Oct. 11, 1932. P. B. HARWOOD ET AL 1,882,219

CONTROLLER FOR MOTOR DRIVEN MACHINES

Filed March 22, 1929 2 Sheets-Sheet 1

Fig. 1

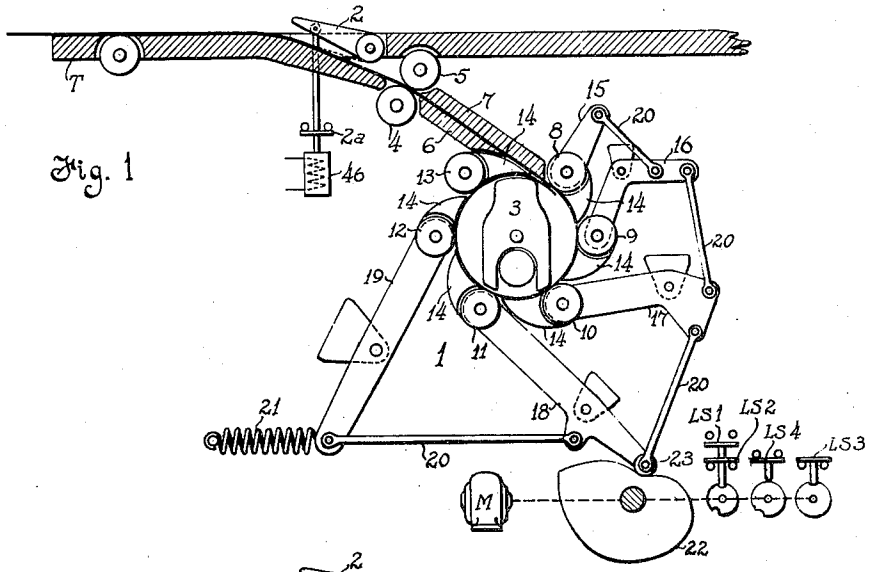

Fig. 2

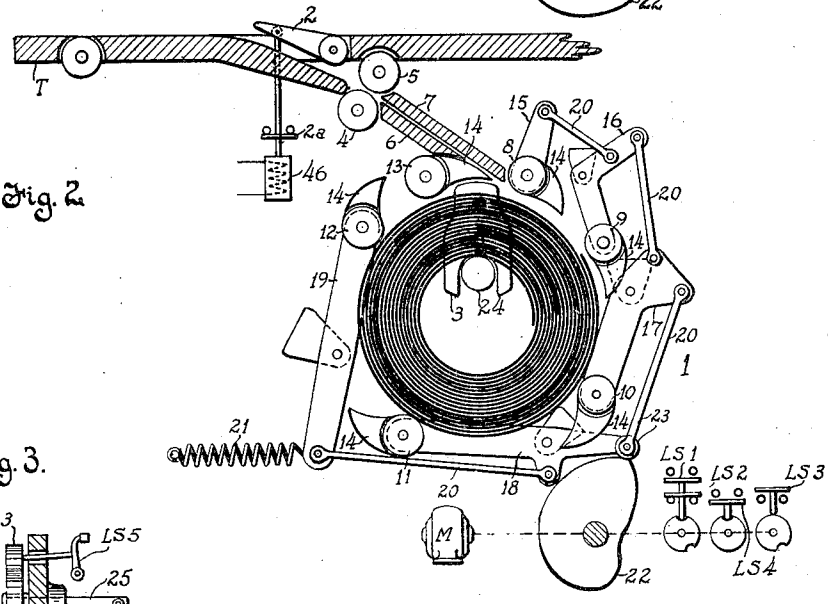

Fig. 3.

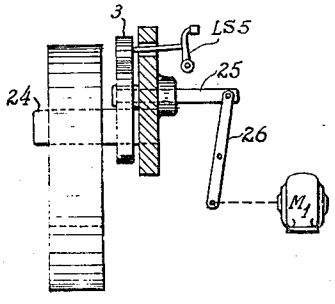

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Fig. 4

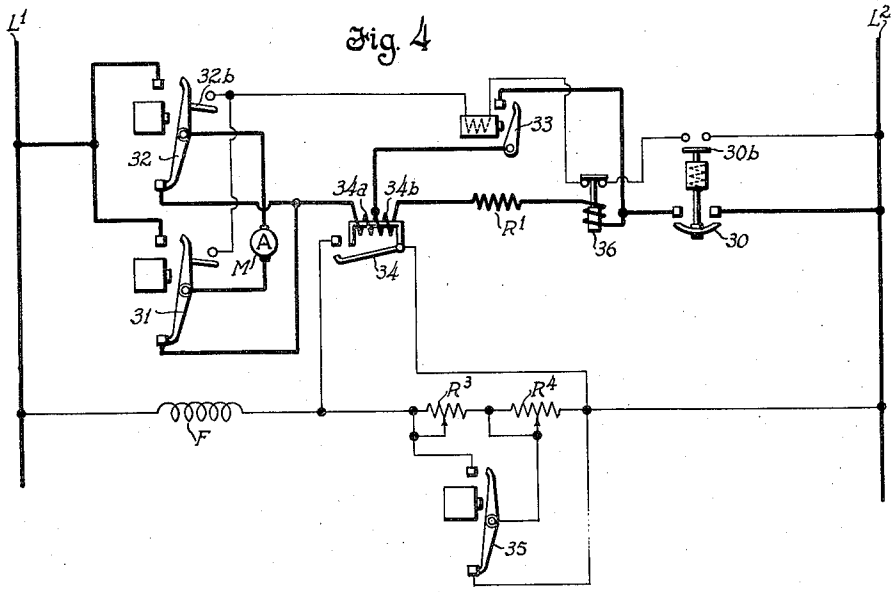
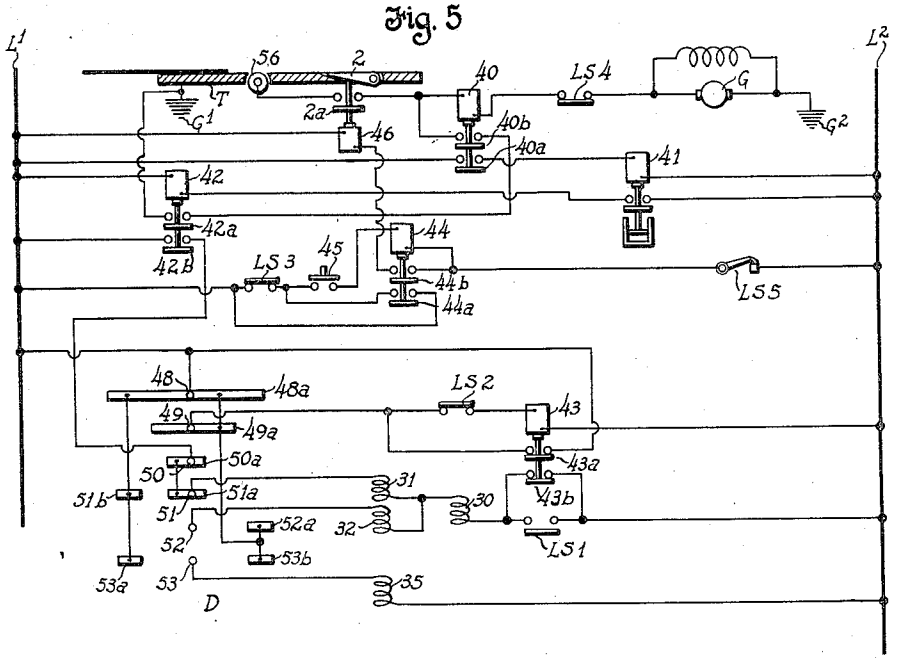


Fig. 5



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UNITED STATES PATENT OFFICE

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CONTROLLER FOR MOTOR DRIVEN MACHINES

Application filed March 22, 1929. Serial No. 349,165.

This invention relates to controllers for motor driven machines, as for example motor driven reels such as are employed in rolling mills for coiling hot strip metal.

Such reels are commonly provided with a motor driven coiling mechanism comprising a plurality of coil forming elements which require outward adjustment as the coiling operation progresses, a gate operable to direct a strip of metal into such coiling mechanism or to cause the same to pass therebeyond and a motor driven ejector for removing the coiled strip from the coiling mechanism. In operating such reels the gate must not be opened to admit a strip of material to the coiling mechanism unless the coil forming elements are properly set to begin the coiling operation and unless the ejector is in its retracted position. It is also necessary upon admission of a strip of material to the coiling mechanism to start outward adjustment of the coil forming elements at the proper instant and to stop such elements upon full upward movement thereof to permit removal of the coiled strip.

The present invention has among its objects to provide an automatic controller for reels of the aforesaid character which will insure operation thereof in the manner above stated.

Another object is to provide a controller of the aforesaid character including manual control means enabling the operator to stop automatic adjustment of the coil forming elements at any point and to then effect inward or outward adjustment of said elements at will.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate an embodiment of the invention which will now be described, it being understood that various modifications may be made in the embodiment illustrated without departing from the spirit and scope of the appended claims.

In the drawings,

Fig. 1 is a schematic view of a strip winding reel, the parts thereof being shown in the positions they occupy to being a coiling operation.

Fig. 2 is a view similar to that shown in Fig. 1 illustrating the position of the parts of the reel upon completion of the coiling operation.

Fig. 3 is a schematic view of the ejector mechanism of the reel, and

Figs. 4 and 5 diagrammatically illustrate a controller for the reel shown in Figs. 1 and 2.

Referring to Fig. 1, the same shows a strip winding reel including a coiling mechanism 1, a gate 2 operable to direct the strip material into such mechanism or to cause the same to pass therebeyond, and an ejector 3 for removing the coiled material from such mechanism.

The gate 2 is arranged upon the table T of the reel and when the same is in the position shown in Fig. 1 the strip of material is deflected downwardly into engagement with a pair of driven pinch rollers 4 and 5. In leaving the pinch rollers the strip of material is fed between a pair of guide members 6 and 7 into the coiling mechanism which comprises a plurality of guide rollers 8 to 13, inclusive, each of which has a deflector member 14 associated therewith. Each of the guide rollers is provided with means (not shown) for driving the same at a speed corresponding to the speed at which the material is fed into the coiling mechanism. Rollers 8 and 13 are mounted in stationary bearings and the deflector member 14 associated with roller 8 is provided with an arm 15 for swinging the same about the axis of said roller. Rollers 9, 10, 11 and 12 and their associated deflector members 14 are carried by pivoted arms 16, 17, 18 and 19, respectively, and the arms 15 to 19, inclusive, are connected by a plurality of links 20. All of said arms are biased to the positions shown in Fig. 1 by a tension spring 21 and the same are adapted to be moved to the positions shown in Fig. 2 against the action of said spring by a rotatable cam 22 which engages a roller 23 mounted upon arm 18. Cam 22 is driven by a motor M and in practice a suitable change speed gearing (not shown in the drawings) is provided for varying the speed at which the cam is rotated.

When the coiling mechanism is in the position shown in Fig. 1 the rollers 8 to 13, inclusive, and their associated deflector members 14 act on the forward end of the strip as the same leaves the guide members 6 and 7 to form said strip into a circular loop as shown in Fig. 1. Immediately upon entrance of the material into the coiling mechanism, motor M is started to operate the cam 22 in a counterclockwise direction to move the rollers and deflector members associated with arms 15 to 19, inclusive, towards the positions shown in Fig. 2. Upon continued feeding of the material into the coiling mechanism the material is wound as shown in Fig. 2 and upon completion of the coiling operation the parts are in the position shown in Fig. 2 and the coil of material rests upon a stationary supporting member 24.

The completed coil of material is removed from the coiling mechanism by outward movement of the ejector member 3. As shown in Fig. 3 said ejector member is mounted upon a slidable shaft 25 which is adapted to be driven in opposite directions by a motor M^1 through a suitable driving mechanism which is schematically illustrated at 26. Motor M^1 is provided with suitable control means which is not shown in the drawing for effecting reverse movements of the ejector member 3.

Referring now to Fig. 4, the same illustrates a controller for motor M. Motor M is of a direct current type, the same being provided with an armature A and a shunt field winding F and the supply circuit therefor is indicated by lines L^1—L^2. The armature circuit of said motor is controlled by an electroresponsive main switch 30, a pair of electroresponsive reversing switches 31 and 32 and an electroresponsive accelerating switch 33 while the field circuit of said motor is controlled by an electroresponsive relay 34 and an electroresponsive field switch 35. Each of the reversing switches is provided with normally open up contacts and normally closed down contacts, and as is apparent from the drawing selective energization of said reversing switches provide for establishment of reverse power connections for the motor armature. It is assumed, as hereinafter set forth, that reversing switch 31 provides for operation of the motor M in a direction to effect outward movement of the arms 15 to 19, inclusive, while reversing switch 32 establishes connections for operation of said motor in a reverse direction. Upon response of either of the reversing switches a resistance R^1 is included in the armature circuit of the motor which is adapted to be shunted to accelerate the motor by accelerating switch 33. The energizing circuit of accelerating switch 33 is controlled in a well known manner through the medium of auxiliary contacts *b* associated with main switch 30 and each of the reversing switches 31 and 32 and also by a series relay 36. The series relay 36 responds immediately upon establishment of power connections for the motor and drops out when the current in the armature circuit is reduced to complete the energizing circuit for accelerating switch 33 which then responds to shunt the resistance R^1.

Relay 34 is provided with a pair of windings 34^a and 34^b which are connected in series with the armature of the motor and immediately upon establishment of power connections for the motor armature said windings act cumulatively to effect closure of their associated relay. Relay 34 in closing connects field F of the motor directly across lines L^1—L^2 for full excitation thereof. Accelerating switch 33 in closing shunts the winding 34^b of relay 34 and under given current conditions in the armature circuit of the motor said relay drops out to open a shunt circuit around resistances R^3 and R^4 which are permanently connected in series with the field winding F of the motor. Field switch 35 controls the resistances R^3 and R^4 to selectively exclude the same from the field circuit of the motor. As hereinafter set forth resistance R^3 provides for slow speed operation of the motor while resistance R^4 provides for high speed operation thereof and the switch 35 is provided with normally closed down contacts for normally excluding the latter resistance. Switch 35 in responding includes the high speed resistance R^4 in the field circuit of the motor and excludes the slow speed resistance R^3.

Referring now to Fig. 5, the same illustrates control means for the main switch 30, reversing switches 31 and 32 and the field switch 35 of the above described controller, and also means for effecting operation of the gate 2. Such means includes a drum controller D, relays 40 to 44, inclusive, limit switches LS^1 to LS^5, inclusive, a master switch 45 and an operating solenoid 46 associated with gate 2.

Drum controller D is provided with stationary contacts 48 to 53, inclusive, and a movable contact drum having an intermediate off position, extreme forward and return positions and two off positions which are located intermediate said extreme positions and said neutral position. The contact drum is provided with a continuous contact ring 48^a which engages contact 48, and in the neutral position of said drum contacts 49, 50 and 51 engage movable contact 49^a, 50^a and 51^a, respectively. Upon movement of the drum out of neutral position contacts 50^a and 51^a disengage their associated stationary contacts while contact 49^a remains in engagement with contact 49. Upon movement of the drum into either of its extreme positions contact 49^a moves out of engagement with contact 49 and

when the drum is in its forward extreme position contacts 51 and 53 are engaged by movable contacts 51^b and 53^a, respectively. When the drum is moved into its other extreme position contacts 52 and 53 are engaged by movable contacts 52^a and 53^b, respectively.

As hereinafter set forth relay 40 is adapted to be supplied with current from a low voltage generator G through the medium of an insulated roller 56 which is mounted on table T of the coiling mechanism in advance of the gate 2, while the relays 41 to 44, inclusive, and also the operating solenoid 46 associated with gate 2 are adapted to be supplied with current from lines L^1—L^2.

The limit switches LS^1 to LS^4, inclusive, are associated with the operating cam 22 of the coiling mechanism, while the limit switch LS^5 is associated with the ejector 3. As shown in Fig. 1, when the parts of the coiling mechanism are positioned to begin a coiling operation limit switch LS^1 is open while limit switches LS^2, LS^3 and LS^4 are in closed position. Limit switch LS^1 is normally open while limit switch LS^2 is normally closed and upon initial movement of the cam 22 out of the positions shown in Figs. 1 and 2 the former limit switch closes while the latter opens. Limit switch LS^3 is normally closed and opens immediately upon initial outward movement of the parts of the coiling mechanism and returns to closed position only upon restoration of the parts of the coiling mechanism to the position shown in Fig. 1. Limit switch LS^4 is normally closed and opens only upon full outward movement of the parts of the coiling mechanism to the position shown in Fig. 2. The limit switch LS^5 is associated with the ejector mechanism and is closed only when the ejector 3 is in its retracted position.

The operation and circuit connections of the control system will now be more fully described.

With the coiling mechanism in the position shown in Fig. 1 opening of gate 2 is effected by depressing push button 45. Depression of push button 45 establishes a circuit from line L^1 through limit switch LS^3 through push button 45 through the operating winding of relay 44 and thence through the limit switch LS^5 to line L^2. Relay 44 thus responds and the contacts 44^a thereof shunt the limit switch LS^3 while the contacts 44^b thereof establish an energizing circuit for the gate operating solenoid 46 extending from line L^1 through the solenoid 46 through the contacts 44^b of relay 44 and the limit switch LS^5 to line L^2. As before stated limit switch LS^3 opens immediately upon outward movement of the parts of the coiling mechanism but since the contacts 44^a shunt the same as above described relay 44 is maintained energized to maintain the gate 2 in open position as long as push button 45 is held in closed position.

Assume now that the forward end of the strip of material approaches the gate 2. When said strip of material makes contact with roller 56 circuit is established from a ground connection G^1 to the table T of the coiling mechanism, through the strip of material to roller 56, through contacts 2^a associated with gate 2, through the operating winding of relay 40, through the limit switch LS^4 and thence through the generator G to a ground connection G^2. Relay 40 thus responds and connects the operating winding of relay 41 across lines L^1—L^2 through the medium of its contacts 40^a. Relay 41 responds after a given interval determined by setting of its dash pot, and in closing connects the operating winding of relay 42 across lines L^1—L^2. Upon closure of relay 42 relay 40 is maintained energized by a circuit extending from ground connection G^1 through contacts 42^a through contacts 40^b associated with relay 40 through the limit switch LS^4 and through the generator G to the ground connection G^2.

With drum controller D in its neutral position and the coiling mechanism in the position shown in Fig. 1 relay 43 is energized by a circuit extending from line L^1 to contact 48 through contacts 48^a and 49^a to contact 49 and thence through limit switch LS^2 and the operating winding of said relay to line L^2. Relay 43 in responding is maintained in closed position by a circuit extending through its contacts 43^a and limit switch LS^2. With relay 43 in closed position, relay 42 in responding energizes main switch 30 and reversing switch 31 by a circuit extending from line L^1 through the contacts 42^b of relay 42 to contact 50 of drum D through contacts 50^a and 51^a to contact 51 of said drum, through the operating windings of reversing switch 31 and main switch 30 and through the contacts 43^b of relay 43 to line L^2. Closure of main switch 30 and reversing switch 31 establishes an energizing circuit for the armature of motor M and said motor is then started and accelerated as hereinbefore described. However, it should be noted that the field switch 35 is deenergized and thus resistance R^3 is included in the field circuit to provide for slow speed operation of the motor.

In connection with the foregoing it should be noted that the relay 41 is energized immediately following engagement of the strip of material with roller 56 and after a predetermined interval relay 41 closes to effect starting of motor M for outward movement of the parts of the coiling mechanism. Relay 41 is calibrated to effect starting of motor M at the proper instant after entry of the strip of material into the coiling mechanism.

Immediately upon movement of the parts of the coiling mechanism out of the position shown in Fig. 1 limit switch LS^1 closes to

shunt the contacts 43^b of relay 43 and in the meantime limit switch LS^2 opens to interrupt the energizing circuit of said relay. The reversing switch 31 and main switch 30 are thus maintained energized through limit switch LS^1 but upon full outward movement of the parts of the coiling mechanism to the position shown in Fig. 2 said limit switch opens to deenergize said switches for automatic stopping of motor M. Also at this time limit switch LS^4 opens to interrupt the afore-described energizing circuit for relay 40. Relay 40 in dropping out deenergizes relay 41 and relay 41 in dropping out deenergizes relay 42. Also at this time the limit switch LS^2 recloses whereby relay 43 is again energized as hereinbefore described.

Upon completion of the coiling operation the operator releases push button 45 to deenergize relay 44 and said relay in dropping out deenergizes solenoid 46 to permit closure of gate 2. The operator then ejects the roll of material from the coiling mechanism by effecting operation of motor M^1 so as to cause outward movement of the ejector 3. Limit switch LS^5 opens immediately upon movement of the ejector 3 out of its retracted position and it is thus apparent that the same insures opening of relay 44 to prevent opening of the gate 2 until ejector 3 is returned to its retracted position. Also it should be noted that when the coiling mechanism is in the position shown in Fig. 2 limit switch LS^3 is open whereby push button 45 is rendered ineffective to operate relay 44, which operation as hereinbefore stated is necessary to effect opening of gate 2. With gate 2 in closed position the strip material passes over said gate and cannot effect the aforedescribed automatic operation of the controller since the roller 56 is disconnected from the generator G by contacts 2^a.

After ejection of the coil of material from the coiling mechanism such mechanism is returned from the position shown in Fig. 2 to the position shown in Fig. 1 by moving the drum controller D to its extreme forward position. In this position drum D establishes an energizing circuit for the forward reversing switch 31 and main switch 30 extending from line L^1 to contact 48 through contacts 48^a and 51^b to contact 50 through the operating windings of reversing switch 31 and main switch 30 and through the contacts 43^b of relay 43 to line L^2. Also with the drum in this position field switch 35 is energized by a circuit extending from line L^1 to contact 48 through contacts 48^a and 53^a to contact 53 and thence through the operating winding of said field switch to line L^2. Field switch 35 in responding excludes the slow speed resistance R^3 from the field circuit of the motor and includes the high speed resistance R^4 therein whereby motor M is operated at a relatively high speed to return the coiling mechanism from the position shown in Fig. 2 to the position shown in Fig. 1. Immediately upon movement of the coiling mechanism out of the position shown in Fig. 2 limit switch LS^2 opens to interrupt the energizing circuit for relay 43 but in the meantime limit switch LS^1 closes to maintain main switch 30 and reversing switch 31 energized. Upon full return movement of the coiling mechanism to the position shown in Fig. 1 limit switch LS^1 opens to deenergize main switch 30 and reversing switch 31 for stopping of the motor.

During the aforedescribed automatic operation of the coiling mechanism from the position shown in Fig. 1 to the position shown in Fig. 2 the motor can be stopped at any time by moving the drum controller D into either of its off positions. When drum D is moved to either of its off positions contacts 50^a and 51^a disengage their cooperating stationary contacts to thereby deenergize the main switch 30 and reversing switch 31 for interruption of the motor circuit.

Drum controller D also provides for operation of motor M in a reverse direction. Upon movement of the drum D into its extreme reverse position reversing switch 32 and main switch 30 are energized by a circuit extending from line L^1 to contact 48 through contacts 48^a and 52^a to contact 52 through the operating windings of said main switch and reversing switch and either through contacts 43^b of relay 43 or the limit switch LS^1 to line L^2. Also during reverse operation of the motor, field switch 35 is energized by a circuit extending from line L^1 to contact 48 through contacts 48^a and 53^b to contact 53 and through the operating winding of said field switch to line L^2. As hereinbefore set forth energization of the field switch 35 provides for high speed operation of the motor.

What we claim and desire to secure by Letters Patent is:

1. The combination with a machine for coiling metal strips including a plurality of adjustable coil forming elements, of a driving motor for operating said elements, control means for said motor including an electromagnetic relay responsive after a given delay to effect starting of said motor, and control means for said relay including a part adapted to be engaged by the strip material to establish an energizing circuit for said relay.

2. The combination with a machine for coiling metal strips including a plurality of associated coil forming elements normally in a retracted position and requiring operation through a given range during a coiling operation, of a driving motor for said elements, an electromagnetic relay adapted to respond subject to a delay to effect starting of said motor, and control means for said relay in-

cluding a part adapted when engaged by the strip of material to effect response of said relay but only upon positioning of said coil forming elements in normal position.

3. The combination with a machine for coiling metal strips including a plurality of associated coil forming elements normally in a retracted position and requiring operation through a given range during a coiling operation, of a driving motor for said elements, manual means for controlling said motor to effect operation thereof in opposite directions at will, and automatic means adapted only upon positioning of said coil forming elements in their retracted position to effect starting of said motor, said automatic means including an electromagnetic relay responsive after a given delay to effect starting of said motor, and means for controlling said relay including a part adapted to be engaged by the strip material to establish an energizing circuit for said relay.

4. The combination with a machine for coiling metal strips including a plurality of associated coil forming elements normally in a retracted position and requiring operation through a given range during a coiling operation, of a driving motor for said coil forming elements, of a normally closed gate associated with said machine and adapted when opened to cause the strip material to enter said machine, control means for said motor including means controlled by the strip material to effect starting of said motor, said control means being operative only upon opening of said gate, and means for preventing opening of said gate unless said coil forming elements are in normal position.

In witness whereof, we have hereunto subscribed our names.

PAISLEY B. HARWOOD.
CARROLL STANSBURY.