

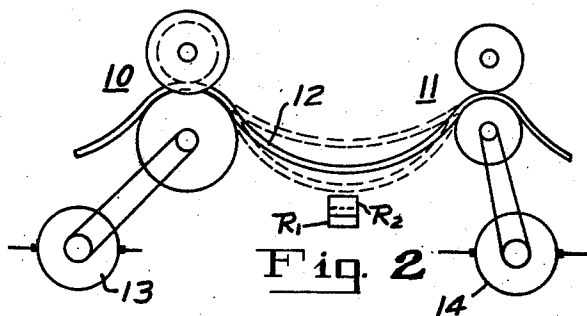
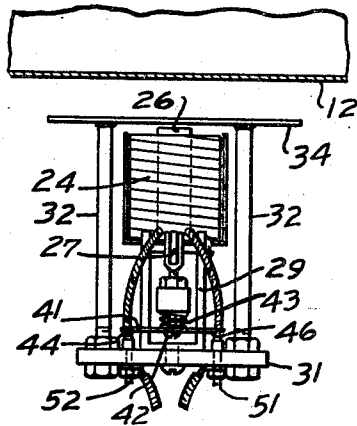
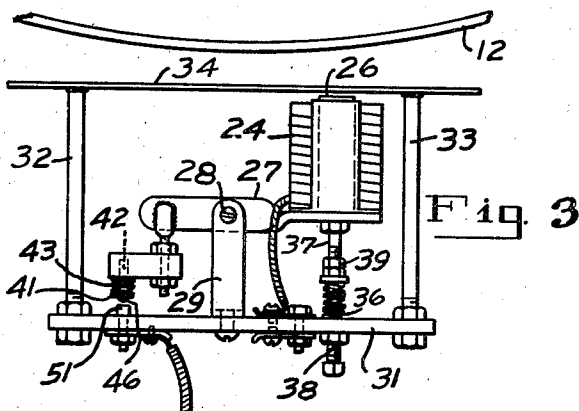
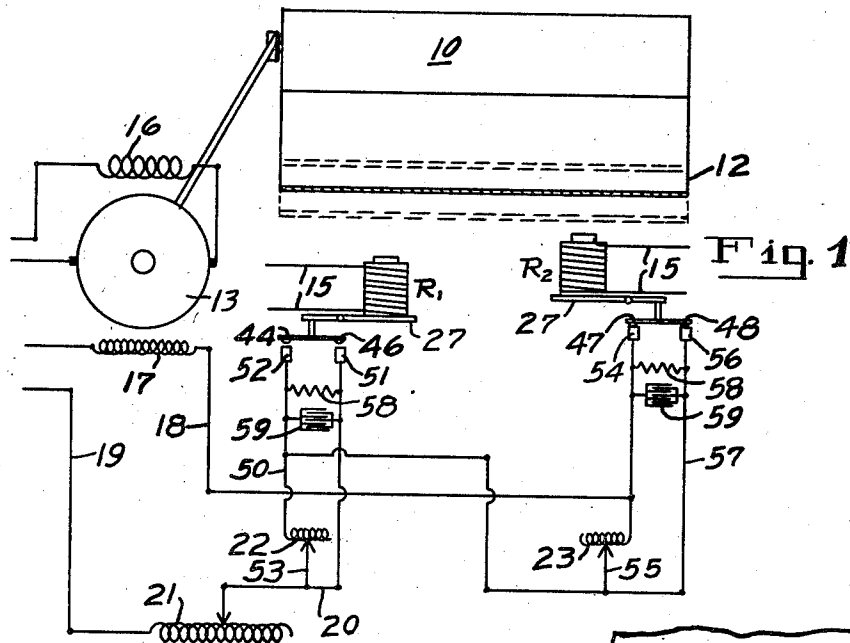
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2,193,189

CONTROL MEANS FOR ROLLING MILLS

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CONTROL MEANS FOR ROLLING MILLS

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This invention relates to control means for a continuous strip steel rolling mill, and has for an object the provision of means for controlling the relative speeds of adjacent pairs of rolls in such a mill whereby to avoid tension on the strip as it is being rolled.

A further object of our invention is to provide a means for controlling the speed of adjacent pairs of rolls in a continuous strip rolling mill, whereby a predetermined sag in the material between the pairs of rolls may be maintained.

A still further object of our invention is to provide a system of control for the driving means for adjacent pairs of rolls in a continuous strip rolling mill, which shall include electro-magnetic means positioned beneath the strip between the pairs of rolls, and speed control means responsive to entrance into and departure from the magnetic field of said electro-magnetic means, to vary the relative speeds of the adjacent pairs of rolls.

A still further object of our invention is to provide an improved electro-magnetic relay for controlling the speed of the driving means for rolls in a continuous strip rolling mill.

As is well known in the art to which our invention relates, it is essential that the strip in a continuous strip mill be rolled substantially without tension between adjacent pairs of rolls, and also that it be prevented from sagging too much between adjacent pairs of rolls. Too great tension on the strip tends to distort and weaken it, while too great a sag between pairs of rolls will bring about buckling and crumpling of the sheet. In tin plate mills, also, it is highly important that the strip shall not touch or rub against anything other than the rolls in its course through the mill, or else the plating is marked and its value impaired. This last mentioned requirement renders objectionable the use of ordinary limit switches actuated by mechanical contact with the strip. It is accordingly a principal feature of our invention that our improved control operates by entrance of the strip into or departure from the magnetic field of an electro-magnetic relay, and there is avoided actual physical contact of the strip with anything other than the rolls.

Briefly, our invention comprises a suitable motor drive for adjacent pairs of rolls through which the steel strip passes, which strip is permitted a predetermined amount of sag between the rolls in order to avoid tension therein. Positioned beneath the sag of the strip are a pair of electromagnetic relays having elements movable upon entrance into or departure from the mag-

netic field thereof by the strip being rolled. The electro-magnetic relays serve to vary the relative speeds of the driving motors for the rolls, as by varying the resistance in the exciter field of one of the motors, though it will be apparent from a further description of our invention, that the relays may be employed to vary the speed of the driving means in any suitable manner known to the art.

Our improved relay embodies a coil having a fixed core and is mounted upon one end of a tilting bar carrying contacts on its opposite end and adapted to open and close a suitable control circuit. The relay is so located with respect to the moving strip that when the strip enters the magnetic field of the coil, the coil moves toward the strip and closes its associated circuit. When the strip leaves the magnetic field of the coil, the weight of the coil and its core causes that end of the bar to move downwardly and open the control circuit. By placing one such relay farther from the strip than the other, and so operating the mill that the circuit of one relay is normally closed while the other is open, the relative speeds of the driving motors may be so controlled as to maintain a predetermined sag in the strip between the pairs of rolls.

Apparatus embodying features of our invention is illustrated in the accompanying drawing forming a part of this application, in which:

Fig. 1 is a diagrammatic view of the control means;

Fig. 2 is a diagrammatic view illustrating adjacent pairs of rolls and the location of the relays with respect to the sag in the strip between the pairs of rolls;

Fig. 3 is a side elevation of one of the electro-magnetic relays; and

Fig. 4 is an end elevation thereof.

Referring to the drawing for a better understanding of our invention, I show adjacent pairs of rolls 10 and 11 between which a continuous steel strip 12 passes. The rolls 10 and 11 are driven by motors 13 and 14 respectively, at such relative speeds that there is a sag in the strip 12, as shown in Fig. 2, to prevent tension of the strip and also to prevent the strip buckling between adjacent pairs of rolls. For the purpose of illustration, the motor 14 may be a constant speed motor and the motor 13 have its speed controlled so as to maintain the proper sag in the strip 12. It will be understood, however, that either or both of the motors may be controlled so as to maintain the proper relative speeds between adjacent pairs of rolls.

Referring particularly to Fig. 1 for a specific embodiment of the speed control means, the motor 13 is shown as having a series field winding 16 and a separately excited field winding 17, the winding 17 being included in an exciter circuit consisting of wires 18 and 19. A manually controlled rheostat 21 is included in the exciter circuit and serves to provide as close a manual control of the speed of the motor 13 as is possible.

Additional adjustable rheostats 22 and 23 are adapted to be included in the exciter circuit or be short circuited to further vary the speed in response to the position of the strip 12, as hereinafter explained.

Positioned beneath the sag of the strip 12 are two electro-magnetic relays R1 and R2. Each of the relays R1 and R2 comprises a coil 24 constantly energized by a circuit 15. Each coil 24 has a steel core 26 and is mounted upon one end of a tilting bar 27, made of non-magnetic material and pivotally mounted at 28 to a support 29. The support 29 is in turn mounted upon a base 31 of non-magnetic material which carries corner supports 32 and 33 having a plate 34 mounted on the upper ends thereof. The plate 34 is also made of non-magnetic material, such as brass. The weight of the coil 24 and its associated parts is counter-balanced by a spring 36 positioned between adjusting nuts 39 on a threaded stem 37 extending downwardly into the spring 36 from the core 26, and a lower set screw 38 carried by the base 31. The position of the coil may be adjusted by adjusting the position of the nuts 39 on the stem 37, and thus raise or lower the coil with respect to the spring 36. At the opposite end of the tilting bar 27 is yieldingly mounted a cross bar 41 by means of a screw 42 extending upwardly into the tilting bar 27 and a spring 43 surrounding the screw. On the ends of the cross bar 41 are contacts designated 44 and 46 with respect to relay R1, and as 47 and 48 with respect to relay R2.

The contacts 44 and 46 are adapted to coact with contacts 51 and 52, the contact 51 leading to the rheostat 21 through wire 20, and the contact 52 leading through wire 50 to the rheostat 22, which latter rheostat is connected on the other side to the wire 20 by a lead 53.

The contacts 47 and 48 are adapted to coact with contacts 54 and 56. The contact 54 is connected to the rheostat 23 and to wire 18, while the contact 56 is connected to a wire 57 which is connected to the wire 50 and to the other side of the rheostat 23 through wire 55. A resistance 58 and a condenser 59 are interposed across each of the circuits controlled by the relays R1 and R2 to prevent arcing upon breaking of the circuit and to discharge induced current occurring upon breaking of the circuit.

In practice, the relay R2 is located nearer the strip 12 than is the relay R1, and is so located that the strip 12 is normally within the magnetic field of the coil 24. The coil is thus attracted toward the strip and is held in its upward position and the contacts 47 and 48 are held down against the contacts 54 and 56. The relay R1 being positioned lower than the relay R2, the strip 12 is above the magnetic field of its coil 24 and the contacts 44 and 46 are accordingly normally separated from the contacts 51 and 52 so that the circuit controlled thereby is open. The exciting current, under such conditions, passes through the field 17, the wire 18, through closed contacts 54, 47, 48 and 56, wires 57 and 50, rheostat 22, wires 53 and 20, through rheostat 21, and

back through 19. The motor 13 is then running at its normal speed. Should the strip 12 sag too low it would come within the magnetic field of the relay R1, and the coil 24 of R1 would then move toward the strip 12, closing the contacts 44 and 46 against the contacts 51 and 52. The exciting current would then pass through the field winding 17, contacts 54, 47, 48 and 56, wire 57, contacts 52, 44, 46 and 51, and back through wire 20, rheostat 21, and wire 19. Both rheostats 22 and 23 would thus be short circuited, reducing the resistance in the exciter field 17 and decreasing the speed of the driving motor 13. As soon as the sag in the strip 12 has reached the full line position of Fig. 1, it is outside the magnetic field of the relay R1 and the parts again assume the positions shown in Fig. 1, with the motor 13 running at normal speed.

Should the sag in the strip 12 become shorter so that it is raised to the upper dotted positions of Figs. 1 and 2, it would leave the magnetic field of relay R2, and its coil 24 would then move down, raising the contacts 47 and 48 off of the contacts 54 and 56, thus opening the circuit. The exciting current would then flow through the field 17, wire 18, rheostat 23, wires 57 and 50, rheostat 22, wires 53 and 20, and thence through rheostat 21 to wire 19. The resistance of the rheostats 22 and 23 would thus be added to the exciter field current, causing the speed of the motor 13 to increase and thus cause the strip 12 to sag lower until it again comes to the full line position of Figs. 1 and 2, and causes the speed of the driving motor 13 to be restored to normal.

It will thus be seen that the relays R1 and R2 act as upper and lower limits for controlling the speed of the driving motor 13 and to maintain it at a normal speed whereby to maintain a predetermined looseness or sag in the strip 12 between the adjacent pairs of rolls 10 and 11. It will also be apparent that the limits may be varied by varying the positions of the relays R1 and R2 with respect to the strip and to each other or by varying the energizing current in the relays by any suitable means, not shown.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What we claim is:

1. A control means for continuous strip steel rolling mills in which the strip is allowed to sag between adjacent pairs of rolls, comprising a motor for driving one pair of the rolls, an electro-magnetic means containing movable elements adapted to be attracted by the strip disposed adjacent the strip between the pairs of rolls in position for the strip to enter its magnetic field and effect movement of said elements when the sag in the strip is abnormal, and means responsive to movement of the movable elements of said electro-magnetic means to vary the speed of the motor.

2. A control means for continuous strip steel rolling mills in which the strip is caused to sag between adjacent pairs of rolls, comprising a motor for driving one pair of rolls, electro-magnetic means between the pairs of rolls beneath the sag in the strip and containing elements adapted to be attracted by the strip and movable upon en-

trance into and departure from the magnetic field thereof by said strip, and means responsive to movement of said elements for varying the speed of said motor.

5 3. A control means for continuous strip steel rolling mills comprising a pair of electro-magnets disposed beneath the strip between adjacent pairs of rolls and containing elements adapted to be attracted by the strip and movable
10 responsive to entrance into and departure from the magnetic field thereof by said strip, means for driving the rolls, and means responsive to movement of said elements to vary the speed of the driving means.

15 4. In a continuous strip steel rolling mill, adjacent pairs of rolls between which the strip is allowed to sag, a pair of electro-magnets each having elements movable upon entrance into and departure from the magnetic field thereof by said
20 strip, one of said electro-magnets being positioned nearer said strip than the other, driving means for the rolls, and means responsive to movement of said elements for varying the speed of the driving means.

5 5. In a continuous strip steel rolling mill, adjacent pairs of rolls between which the strip is allowed to sag, an electro-magnet disposed beneath the sag in the strip through the magnetic field

of which the strip normally runs, a second electro-magnet disposed beneath the sag in the strip the magnetic field of which is normally beneath the path of travel of the strip, elements in each
5 of said electro-magnets movable upon entrance into and departure from the magnetic field thereof by said strip, means for driving the rolls, and means responsive to movement of said elements for varying the relative speeds of said driving
10 means.

6. In a control means for a continuous strip steel rolling mill, motor driven adjacent pairs of rolls through which the strip passes, a pair of electro-magnetic relays disposed intermediate adjacent pairs of rolls so that the strip is free to
15 enter into and leave the magnetic fields thereof without physically engaging the relays, each of said relays comprising a movable coil having a fixed core, a pivoted bar upon which the coil is mounted, speed control circuits for said motor
20 driven rolls associated with each of the relays, and means carried by the pivoted bar for opening and closing the said control circuits upon movement of the coil responsive to entrance of the strip into and departure from the magnetic field
25 of said electro-magnetic relays.

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