transmitter 42 determines the length of each piece. During the operation of the machine the pulse counter 40 is repeatedly reset by the consecutive cut counter 44, which counts the cuts made, the cycles being repeated until the number of cuts preset on the number-of-cuts transmitter 48 is reached, whereupon the electric motor 11 is switched off, for example through a conductor 49 and/or the lower pair of driving rollers 2 is lowered, bringing the travelling material to a standstill.

In the preferred example of the invention a programming system as shown in FIG. 4 is provided. The programming system contains a number of required length transmitters 42 which can be individually preset to the required cut-off lengths, and an equal number of number-of-cuts transmitters 48 which can be individually preset to the required number of pieces in each batch. All the required length transmitters 42 are connected in common through individual relay switches 50 to the comparison circuit 41. Similarly all the number-of-cuts transmitters 48 are connected in common through individual relay switches 51 to the cut counter 44. Each controlling pair of transmitters consisting of a required length transmitter 42 and a number-of-cuts transmitter 48, is connected by simultaneous closing of the relevant switches 50 and 51 in the programming system. In the example shown the required length transmitter 42*a*

is connected through the switch **50***a* to the comparison circuit **41** and the number-of-cuts transmitter **48***a* is connected through the switch **51***a* to the cut counter **44.**

The programming system functions as follows: when the machine is in operation, the material travels forwards along the path A—A and as soon as the comparison circuit **41** detects that the distance travelled is equal to the required length, the comparison circuit **41** delivers a pulse through the conductor **43** to the consecutive cut counter **44,** which stops the advance of the material and energises the cut commander **46,** actuating the shearing device **31** and cutting the material. The cycle is repeated, successive lengths of material being cut until the number-of-cuts transmitter **48** detects that the required number of lengths of material have been cut for the batch, whereupon a command signal is delivered, for example through the conductor **49,** which closes the next relay switch in the chain of consecutively actuated switches. Thus the two controlling transmitters **42** and **48** are disconnected and a different pair of controlling transmitters are connected for the cutting of a further batch of material, the cycle being repeated until the entire programme of batches has been cut.

The required length transmitter, the measured length sensor, the number-of-cuts transmitter and the cut counter can for example be in the form of four-pole mechanical switches of the kind which have a counting function, particularly pulse controlled step switches. However instead of mechanical switches, electronic switches are preferably used, for example in the form of chain counters or the like.

The example described can be modified in various ways, for example two or more straightening devices can if desired be arranged to operate in parallel with each other, the straightening devices both feeding to a common shearing device. All the straightening devices are then controlled by a common measuring and controlling system, the whole being arranged so that material from two or more production lines is simultaneously cut into lengths.

We claim:

1. In a machine for straightening and cutting material in the form of metal wire or strip into lengths, said machine comprising a straightening device, a conveyor for conveying the material through the machine and a shearing device for cutting off lengths of the material, the improvement comprising measured length sensing means for measuring the length of the material conveyed through the machine, an adjustable required length transmitting means for controlling the length of material to be cut off, means connecting said length sensing means and said transmitting means to a comparison circuit and means operatively connecting said comparison circuit to said shearing device and said conveyor whereby as soon as the length sensed by said length sensing means is equal to that to which said transmitting means is adjusted, said conveyor is operated to bring said material to a standstill and said shearing device is operated to cut off a length of said material and further comprising adjustable number-of cuts counter means and means connecting said number of cuts counter means to said sensing means whereby after each cut has been made said sensing means is reset and the cycle of operations of said machine is repeated until the number of cuts made by said shearing device is equal to that to which said number-of-cuts counter means is adjusted.

2. A machine as claimed in claim **1,** further comprising a programming system including a plurality of independent length transmitting means, an equal plurality of independent number-of-cuts counting means and means for energising one of said plurality of length transmitting means and said counting means successively whereby as soon as the number of cuts made by said shearing device reaches that to which said one of said number-of-cuts counting means is adjusted this counting means and the associated length transmitting means are disconnected and the next successive length transmitting means and number-of-cuts counting means are energised.

3. A machine as claimed in claim **1,** wherein said length sensing means includes a pulse transmittor, a measuring roller, means for rotating said measuring roller by said material as said material is conveyed by said conveyor and means driving the connecting said roller to said pulse transmittor, said pulse transmittor including a toothed disc and a photo-electric or magnetic pulse transmittor cooperating with said toothed disc whereby said disc delivers electric pulses proportional in number to the length of material conveyed by said conveyor and said delivered pulses are transmitted to pulse counting means connected to said comparison circuit.

4. In a machine for straightening and cutting material in the form of metal wire or strip into lengths, said machine comprising a straightening device, a conveyor for conveying the material through the machine and a shearing device for cutting off lengths of the material, the improvement comprising measured length sensing means for the length of the material conveyed through the machine, an adjustable required length transmitting means for controlling the length of material to be cut off, means connecting said length sensing means and said transmitting means to a comparison circuit and means operatively connecting said comparison circuit to said shearing device and said conveyor whereby as soon as the length sensed by said length sensing means is equal to that to which said transmitting means is adjusted, said conveyor is operated to bring said material to a standstill and said shearing device is operated to cut off a length of said material and further comprising adjustable number-of-cuts counter means and means connecting said number of cuts counter means to said sensing means whereby after each cut has been made said sensing means is reset and the cycle of operation of said machine is repeated until the number of cuts made by said shearing device is equal to that to which said number-of-cuts counter means is adjusted, said conveyor includes driving rollers, means for rotating said driving rollers and means for moving said driving rollers towards and away from said material, said means for moving said driving rollers including a pneumatic device and a pneumatic control circuit controlling said device, said pneumatic control circuit including an electro-pneumatic valve and means connecting said valve to said comparison circuit for control thereby, a pneumatic coupling operatively connected to said shearing device and means operatively connecting said valve to said pneumatic coupling.

5. A machine as claimed in claim 4, further comprising a support supporting said driving rollers, a spring acting upon said support, a rod connected to said sup-

port and a pivoted lever connected to said rod and to said pneumatic device whereby when said pneumatic device is operated, said support is lowered against the action of said spring.

6. A machine as claimed in claim **1**, further comprising a plurality of straightening devices arranged to operate in parallel with each other, said plurality of straightening devices feeding said shearing device and said straightening devices being controlled by said comparison circuit.

* * * * *