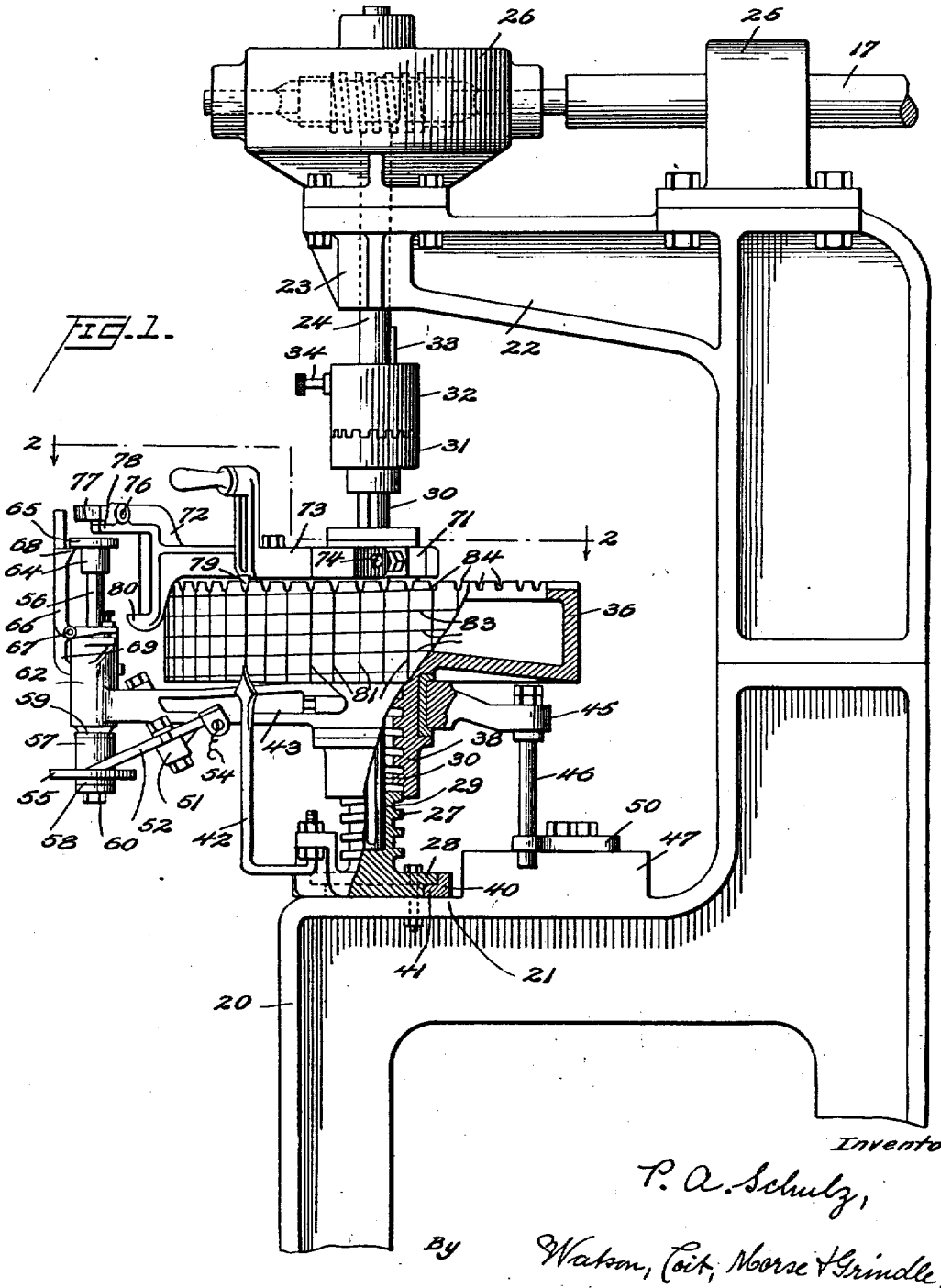
April 15 , 1924. 1,490,436

P. A. SCHULZ

AUTOMATIC CONTROL MECHANISM FOR ROLLING MILL EQUIPMENT

Filed May 23, 1921 3 Sheets-Sheet 1

FIG. 1.



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AUTOMATIC CONTROL MECHANISM FOR ROLLING MILL EQUIPMENT

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FIG. 2.

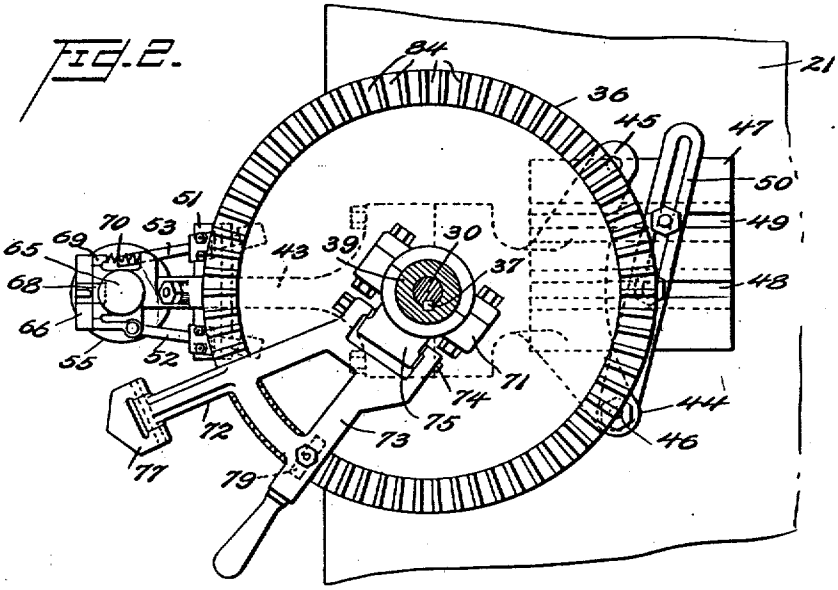


FIG. 4.

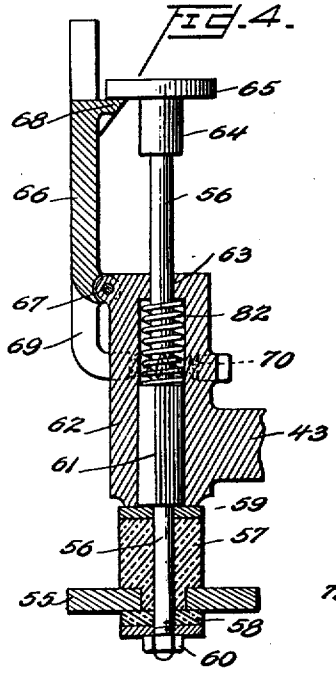
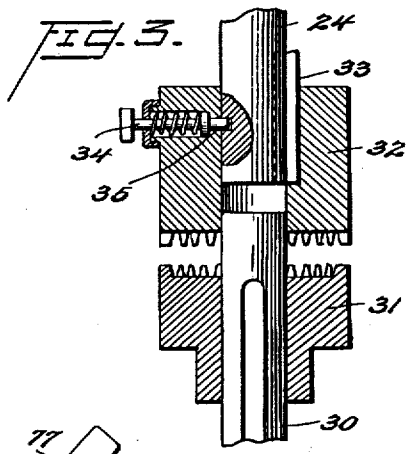


FIG. 3.



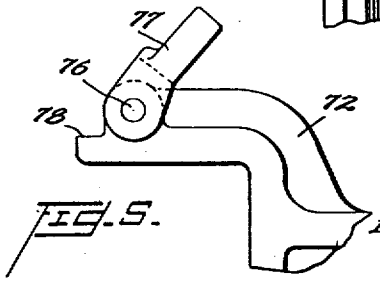


FIG. 5.

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AUTOMATIC CONTROL MECHANISM FOR ROLLING MILL EQUIPMENT

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FIG. 6.

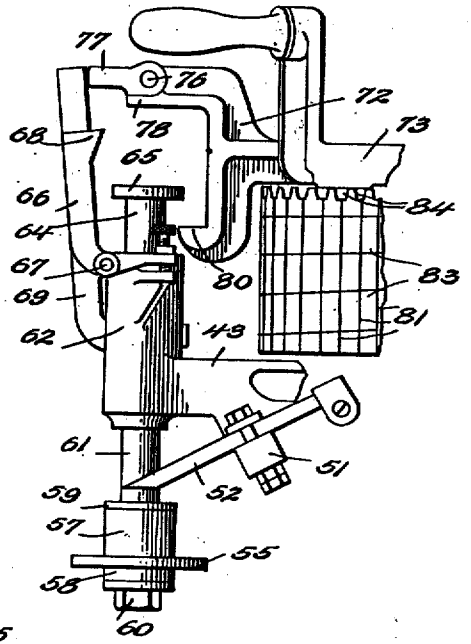
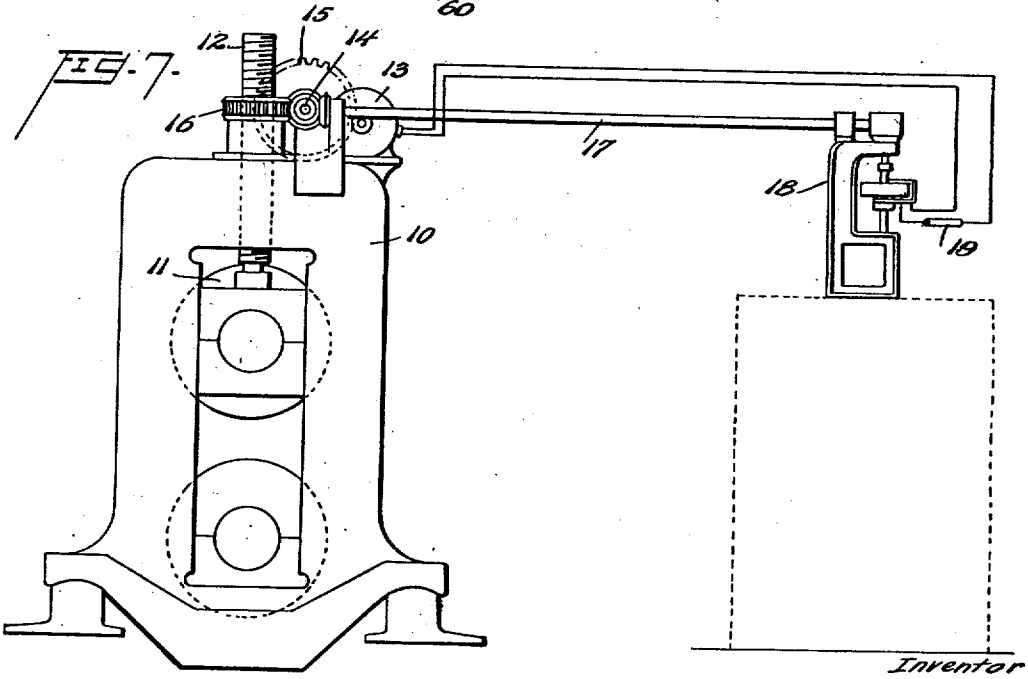


FIG. 7.



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UNITED STATES PATENT OFFICE.

PAUL AUGUST SCHULZ, OF BETHLEHEM, PENNSYLVANIA, ASSIGNOR TO BETHLEHEM STEEL COMPANY, OF BETHLEHEM, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

AUTOMATIC CONTROL MECHANISM FOR ROLLING-MILL EQUIPMENT.

Application filed May 23, 1921. Serial No. 471,866.

To all whom it may concern:

Be it known that I, PAUL AUGUST SCHULZ, a citizen of the United States, and a resident of the city of Bethlehem, county of Northampton, State of Pennsylvania, have invented certain new and useful Improvements in Automatic Control Mechanism for Rolling-Mill Equipment, of which the following is a specification.

This invention relates to mechanism adapted for use in changing the position of the adjustable elements of a rolling mill to bring about a predetermined but different operative relation of the cooperating parts or elements of the mill, as for instance the relative positions of the rolls for successive passes of the material being treated. It includes indicating mechanism which when properly set to indicate the amount of movement or new position desired for the element with which it is operatively connected through its moving means, such as the moving means for an adjustable roll, will automatically cut off the power and stop the movement of the element or roll at the point indicated and desired. It is adapted for use with electrically operated moving means, and automatically breaks the current and cuts off the power. Where there are a series of movements of the roll in the same direction, the total amount of such movements will be indicated as well as the amount of the last movement. The novel features will be more fully understood from the following description and claims taken in connection with the drawings.

In the drawings:

Figure 1 is a side view of the indicating and control mechanism and its stand partly in elevation and partly in section, with the circuit breaker closed ready for operation when current is turned on.

Figure 2 is a plan view of the parts below the section line 2—2 of Figure 1, the parts being in the same position as Figure 1;

Figure 3 is an enlarged vertical section of the clutch connection in the drive shaft;

Figure 4 is an enlarged view partly in vertical section of the circuit breaking or cut-out mechanism with the circuit breaker in closed position;

Figure 5 is an enlarged side view of the end of the arm which operates the circuit breaker carrying its pivoted cam;

Figure 6 is a side view of the circuit breaker mechanism and adjacent cooperating parts when the circuit breaker has been brought to open position; and

Figure 7 is a side diagrammatic view showing the operative connection between the automatic control mechanism and a rolling mill and its moving mechanism.

It is well known in the art that in operating rolling mills and similar devices it is often necessary to move or change the adjustment relatively to each other of the rolls, guides and other parts, and that the source of power for the purpose is usually an electric motor. Referring first to Figure 7 showing the operative relation and connection between the indicating and controlling mechanism and the thing that is to be controlled by it, 10 is an ordinary rolling mill having a lower fixed roll and an upper vertically adjustable roll 11. The adjustable roll 11 is moved up or down, varying the distance between it and the lower roll, by well known screw mechanism 12 driven by the electric motor 13, the drive connection consisting in the shaft 14 having gear connection 15 with the motor and gear connection 16 with the screw mechanism 12. The shaft 14 also has gear connection for driving the laterally extending shaft 17 which is operatively connected at its other end to a part of the control mechanism 18 mounted on a suitable separate support. The switch 19 for making the electrical connection for operating the motor is preferably located near the control mechanism and the circuit passes through parts of said control mechanism as hereinafter described, and is there provided with an automatic make and break mechanism.

The indicating and controlling mechanism is mounted on a suitable stand 20, Fig. 1, which has below its upper end a shelf 21 from which the main operating parts are supported and at its top has an arm 22 extending out over the shelf and having near its end a vertical bearing bracket 23 for a vertical downwardly extending driving spindle 24. The shaft 17 which is driven by the roll moving mechanism as shown in Fig. 7 is mounted in a bearing bracket 25 secured in place on stand 20, and has an extension, making worm gear connection with spindle 24 in the housing 26 mounted on the end of

arm 22, whereby the spindle will be driven by the shaft. Mounted on the shelf 21 there is an externally screw threaded supporting member 27 which is axially in line with spindle 24 and extends upwardly to a predetermined point below the end of said spindle, and which has a lateral flange 28 at its base, through which it is rigidly secured to shelf 21 by bolts. This screw threaded member has a cylindrical socket 29 extending centrally down therein from the top to a point near the bottom. A drive spindle 30 fits in socket 29 at its lower end and is adapted to turn therein and extends at its upper end to a point slightly below the lower end of spindle 24, and has secured in fixed position a clutch member 31 having upwardly projecting engaging teeth. A vertically movable clutch member 32 is keyed to the lower end of spindle 24 against relative rotation by the key 33 fitting in a vertical groove and has at its lower end downwardly extending teeth matching those on member 31. The clutch member 32 is held in its upper inoperative position by the spring pressed hand operated locking bolt 34 passing radially through it and entering a socket 35 in spindle 24 (see Fig. 3). It will be understood that when the bolt is in the socket, clutch member 32 will be held in its upper position out of engagement with member 31, but when the bolt is pulled against the tension of its spring out of the socket the clutch member 32 will move down by gravity into engagement with member 31, thus connecting spindles 24 and 30 to rotate together. Below the clutch member 31 there is an enlarged drum 36 having a central bore so fitting spindle 30 as to permit vertical movement thereon, but held against relative rotary movement by key 37 (see Fig. 2). This drum has a downwardly extending sleeve 38 with an enlarged internally threaded bore fitting and engaging, through the screw threads, the stationary screw threaded member 27, and it also has an upwardly extending sleeve 39 with a bore fitting spindle 30 and its key 37. Rotatively surrounding the flanged base 28 of screw threaded member 27 is a member 40 having an interior circular flange 41 at its lower edge fitting under an external flange of the base, and this member 40 carries the pointer or indicator 42 which extends upwardly close to the outer surface of drum 36 to serve as an indicator in connection with data carried on said drum as will be explained later.

The circuit breaker proper is carried by a switch arm 43 which is mounted on sleeve 38 immediately below the drum 36 in a bearing groove formed by parallel projecting shoulders on said sleeve so as to permit relative turning movement and to cause it to move up and down axially with the drum. In the automatic operation, this switch arm does not however turn with the drum but is brought to the desired relative position angularly or rotatively and is there secured against further rotary movement. For this purpose it has at one end two arms 44 and 45 (Fig. 2) projecting on opposite sides at an angle, each having a bolt hole in its end through either of which the downwardly extending bolt 46 may pass. Below these arms the elevated portion 47 (Fig. 1) on the shelf 21 of the support is provided with parallel T-slots 48, 49 (Fig. 2) and a slotted flat strip 50 is secured to the fixed frame or support through T bolt connection through its slot and the slots 48, 49. The lower end of bolt 46 passes through an opening in the end of strip 50 thus permitting that bolt with arm 43 to move up and down but holding them against rotation. It will be noted that this arrangement gives considerable latitude for adjustment since the connection may be made to either arm.

Rigidly secured to the under side of the switch arm 43 on the opposite end from arms 44 and 45 there is a transversely extending bar 51 (Fig. 2) formed of insulating material and carrying at its ends the downwardly inclined contact brushes 52 and 53 which are out of contact with each other. These brushes are interposed in the electric circuit supplying motor 13, one end of the circuit wire 54 being connected to brush 52 and the other end to brush 53. These brushes make contact at their lower ends with the upper surface of a disk 55 of conducting material when that disk is in its upper position thus completing the circuit, but, as will be explained, when the disk 55 moves downward the brushes cannot follow and the current is broken and the motor disabled. The purpose in thus providing in a sense two breaks or gaps in the circuit is to reduce sparking. The disk 55 is mounted on the lower end of a vertically movable rod 56 but is insulated therefrom by the sleeve 57 and disk 58 of suitable insulating material. The rod 56 has a washer 59 serving as an abutment for sleeve 57 against which it is pressed by the action of nut 60 and its washer, and the rod has an enlarged portion 61 above the flange 59 fitting upwardly in the lower end of a cylindrical vertical socket 62 in the end of arm 43. A reduced section of the rod 56 passes up through the central small opening 63 at the top of the socket and has at its upper end a materially enlarged cylindrical portion 64 having a marginal flange 65 at its top. A coil spring 82 may be placed in socket 62 bearing down on the upper end of the enlarged portion 61 to aid gravity in tending to move rod 56 and the contact disk 55 downward away from the contact brushes 52 and 53. The rod 56 and contact disk 55 are normally held in the upper or closed circuit position by the swinging arm 66 pivoted at

67 to the upper portion of arm 43 at its extreme end and extending upwardly therefrom substantially parallel to rod 56 but provided near its upper end with a lateral projection 68 extending towards the line of rod 56 with a horizontal upper surface catching under the flange 65 of the rod and thus supporting it. It will be noted that the face of the projection 68 is on an incline from its top downwardly so that the flange 65 may in rising to the position shown in Figure 4 automatically turn the arm 66 on its pivot by a wedging action sufficiently to permit the flange to pass to a point above the lug. The arm 66 has an extension 69 below pivot 67 and a coil sping 70 is interposed between that end and a fixed part of arm 43 thus tending to turn arm 66 on its pivot moving its upper end and catch in towards rod 56 (see Fig. 2). It will be noted from what has been said that if the arm 66 is moved outward a sufficient distance to release flange 65 from catch 68, the rod 56 and contact disk 55 will automatically move downward thus breaking the circuit. The means for moving arm 66 outwardly automatically and with proper timing includes what may be called a trip arm or knockout rotary member mounted to turn on sleeve 39 above the drum through a bearing member 71 and to move vertically with the drum. It includes the trip or cam arm 72 for effecting the movement of arm 66 and handle arm 73 for manual movement and setting rigidly connected together and pivoted for vertical turning at 74 to a lug 75 on the bearing member 71. In operation they are supported by and lie immediately across the upper edge of drum 36. The cam arm 72 has pivoted to a projection on its top near its end at 76 a cam 77 which may be turned to upright or inoperative position shown in Figure 5, or to a horizontal position resting on the end ledge 78 with its V-shaped end projecting beyond. This cam arm extends beyond the margin of the drum 36 sufficiently to cause the cam's V-shaped inclined surface when horizontally rotated past arm 66 to engage that portion of release arm 66 which is above supporting lug 68 and move it outwardly a sufficient distance to release supporting flange 65 and break the circuit. In this operation the cam is of course in horizontal position as illustrated in Figure 2. The drum 36 has at its upper outer margin a series of equally spaced radial V-shaped notches 84 and the handle arm 73 has secured to its under surface above said notches an engaging and centering projecting member or tooth 79 which has an engaging edge V-shaped in cross section fitting in one of said notches and supporting the arms. It will be understood that cam arms 72 and 73 may be turned upward by hand on pivot 74 carrying the tooth 79 out of the notch and permitting those arms to be turned on sleeve 39 as an axis into any adjusted position, but that so long as it rests by gravity with the teeth engaging a notch it will be turned by drum 36. The cam arm 72 has a part projecting downwardly over the margin of the drum for some distance with a hook 80 at its end adapted to engage the under surface of flange 65 and lift it and rod 56 as the arm is turned upward by hand on pivot 74. Of course this does not happen except when rod 56 is in lowered position and the cam arm and the hook are in position at and in line with the rod, as would be the case when the cam by moving arm 66 effected the breaking of the circuit and stopping of the apparatus.

As heretofore stated, the drum 36 carries on its surface certain characters and markings which constitute data which enables the operator to set the device to indicate and automatically bring about the desired operation, and their nature will be best understood by first considering the movements of the parts in operation. When the clutch mechanism 31, 32, is in engagement and the motor is operating to turn the shaft to move the roll, the drum 36 will turn simultaneously and at a peripheral speed having a definite ratio to the movement of the roll determined by the nature of the gear connection. Vertical lines 81 are placed on the surface of the drum spaced apart the right distance to indicate the peripheral movement of the drum which will take place in the particular apparatus on a definite and known movement of the roll, and the data relating to that is placed on the spiral line 83 at the vertical lines. Any desired unit of measurement may be adopted to give sufficiently fine adjustment in fixing the movement and the data may proceed progressively from a fixed starting point at the bottom around the drum on the spiral line several times. The line for the data is made spiral so that it will be followed in successive adjustments and operations by the pointed end of the indicator 42 during the downward movement of the drum 36 due to its turning in screw threaded engagement with the fixed member 27, and the inclination of the spiral is made to correspond with that down movement. It will be noted that the indicator 42 does not move up and down or rotatively with drum 36 but maintains a fixed position until reset. The vertical and rotary movement of the drum is what makes its point follow the spiral line.

In using the device the operator will set the parts in such position or relation that the data on the drum indicating the known and desired position of the roll will be at the point where the device if operating would break the circuit and prevent movement, and this can be easily done because the

parts may be rotated by hand when the clutch is disconnected. During the passage of the article being treated through the rolls the operator sets the pointer 42 by turning it on its base to indicate on the drum the desired position of the roll for the next pass and lifts the cam and handle arms 72 and 73 on the pivot 74 and turns them on sleeve 39 until the tooth 79 on the bottom of arm 73 is directly over the slot in drum 36 corresponding to the vertical line indicated by the pointer 42 and then lowers the arm rotatively engaging it with the drum by the tooth and slot. It will be noted that there is a slot for each vertical line and that each line leads to the central vertical plane of the slot. The clutch member 32 is then released by pulling outward locking pin 34 and it automatically completes the driving connection by interlocking with clutch member 31. When the passage of the articles through the rolls is completed and it is desired to bring the rolls into position for the next pass, current is turned on to motor 13 through switch 19 and the change of position of the roll and the rotary movement of the drum take place. The drum moves in a direction which carries the cam arm around until at the finish of the indicated movement its cam strikes the upper end of arm 66 moving it outward and releasing rod 56 and breaking the electrical connection and stopping the movement of the parts with the rolls ready for the next operation. The switch 19 is then turned to make another break in the circuit before resetting the mechanism for the next change in the position of the rolls. To then bring the rolls still closer together for another pass it is merely necessary to place the indicator 42 at the desired mark and lift the cam arm on its pivot 74 and move it circumferentially until the tooth 79 enters the indicated slot. During the up movement the hook 80 engages flange 65 and carries it up over the automatic catch 68 which serves to hold rod 56 and disk 55 in position to complete the circuit through brushes 52 and 53 and disk 55.

When the articles being treated have been subjected to the number of reducing passes desired and it is desired to return the movable roll to its original position and the action of the motor is reversed for that purpose, the automatic indicating and controlling means may also be returned to original position through the action of the motor. To this end the cam 77 is turned up into its inoperative position shown in Fig. 5 where it will not strike arm 66 in passing, and the clutch being engaged and the automatic current breaker closed, the drum 36 and parts movable with it will through the equal total reverse movement return to original position. While pointer 42 and the engaging tooth 79 on the hand operating arm 73 are not in the same vertical radial plane as the circuit breaking cam 77 or arm 72 but are angularly removed therefrom, this fact is taken into consideration in applying the data to the drum.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism near said controlling members, and a tripping device movable along said controlling member adapted for detachable connection therewith at any point, which tripping device when connected to and moving with said member past said switch will cause said switch to automatically break the circuit and stop the mechanism.

2. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism near said controlling member, a tripping device movable along said controlling member adapted for detachable connection therewith at any point, which tripping device when connected to and moving with said member past said switch will cause said switch to automatically break the circuit and stop the mechanism, and a pointed indicator freely movable along said controlling member adapted to be set by reference to the data thereon at the point thereon which will cause said tripping device to operate the switch after a predetermined movement.

3. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data

arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism near said controlling member, and a tripping device movable along said controlling member adapted for detachable connection therewith at any point, which tripping device when connected to and moving with said member past said switch will cause said switch to automatically break the circuit and stop the mechanism, said tripping member having a part which will in tripping position engage a part of the switch mechanism and move the switch to closed position when said tripping mechanism is so moved as to disconnect it from the controlling member.

4. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with a rotary drum adapted to be so connected to said mechanism as to be driven thereby and move simultaneously therewith in fixed relation having thereon successive data indicating corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives said mechanism, adjustable means adapted to be carried by said drum at any selected point around its periphery determined from said data to automatically cause the operation of said switch and the breaking of the circuit on the predetermined movement of the drum.

5. The combination with a machine having a part movable to different adjusted positions within limits for different operations, means for moving it including an electric motor, a controlling mechanism for fixing and limiting the amount of movement imparted by the moving means when set in operation including a mechanical drive connection with the moving means, a make and break contact switch in the circuit of said motor, a rotary trip arm driven through said drive connection adapted at one point of its rotation to cause the opening of said switch to break the circuit and stop the motor, means for manually releasing said trip arm from its driving means and moving it to a predetermined angular position with reference to the point where it causes the break and there re-engaging it with the driving means whereby the circuit will be automatically broken and the movement of the part stopped on the movement of said arm through said predetermined angle.

6. The combination with a machine having a part movable to different adjusted positions within limits for different operations, means for moving it including an electric motor, a controlling mechanism for fixing and limiting the amount of movement imparted by the moving means when set in operation including a mechanical drive connection with the moving means, a make and break contact switch in the circuit of said motor, a rotary trip arm driven through said drive connection adapted at one point of its rotation to cause the opening of said switch to break the circuit and stop the motor, means for manually releasing said trip arm from its driving means and moving it to a predetermined angular position with reference to the point where it causes the break and there re-engaging it with the driving means whereby the circuit will be automatically broken and the movement of the part stopped on the movement of the said arm through said predetermined angle, data on the driving means adjacent said trip arm for indicating the amount of movement which will be given said movable part during the movement of said trip arm from any selected point of re-engagement to the point where it causes the break in the circuit.

7. The combination with a machine having a part movable to different adjusted positions within limits for different operations, means for moving it including an electric motor, a controlling mechanism for fixing and limiting the amount of movement imparted by the moving means when set in operation including a mechanical drive connection with the moving means, a make and break contact switch in the circuit of said motor, a rotary drum driven by said connection having vertical lines thereon successively marked to indicate what movement will be given said movable part during the movement of any selected number of lines on and with the drum past a fixed point, a rotary trip arm with the same center of rotation as the drum adapted to be rotatively moved freely to a desired position in reference to the drum chosen from the data on the drum and there operatively connected to the drive means through the drum so as to rotate with the drum, and a control arm for the switch in the path of the said trip arm whereby it will be struck and operated by said switch arm in its rotary movement to cause the breaking of the switch contact and the stopping of the motor.

8. In a device of the class described the combination with a machine having a part movable and adjustable within limits to different positions for successive operations of the machine, electrically operated means for moving said part independently of the means for operating or running the properly adjusted machine, and controlling means driven by said moving means and including adjustable setting and indicating mechanism for automatically breaking the electric circuit which supplies the power operated means at a predetermined limit of

movement of said part indicated by said setting means, the said indicating and controlling means comprising a drum having indicating data thereon and connected to concentrically rotate with a shaft having releasable clutch connection to said drive means for adjustment, a make and break switch for the motor current adjacent said drum, adjustable control means for said switch extending up beyond the margin of the drum held when adjusted against rotation, and a trip arm rotatively mounted concentric with and with reference to but above said drum extending out beyond the margin of the drum and hinged for manual elevation but in operative position adapted to rest by gravity on the top portion of said drum, the meeting surfaces under the influence of gravity being such as to cause it to rotate with the drum, and its outer portion being so shaped and positioned that it will trip said control mechanism for the switch when it is reached in the rotation and break the circuit thus stopping the motor.

9. In a device of the class described the combination with a machine having a part movable and adjustable within limits to different positions for successive operations of the machine, electrically operated means for moving said part independently of the means for operating or running the properly adjusted machine, and controlling means driven by said moving means and including adjustable setting and indicating mechanism for automatically breaking the electric current which supplies the power operated means at a predetermined limit of movement of said part indicated by said setting means, the said indicating and controlling means comprising a drum having indicating data thereon and connected to concentrically rotate with a shaft having releasable clutch connection to said drive means for adjustment, a make and break switch for the motor current adjacent said drum, adjustable control means for said switch extending up beyond the margin of the drum held when adjusted against rotation, and a trip arm rotatively mounted concentric with and with reference to but above said drum extending out beyond the margin of the drum and hinged for manual elevation but in operative position adapted to rest by gravity on the top portion of said drum, the meeting surfaces under the influence of gravity being such as to cause it to rotate with the drum and its outer portion being so shaped and positioned that it will trip said control mechanism for the switch when it is reached in the rotation and break the circuit thus stopping the motor, and having a projecting part which will on lifting said arm from the drum for resetting, reset the switch and close the gap in the current.

10. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism, a movable tripping device adapted in one position of movement to cause the operation of the switch to break the circuit, means for freely moving said tripping device to any selected distance in its path of movement from its position when operating the switch fixed by the indications on said controlling member and releasable means for there bringing it into such connection with the drive means as to cause it to move to position to operate the switch simultaneously with a corresponding movement of the indicating member.

11. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism, a movable tripping device adapted in one position of movement to cause the operation of the switch to break the circuit, means for freely moving said tripping device to any selected distance in its path of movement from its position when operating the switch fixed by the indicators on said controlling member and releasable means for there bringing it into such connection with the drive means as to cause it to move to position to operate the switch simultaneously with a corresponding movement of the indicating member, an adjustable indicator disconnected from the moving means for pointing to the selected point on said indicating member determining the limit of the desired movement and the setting of the tripping device.

12. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data

arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism, means for adjusting the relation of said switch mechanism and indicating mechanism, and adjustable means adapted to be set by the data on said indicating member to automatically cause the operation of the switch and the breaking of the circuit on a predetermined movement of said controlling member.

13. In a device of the class described for controlling the operation of an electrically driven mechanism the combination of a rotary spindle driven by said mechanism, a second spindle in line with said first spindle and having releasable clutch connection therewith, a drum having indicating data thereon and a symmetrically arranged series of radial grooves around the top splined to said second spindle to rotate therewith but movable longitudinally thereof, a stationary support for said drum having screw threaded engagement therewith causing longitudinal movement on rotation, a switch arm pivoted for turning concentric with but below said drum and connected therewith to move longitudinally of the spindle together carrying spaced contact elements connected in series in the circuit which supplies the current for the operating mechanism, a movable contact member engaged by said contact elements to close the circuit, means tending to move said member out of contact with said elements and a movable switch controlling part extending upwardly beyond the margin of the drum adapted in one position to hold said member in contact with said elements but to release it when moved to another position, means for rotatively adjusting said switch arm in reference to said drum and for securing it when in adjusted position against further rotation, while permitting longitudinal movement with the drum, a trip arm extending outwardly over and adapted to rest on the top of said drum rotatable on an axis concentric with that of the drum, but having a pivot connection between its ends permitting lifting the outer end out of contact with the drum and having a projection or tooth on its lower surface so shaped as to enter for rotary engagement any one of the radial grooves in the top of the drum, and having a projecting part or cam portion adapted at one point of its rotation to strike and move said switch controlling part to release position thus causing a break in the electric power circuit.

14. In a device of the class described for controlling the operation of an electrically driven mechanism the combination of a rotary spindle driven by said mechanism, a second spindle in line with said first spindle and having releasable clutch connection therewith, a drum having indicating data thereon and a symmetrically arranged series of radial grooves around the top splined to said second spindle to rotate therewith but movable longitudinally thereof, a stationary support for said drum having screw threaded engagement therewith causing longitudinal movement on rotation, a switch arm pivoted for turning concentric with but below said drum and connected therewith to move longitudinally of the spindle together carrying spaced contact elements connected in series in the circuit which supplies the current for the operating mechanism, a movable contact member engaged by said contact elements to close the circuit, means tending to move said member out of contact with said elements and a movable switch controlling part extending upwardly beyond the margin of the drum adapted in one position to hold said member in contact with said elements but to release it when moved to another position, means for rotatively adjusting said switch arm in reference to said drum and for securing it when in adjusted position against further rotation, while permitting longitudinal movement with the drum, a trip arm extending outwardly over and concentric with that of the drum, but having a pivot connection between its ends permitting lifting the outer end out of contact with the drum and having a projection or tooth on its lower surface so shaped as to enter for rotary engagement any one of the radial grooves in the top of the drum, and having a projecting part or cam portion adapted at one point of its rotation to strike and move said switch controlling part to release position thus causing a break in the electric power circuit, and an indicator freely rotatable on an axis concentric with the drum to adjusted position, but otherwise immovable with its pointed upper end closely adjacent the surface of the drum, the successive data on the drum being on a spiral line at such incline that it will maintain a uniform relation to the end of the pointer on successive revolutions of the drum.

15. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with a rotary drum adapted to be so connected to said mechanism as to be driven thereby and move simultaneously therewith in fixed relation having thereon successive data indicating corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives said mechanism, adjustable means adapted to be carried by said drum at any selected point around its periphery determined from said

data to automatically cause the operation of said switch and the breaking of the circuit on the predetermined movement of the drum, and a pointed indicator separately movable around said drum to indicate the point on said drum at which the means for operating the switch should be carried.

16. In a device of the class described for controlling the operation of an electrically driven mechanism, the combination of a rotary spindle driven by said mechanism, a second spindle in line with said first spindle and having releasable clutch connection therewith, a drum having indicating data thereon splined to said second spindle to rotate therewith but movable longitudinally thereof, a stationary support for said drum having screw threaded engagement therewith causing longitudinal movement on rotation, a switch arm pivoted for turning concentric with but independently of said drum and so connected therewith to move longitudinally of the spindle together carrying at its outer end near the outer surface of said drum, a make and break switch in the circuit which supplies the current for the operating mechanism, a trip arm extending outwardly over said drum rotatable on an axis concentric with that of the drum, but independently thereof, its outer end portion being movable vertically into and out of contact with the top of the drum, the contacting surfaces being adapted to interengage for rotation together, the said trip arm being adapted at one point of its rotation to strike and move said switch controlling part to release position thus causing a break in the electric power circuit.

17. In a device of the class described for controlling the operation of an electrically driven mechanism, the combination of a rotary spindle driven by said mechanism, a second spindle in line with said first spindle and having releasable clutch connection therewith, a drum having indicating data thereon splined to said second spindle to rotate therewith but movable longitudinally thereof, a stationary support for said drum having screw threaded engagement therewith causing longitudinal movement on rotation, a switch arm pivoted for turning concentric with but independently of said drum and so connected therewith to move longitudinally of the spindle together carrying at its outer end near the outer surfaces of said drum, a make and break switch in the circuit which supplies the current for the operating mechanism, a trip arm extending outwardly over said drum rotatable on an axis concentric with that of the drum, but independently thereof, its outer end portion being movable vertically into and out of contact with the top of the drum, the contacting surfaces being adapted to interengage for rotation together, the said trip arm being adapted at one point of its rotation to strike and move said switch controlling part to release position thus causing a break in the electric power circuit, and an indicator freely rotatable on a fixed support concentric with the drum with a pointed end closely adajcent the outer surface of the drum pointing to data thereon.

18. In a device of the class described for controlling and indicating the successive operative movements of an electrically driven mechanism, the combination with an indicating and controlling member adapted to be so connected to said mechanism as to be driven thereby and move therewith in a fixed relation having thereon successive data arranged on a line which during movement passes a fixed point and indicating the corresponding movement of said mechanism, an automatic switch for making and breaking the circuit which drives the mechanism near the path of movement of said controlling member, comprising spaced contact elements connected in series in the circuit which supplies the current for the operating mechanism, a movable contact member engaged by said contact elements to close the circuit, means tending to move said member out of contact with said elements and a movable switch controlling part extending upwardly by the controlling member adapted in one position to hold said member in contact with said elements but to release it when moved to another position, and an adjustable trip carried by said controlling member at a predetermined position adapted at one point of its movement with said member to strike and move said switch controlling part to release position thus causing a break in the electric power circuit.

In testimony whereof I hereunto affix my signature.

PAUL AUGUST SCHULZ.