C. M. GREY.

INDICATING AND ADJUSTING MECHANISM.

APPLICATION FILED SEPT. 4, 1908.

997,619. Patented July 11, 1911.

4 SHEETS-SHEET 1.

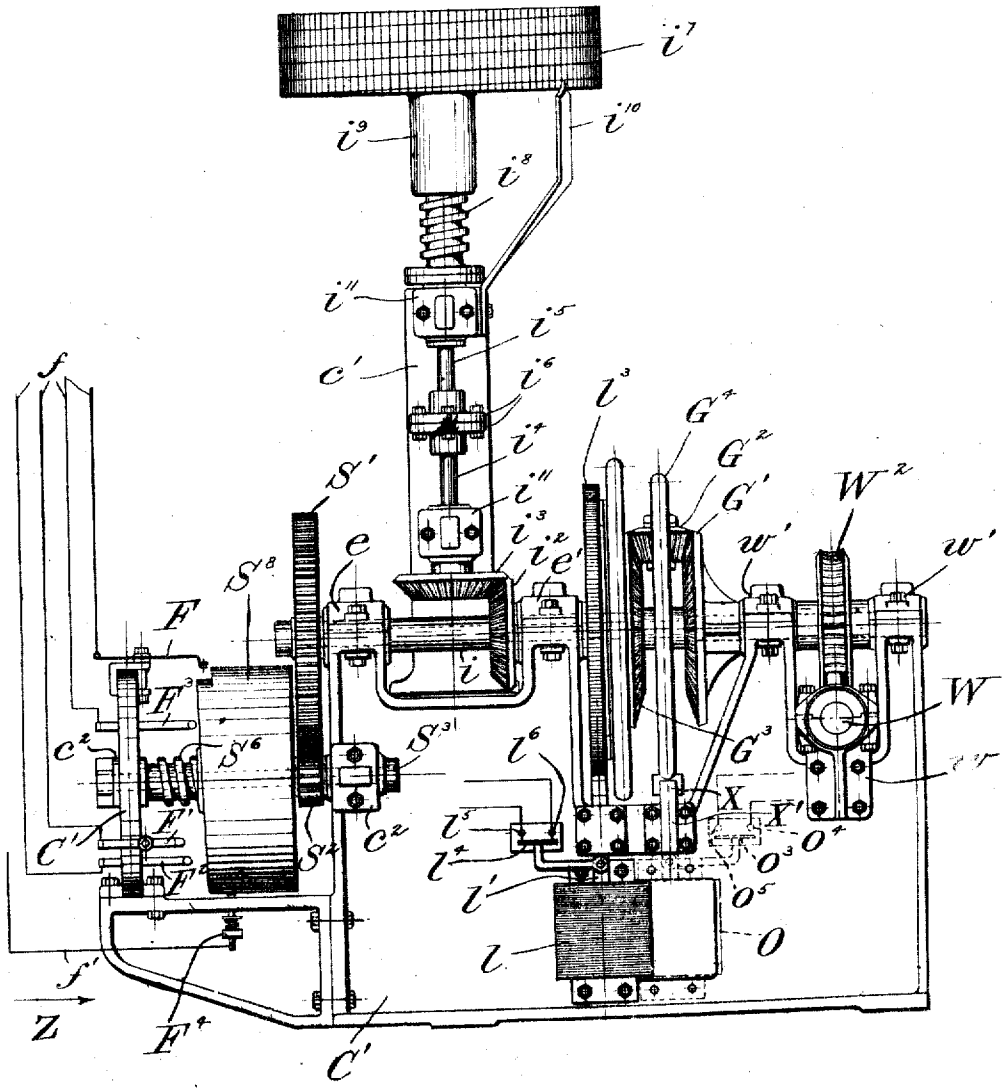

Fig. 1.

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4 SHEETS—SHEET 2.

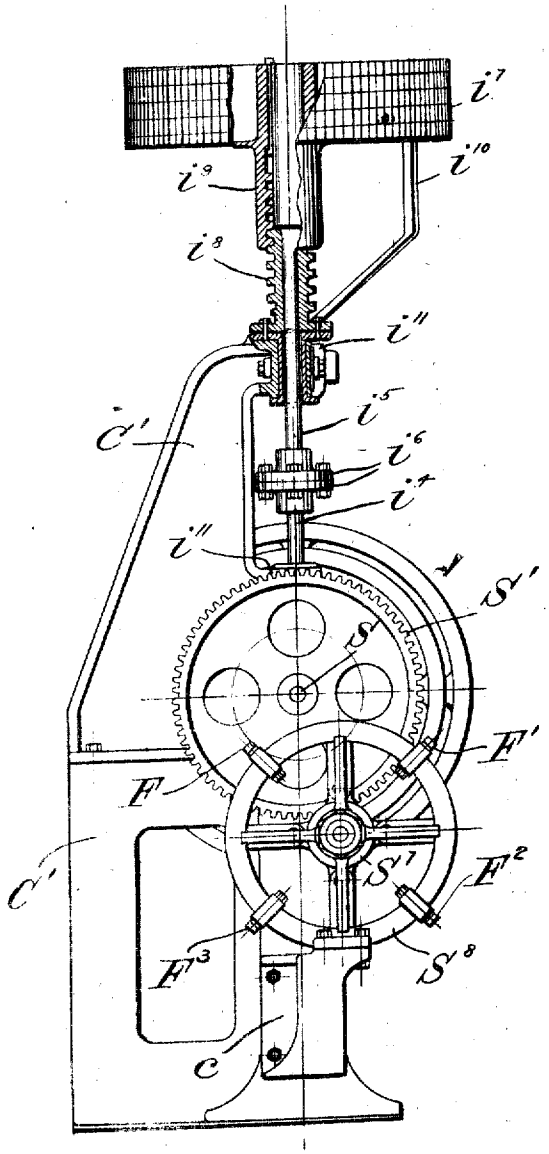

Fig. 2.

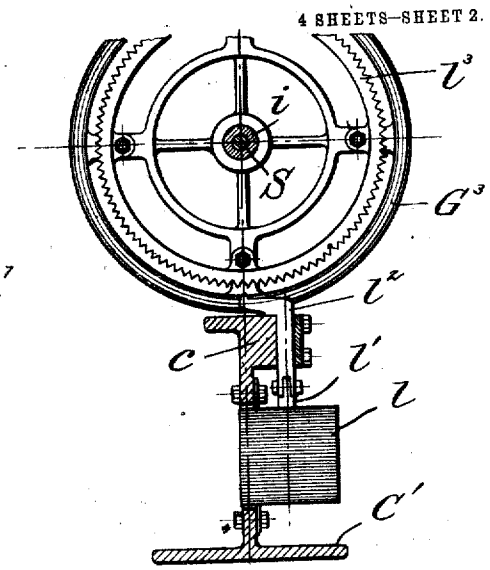

Fig. 3.

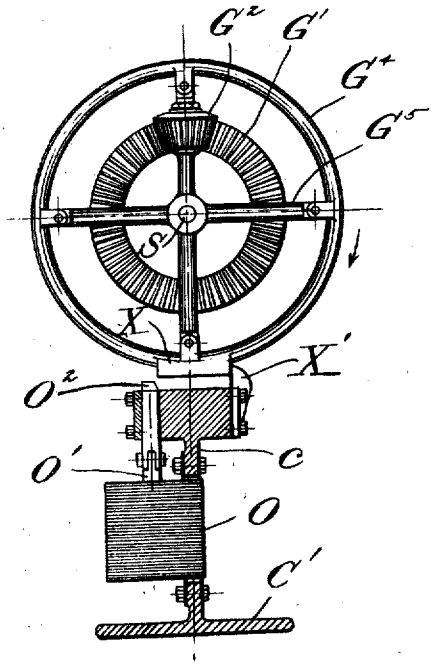

Fig. 4.

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4 SHEETS—SHEET 3.

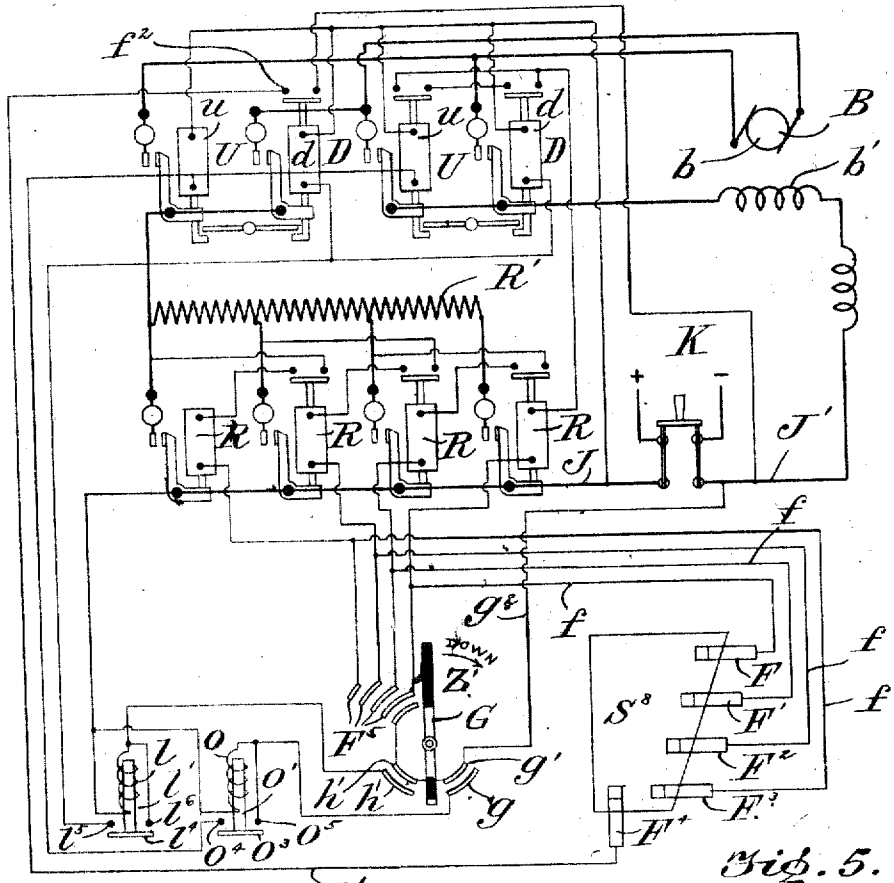

Fig. 5.

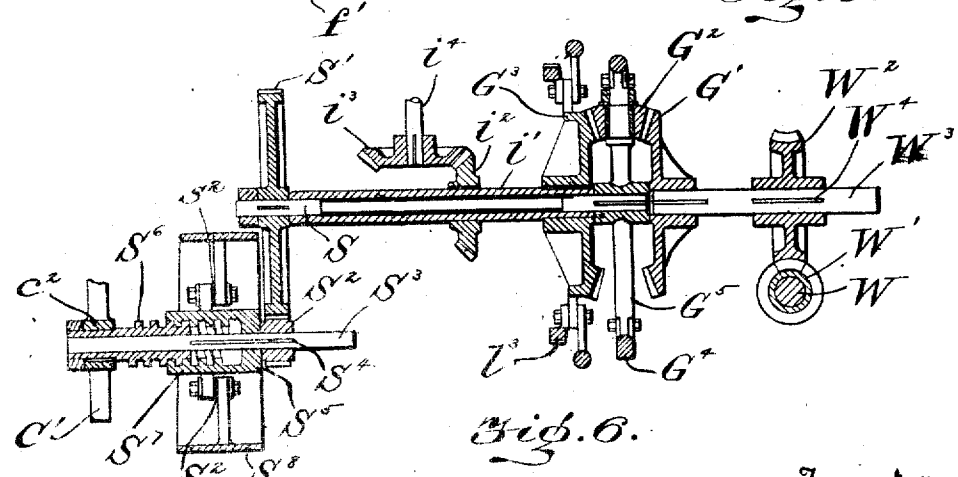

Fig. 6.

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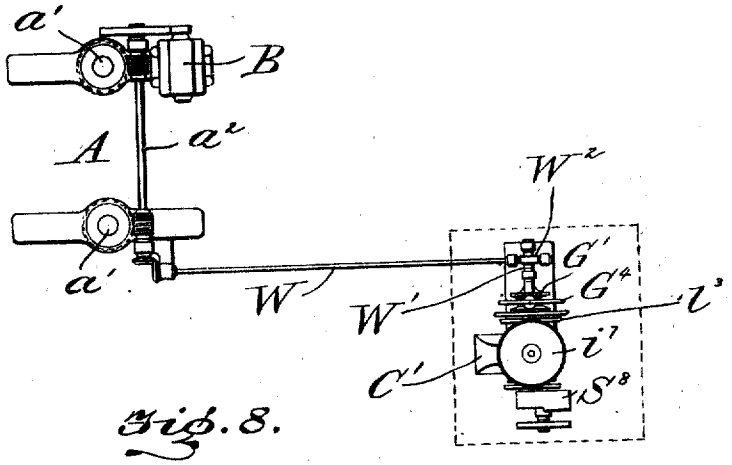

Fig. 8.

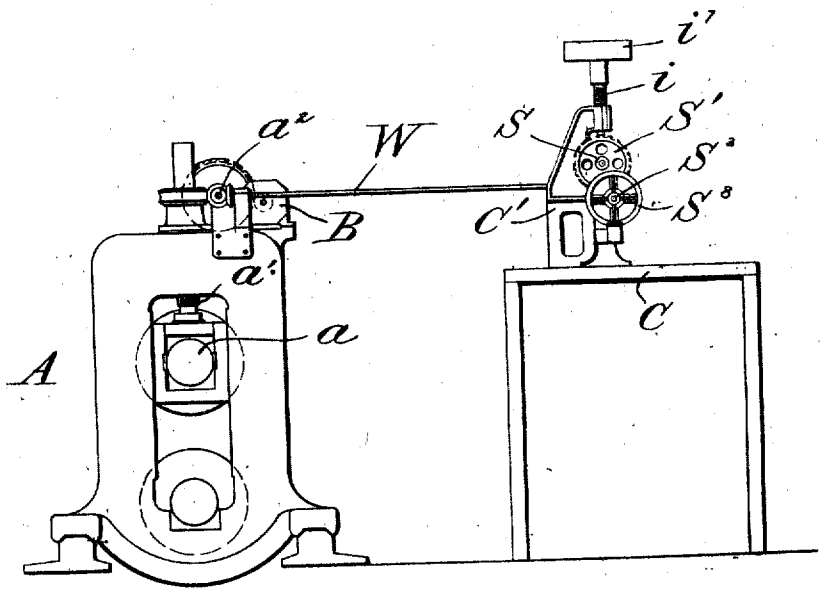

Fig. 7.

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INDICATING AND ADJUSTING MECHANISM.

997,619. Specification of Letters Patent. Patented July 11, 1911.

Application filed September 4, 1909. Serial No. 451,724.

To all whom it may concern:

Be it known that I, CHARLES M. GREY, a citizen of the United States, residing in East Orange, county of Essex, and State of New Jersey, have invented a certain new and useful Indicating and Adjusting Mechanism, of which the following is a specification.

This invention is an indicating and adjusting mechanism adapted for use in different arts for the purpose of controlling the adjustment of working members and for visually indicating such adjustment of said members.

The invention will be hereinafter described in connection with a rolling mill for reducing the thicknesses of metal bars, beams, or other metal products, for which purpose the new mechanism is especially adapted, but it is to be distinctly understood that my invention is not confined to this especial application, for the reason that said mechanism may be used to advantage in other arts.

In its broad aspect, the invention embodies an indicating mechanism, a member adapted to be operated at will for setting the indicating mechanism in either of a number of positions for determining the adjustment of the machine to be operated, and means operated by the movement of the aforesaid member for automatically controlling the operation of the machine, such automatic operation of the machine taking place subsequent to, and in accordance with, the adjustment of the indicator as determined by the manipulation of the aforesaid member.

More specifically stated, the invention embodies an adjusting and indicating mechanism for a rolling mill wherein a roll adjusting mechanism is operated by an electric motor. Said motor is started automatically each time a metal bar, beam, or the like clears one pass, so that the rolls are adjusted automatically to the required degree prior to the next passage of the bar, beam, etc., and said adjustment of the roll is, in like manner, automatically arrested when the rolls, or any one of them, reaches the position determined by the adjustment of the indicator devices.

My invention enables one operator to control one or a number of rolling mills for the purpose of adjusting each mill so as to regulate the pass between the rolls of each mill each time a piece passes between said rolls.

The adjustment of the mechanism may be, and preferably is, performed by the operator while a metal piece is passing through and between the rolls of the mill, whereas the actual adjustment of the roll or rolls is performed by mechanism, preferably automatic, subsequent to the passage of the metal piece between said rolls, whereby a substantial saving in time and labor is attained, besides securing an accurate adjustment of the rolls relative to each other in each mill, one operator being enabled to attend to a number of rolling mills.

Furthermore, my invention makes provision for the successive adjustments of the roll or rolls of the mill to secure a gradual and progressive reduction in the width of the pass between said rolls, thus meeting the demands which arise in the practical rolling of a bar, beam, or other metal piece.

Furthermore, the invention embodies means operated by power and under the easy quick control of the attendant, for raising one roll of a mill relative to the other, in order to separate said rolls after the piece shall have passed for the last time between the rolls, thus placing the mill in condition to begin operations on a fresh metal piece.

An important practical advantage which is secured by my indicating device is that the operator is able to determine, by a glance at the indicator mechanism, the exact position of the rolls in the mill, irrespective of the number of times said rolls may have been adjusted, thus enabling the operator to determine quickly and accurately the next adjustment which should be given to the rolls of a particular mill.

Another advantage from a practical standpoint which is secured by the indicating mechanism is that the operator is able to set the indicating mechanism by an effaceable indicating mark so as to compensate for the "drift" or lost motion of the parts which operate the roll adjusting mechanism, thus enabling the operator to determine with exactitude the adjustment which should be given to the rolls to secure passes of the widths required in securing the progressive reduction of the metal piece.

In the accompanying drawings I have

illustrated one practical embodiment of the invention, but the construction shown therein is to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is an elevation looking at the front of an indicating and adjusting mechanism constructed in accordance with my invention and adapted for use in connection with a metal rolling mill. Fig. 2 is an end elevation looking at the indicating and adjusting mechanism in the direction of the arrow in Fig. 1. Fig. 3 is a vertical cross section, partly in elevation, showing electrically operated means for locking one member of a train of bevel gears. Fig. 4 is a vertical cross section illustrating means for arresting at a predetermined point the adjustment of a member which is operated at will, said view showing, also, means for locking said member, operated at will, against rotation in either direction. Fig. 5 is a diagram illustrating the wiring of an electric circuit and a portion of the means for controlling said circuit automatically. Fig. 6 is a view taken longitudinally through the mechanism of Fig. 1 showing the various rear devices and the automatically operated circuit controller. Fig. 7 is an end view showing my indicating and adjusting mechanism in coöperative relation to a metal rolling mill, and Fig. 8 is a plan of the parts shown in Fig. 7.

In Figs. 7 and 8 of the drawings I have shown an ordinary rolling mill, A, the roll, a, of which is in coöperative relation to screw operated adjusting mechanism, a'. Two screws are shown in Fig. 8 as being connected by a cross shaft, a^2, for the purpose of simultaneously operating said screw operated adjusting mechanism. The power for driving said adjusting mechanism is furnished, in the present instance by an electric motor, B, shown in Fig. 8, the armature, b, and the field coil, b', of said motor being shown diagrammatically in Fig. 5.

The rolling mill, A, is connected operatively with the indicating and adjusting mechanism through the agency of a shaft, W, which is geared to the cross shaft, a^2, as shown in Figs. 7 and 8, and on one end portion of said intermediate or connecting shaft, W, is provided a worm, W'. This worm meshes directly with a worm gear, W^2, which is keyed at W^4 to a shaft, W^3, the latter forming one of the shafts of the indicating and adjusting mechanism, which mechanism is mounted on a suitable table or support, C.

The several working parts of the indicating and adjusting mechanism are carried or supported by a main frame, C', shown in Figs. 1 and 2 of the drawings. This main frame is equipped with appropriate bearings, w, for supporting one end portion of the shaft, W, and with other bearings, w', in which is journaled the shaft, W^3. Said frame is provided, also, with shaft bearings, e, e', adapted to support a tubular shaft, i', and a shaft, S, the last mentioned shaft, S, being disposed in alinement with the shaft, W^3. The shaft, S, extends through, and is concentric with, the tubular shaft, i', and at one end said shaft, S, is next to an end portion of the shaft, W^3, see Fig. 6.

Shaft, S, carries a hand-operated member, G^5, and shafts, W^3 and i, are provided with bevel gears, G', G^3, respectively, said member, G^5, having a bevel pinion, G^2, which, with gears, G', G^3, comprise a train of bevel gears, which train of gears may, for convenience, be designated as an epicyclic train. Gear, G', is keyed or otherwise fastened rigidly to shaft, W^3, whereas gear, G^3, is keyed or otherwise rigidly fastened to hollow shaft, i'. Member, G^5, is a spider positioned intermediate gears, G', G^3, the hub of said spider being keyed or otherwise rigidly fastened to that end portion of shaft, S, which is adjacent to shaft, W^3.

Spider or operating member, G^5, is provided with an external rim, G^4, the latter being fastened rigidly to the arms of the spider, as shown in Fig. 4, whereby rim, G^4, may easily be grasped by hand for the purpose of turning the spider manually to any position desired in order to set the indicating mechanism and the stopping device or controller which makes and breaks the motor controlling circuit. Spider, G^5, carries the beveled gear pinion, G^2, the latter being mounted loosely on said spider for rotation freely thereon, and this gear pinion, G^2, meshes directly with the teeth of gears, G', G^3, carried respectively by shafts, W^3, and i', whereby pinion, G^2, operatively connects the large gears, G', G^3, of the epicyclic train.

The spider, G^5, of the member, G^4, which is operated at will is provided with a stop lug, X, shown in Fig. 4 as extending beyond the periphery of hand wheel, G^4, and in the normal position of the spider and its member, G^4, said stop lug, X, is in engagement with a stop, X', the latter being secured to a fixed part, c, of frame, C', whereby the coacting parts, X, X', limit the rotation in one direction of spider, G^5 and member, G^4. Under certain conditions spider, G^5, and its member, G^4, are adapted to be locked against rotation in either direction by the before-described parts, X, X', and by the adjustment of an electrically operated locking dog, O^2. Said dog is shown in Fig. 4 as being adapted for sliding movement in fixed part, c, of frame, C', and said dog is connected pivotally with the plunger, O', of a solenoid, O, the coil of said solenoid being included in an electric circuit. The solenoid plunger, O', is shown as having a head, O^3, which on the

upward movement of the plunger is adapted to close the circuit through contacts, O^4, O^5, shown in Figs. 1 and 5, for a purpose which will hereinafter appear.

Bevel gear, G^3, forming one member of the epicyclic train is provided with a toothed rim, l^3, said rim being concentric with the gear and fastened rigidly thereto by any appropriate mechanical devices, substantially as shown in Figs. 1, 3 and 6. With this toothed rim, l^3, is adapted to coöperate the toothed end of a locking dog, l^2, the latter being slidably mounted in part, c, of frame, C', as shown in Fig. 3. Said locking dog is connected pivotally with plunger, l', of a solenoid, l, the coil of which is included in an electric circuit shown in Fig. 5 and hereinafter described.

The visual indicator employed in my new mechanism embodies in its construction a rotating and sliding drum, i^7, the surface of which is inscribed to indicate the units of measurement. As shown in Figs. 1 and 2, drum, i^7, is provided with a spiral indicating line intersected by perpendicular indicating lines, the whole furnishing a compact scale adapted to afford a large number of units of measurement. This indicating drum is provided with a hub, i^9, which is formed interiorly with a female screw thread adapted to work on a fixed screw, i^8, the latter being mounted in a stationary position on the head portion of an upright frame member, c', whereby the indicating drum is supported on frame, C', by means which are adapted to secure the rotating and longitudinally sliding movement of said drum. Coöperating with the scale on drum, i^7, is an indicator or pointer, i^{10}, herein shown as an arm fixed rigidly to frame member, c', and terminating in an index point which is adjacent to the inscribed face of scale on drum, i^7.

Screw, i^8, is hollow and through it passes one member, i^5, of the indicator operating shaft, said shaft being mounted in vertically alined bearings, i^{11}, which are provided on upright frame member, c'. The indicator operating shaft consists of two lengths, i^4, i^5, which are connected rigidly by a separable coupling, i^6, whereby the part, i^5, of said shaft may be disconnected temporarily from part, i^4, in order to adjust the drum, i^7, as may be required. The upper part, i^5, of indicator shaft extends loosely through fixed screw, i^8, and it has a sliding connection with drum, i^7, such as by means of a feather shown in Fig. 2, and the rotation of this shaft imparts rotary movement to drum, i^7, while the operation of screw, i^8, and hub, i^9, of said drum gives the sliding travel to said drum.

The indicator operating shaft is provided at its lower part with a bevel gear, i^3, which meshes directly with a bevel gear, i^2, the latter being mounted directly on hollow shaft, i', whereby shafts, i', and i^4, i^5, are geared directly together for the operation of the indicator drum.

The rotation of shaft, S, operates a controller for the electric circuit whereby current is admitted in regulated quantities to the electric motor, B, for the operation of the roll adjusting mechanism of mill, A. To shaft, S, is rigidly secured a gear, S', having meshing engagement with gear pinion, S^2, on a shaft, S^3, the latter being mounted in appropriate bearings, c^2, of frame, C'. A hollow screw, S^6, is fixed rigidly to one bearing, c^2, of said frame and it loosely incases a part of shaft, S^3, said hollow screw extending from bearing, c^2, inwardly toward pinion, S^2, on said shaft, S^3. Shaft, S^3, is provided with a longitudinal feather, S^4, and this feather engages slidably with nut, S^7, the latter being shown in the form of a sleeve which has threaded engagement with the fixed screw, S^6. Said nut, S^7, is shown in Fig. 6 as a sleeve open at one end to receive screw, S^6, and closed at its other end by a head, S^5, said nut being rotated by reason of its feathered connection, S^4, with the shaft, S^3, and the screw connection of nut, S^7, with screw, S^6, imparts the sliding movement to said nut when it is rotated by the action of shaft, S^3. Said nut is connected rigidly to a drum, S^8, forming the main element of the circuit controller, but said nut is insulated electrically from said drum, S^8, by any suitable form of insulation indicated at S^2, whereby the nut and the drum are mechanically connected for rotation as a unit, but they are electrically insulated from each other.

The rotation of spider, G^5, by hand acts through the epicyclic train to rotate the indicator shaft, i^4, i^5, for the purpose of setting the indicator drum, i^7, to the required position, and simultaneously with this operation of setting the indicator drum, said spider, G^5, rotates shaft, S, and gears, S', S^2, for the purpose of turning shaft, S^3, thus imparting movement to nut, S^7, which, by its engagement with fixed screw, S^6, operates to impart rotary and sliding motion to drum, S^8, thereby setting the movable member, S^8, of the circuit controller to a position which will determine the current to be admitted to electric motor, B, for the operation of the roll adjusting mechanism associated with rolling mill, A.

Coöperating with drum, S^8, of the circuit controller is a plurality of contacts, F, F', F^2, F^3, which are connected separately by conductors, f, with the coils, r, of a plurality of resistance switches, R. Another contact, F^4, is in electrical engagement with rotary and sliding drum, S^8, said contact, F^4, remaining normally in engagement with said drum, S^8, during its rotary and sliding motion whereas contacts, F, F',

F^2, F^3, are adapted to be disengaged successively from the drum as it slides in one direction under the influence of screw, S^6, acting on nut, S^7, of the drum. Contact, F^4, is connected by conductor, f', to a terminal, f^2, adjacent to one of the automatic switches, D, which open and close the circuit through motor field, b'.

Each resistance switch, R, is controlled electrically, and they are connected in parallel in a circuit which is normally open. The switches, R, are so related to the bank of resistances, R', and to the rotary and sliding drum of the controller that the current adapted to flow to the motor will be controlled by the number of switches which are in or out of use.

The rotation of drum, S^8, in one direction brings contacts, F, F', F^2, F^3, into electrical engagement with said drum successively, the number of contacts so engaged with drum, S^8, depending upon the degree of endwise travel given to said drum by nut, S^7, and this being dependent, furthermore, upon the adjustment given by hand to the spider, G^5. Contacts, F to F^3, control the amount of resistance, R', which is included in the circuit, through which resistance the current is required to flow prior to its admission to motor, B, and provision is thus made for automatically regulating the admission of current to the motor so as to gradually start the same until it reaches full capacity, as well as regulating the reduction of the current by gradually shutting it off from the motor when stopping it, as will hereinafter appear.

In conjunction with the automatic means for varying the resistance in the motor circuit, the mechanism is equipped with a hand operated member, shown in Fig. 5 as a switch lever, G, adapted to occupy a neutral or idle position between contacts, g, g', and h, h'. Contacts g', h', are electrically connected with each other, the contact, g', being branched at g^2 onto one lead, J', of the two mains, J, J', while contact, g, is in series with the coil of solenoid, O. Contact h, is in series with coil of solenoid, l, and contact, h', is connected with one contact of a group of contacts, F^5, the latter being branched individually onto conductors, f, leading to the coils of resistance switches, R.

A main switch, K, controls the admission of current to motor circuit, J, J', one lead or main, J', of which includes the motor field, two of the motor switches, D, U, and the motor armature, while the other main, J, includes resistance switches, R, bank of resistances, R', and the two remaining motor switches, D, U.

Switches, D, are connected in parallel and included in the motor circuit when switch lever, G, is shifted in the direction "down" indicated by the arrow, Z', in Fig. 5, so as to bridge contacts, h, h', thus energizing solenoid, l, and the solenoids, d, of switches, D, for closing the circuit through motor field, whereby the motor is started and driven in one direction. The other switches, U, are connected in parallel and are adapted to be included in the motor circuit when switch lever, G, is shifted in the opposite or "up" direction, thereby energizing solenoid, O, and the solenoids, u, of switches, U, the operation of said switches reversing the flow of current through armature of the motor so as to drive the latter in the opposite direction and thereby actuate the roll adjusting mechanism of mill, A, for separating the rolls and increasing the width of the pass or passes between said rolls.

The magnetic controller system shown in Fig. 5 is similar in its general features to other systems now in use for the same general purposes, except that I have added thereto the automatic circuit controller. It is not considered necessary, therefore, to enter into a detailed description of the motor circuits, the several switches, resistances and other parts shown in said Fig. 5.

The operation of the apparatus is as follows: Assuming that the rolls of a metal rolling mill, A, are opened or separated to receive an ingot or slab on the first pass, that main switch, K, is closed, switch lever, G, is in a neutral or idle position, and drum, S^8, is free from contacts, F to F^3. As the metal piece on its first pass goes through the mill, the operator rotates hand wheel, G^4, and turns spider, G^5, in the direction of arrow in Fig. 4, and to the extent required to set drum, i^7, to the position for indicating the adjustment of mill rolls for the second pass, said indicator drum being operated to travel in a downward direction for a predetermined distance through the gearing between hollow shaft, i', and indicator shaft, i^4, i^5. As spider, G^5, is turned by hand in a direction to move stop lug, X, away from stop, X', gear pinion, G^2, rotates on its axis for the reason that it is in mesh with gear, G', the latter being temporarily locked from rotation by the worm gear, W^2, of shaft, W^3, being in gear with worm, W', on shaft, W, hence the rotation of gear pinion, G^2, as it moves with spider, G^5, operates to rotate gear, G^3, and hollow shaft, i', whereby the latter shaft imparts rotary motion to indicator shaft, i^4, i^5, for adjusting indicator drum, as previously stated. It should be noted that the graduations on the indicator drum denote a unit of travel of the roll in mill, A; preferably, the units of travel or adjustment are in hundredths (1/100) of an inch, but they may be any other standard of measurement, say one-sixteenth (1/16) of an inch.

Simultaneously with the adjustment of

indicator drum, i', to denote the adjustment of the mechanism for setting the mill rolls at the second pass, spider, G^5, and member, G^4, operate to set the drum, S^8, of the circuit controller to a position for closing the motor circuit so that motor, B, will operate the roll adjusting mechanism automatically in order that the rolls will be caused to approach each other to the distance required for the second pass immediately following the exit from the mill of the piece undergoing the first rolling operation. The described operation of setting the drum of said circuit controller is performed by the before described operation of turning spider, G^5, and member, G^4, and it is due to the rotation of shaft, S, to which spider, G^5, is keyed. Said shaft turns gears, S', S^2, shaft, S^3, and nut, S^7, whereupon screw, S^6, coöperates with shaft, S^3, in giving gliding and rotary motion to drum, S^8. Said drum is thus brought into engagement with one or more contacts, F, F', F^2, F^3, the number so engaged depending upon the endwise movement of drum, S^8, and determined in the first instance by the angular adjustment of spider, G^5, and member, G^4. The engagement of fingers, F, or F, F', or F, F', F^2, or F, F', F^2, F^3, with drum, S^8, completes the circuit with a corresponding number of resistance switches, R, so as to close the circuit through a predetermined bank of resistances, R', and regulate the current adapted to flow to motor, B, when motor switches, D, are closed.

The adjustment of indicator drum, i', and rotary controller drum, S^8, are, or may be, made while a piece is moving through the first pass of mill, A, and when said piece clears the mill, the operator may, at any time subsequent thereto or immediately thereafter, move switch lever, G, in the direction of arrow, Z', in Fig. 5 to the "down" position, thus bridging contacts, h, h', so that the current flows through solenoid, l, and through solenoids, d, of motor switches, D, whereupon current is admitted to motor, B, for operating the roll adjusting mechanism of mill, A, for moving one or more of the rolls to the position required for the second pass. As the current energizes solenoid, l, core, l', is drawn upward and dog, l^2, engages with toothed rim, l^3, on gear, G^3, thereby locking gear, G^3, shaft, i', and indicator mechanism from movement. The upward movement of core, l', not only locks gear, G^3, and the indicator mechanism, but motor switches, D, are cut into the working circuit by part, l^4, of core, l', closing the circuit through contacts, l^5, l^6.

The rotation of gear, G^2, having caused drum, S^8, to complete the circuit of one or more resistance switches, R, engaging with one or more contacts, F, F', F^2, F^3, and the solenoid, l, having closed the circuit through motor switches, D, and switch lever, G, having been shifted to the required position, it follows that the full strength of the current capable of passing through the resistance then in the circuit is admitted to the motor. Now, when motor, B, operates the roll adjusting mechanism for moving the roll or rolls to the second pass, shaft, W, is rotated by shaft, a^2, and worm, W', imparts rotary motion to worm gear, W^2, shaft, W^3, and gear, G'. The rotation of said gear imparts rotary motion to gear pinion, G^2, and as the teeth of this gear pinion, G^2, are in mesh with the teeth of gear, G^3, the latter being held in a locked position by dog, l^2, controlled by solenoid, l, it follows that gear pinion, G^2, must rotate on its axis and at the same time travel around on the face of locked gear, G^3. This movement of gear pinion, G^2, around the gear, G^3, operates to impart rotary motion to spider, G^5, causing the latter to rotate on its axis and to impart motion to shaft, S, which shaft operates gears, S', S^2, and shaft, S^3, so as to cause drum, S^8, to rotate, whereby the drum is moved endwise in a backward direction and returned to normal position. The return movement of said drum, S^8, causes the disengagement of one or more of the contacts which were brought previously, by the forward travel of the drum, into electrical contact therewith, and as the drum is withdrawn from the successive contacts, the resistance switches, R, are rendered inactive successively and the switch levers, r', drop out one after the other, thereby gradually cutting the bank of resistances, R', into the motor circuit and gradually slowing down the speed of the motor until the last contact, F', is released from drum, S^8, at which time the motor is stopped. When this end is attained, stop shoulder, X, of hand operated member, G^5, is brought into engagement with stop, X', but should there result a slight "drift" or "coasting" action of the roll adjusting mechanism, or lost motion of other parts, the stop, l^2, will be forced downward somewhat against the magnetic pull of solenoid, l, for the reason that the coacting angles of the teeth in the locking wheel, l^3, and the face of the stop, l^2, are so shaped and proportioned as to permit said drift or coasting motion to the mechanism without resulting in injury to the coöperating parts. At this time all the operating parts are returned to normal position, switch lever, G, having been shifted back to its neutral position, and while the piece is being rolled in the second pass of mill, A, member, G^4, and spider, G^5, may be again operated to set the mechanism for adjusting mill, A, to the third pass so that by the manipulation of switch lever, G, at the proper time, mill, A, may be again adjusted so as to result in the production of the third pass, these

operations being repeated an indefinite number of times, and at each time the desired automatic operation of motor, B, and adjustment of indicator mechanism will be secured. Now, when the piece shall have been rolled in the last pass of mill, A, or at any time in the operation of the mill, it may become necessary to separate the rolls so as to return mill, A, to the condition of the first pass in order to manipulate a fresh ingot. The return of mill, A, to the first pass is effected by the power of motor, B, controlled through the instrumentalities embodied in the system of Fig. 5. Switch lever, G, is shifted in the opposite direction, or to the "up" position, by moving it to a position where it bridges contacts, g, g', whereupon current flows through solenoid, O, for the purpose of lifting core, O'. This results in dog, O^2, being moved into the path of stop shoulder, X, and the head, O^5, of the core makes the contacts, O^4, O^6. Dog, O^2, coöperates with stop, X', to lock X between them and thereby hold member, G^4, and spider, G^5, from movement in either direction, and core, O'; by engaging with said contacts, O^4, O^6, completes the circuit through motor switches, U, whereupon said switches are operated to complete the circuit through the motor armature in the opposite direction to that completed by switches, D. The operation of shifting switch lever, G, to the left brought it into engagement with one or more contacts of the group, F, which are connected with the coils of resistance switches, R, and thus the coils of the resistance switches, R, will be energized one after the other, whereby the motor will operate the roll adjusting mechanism to separate the rolls of mill, A. The rotation of shaft, a^2, during the return of mill, A, to the condition of the first pass, drives shaft, W, which actuates worm, W', worm gear, W^2, and shaft, W^3, so as to rotate gear, G', and this gear will in turn operate to rotate gear pinion, G^2, on its axis. As spider, G^5, is locked by dog, O^2, and stop, X', whereas gear, G^3, is free to rotate, being free from engagement with dog, l^2, it follows that the rotation of gear pinion, G^2, by the action of shaft, W^3, will cause gear, G^3, to rotate on its axis, whereupon hollow shaft, i', will turn and drive indicator shaft, i^4, i^5, so that indicator drum, i^7, will travel upward on screw, i^8. The indicator drum is returned automatically to normal position at the same time that the roll operating mechanism is in action to restore mill, A, to the condition of the first pass, but the return of the mechanisms to normal positions may be arrested at the will of the operator who is able to stop the parts when they reach the desired positions.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent is:

1. In an indicating and adjusting mechanism, the combination of a motor for moving parts to be adjusted, an indicator, a stopping device, an epicyclic train for operating the indicator and the stopping device, consisting of three parts, one of which is connected to the motor, a second to the indicating device and the third to the stopping device, whereby the motor is arrested as the parts to be adjusted are moved relatively to each other, locking means for the indicator, and means for operating the said locking means when the motor is returning the stopping device to an inoperative position.

2. In an indicating and adjusting mechanism, the combination of a motor for moving parts to be adjusted, an indicator, a stopping device, an epicyclic train consisting of three parts for operating said indicator and stopping device, one of which parts is connected to the motor, a second part to the indicating device and the third to the stopping device whereby the motor is stopped as the parts to be adjusted are moved toward each other, locking means for holding the stopping means in an inoperative position, and means for operating said locking means as the parts to be adjusted are moved apart and thereby cause the indicator to be simultaneously adjusted with said parts.

3. In an indicating and adjusting mechanism, the combination of a motor for moving parts to be adjusted, an indicator for showing the relative position of the parts to be adjusted, a stopping device for the motor, an epicyclic train, for operating the indicator and stopping device, consisting of three parts, one of which is connected to the motor, another to the indicating device, and the third to the stopping means, whereby the motor is stopped as the parts to be adjusted are moved toward each other, locking means for the indicator, mechanism for operating the locking means on the indicator as the motor is returning the stopping device to its inoperative position during the adjustment of the parts toward each other, said locking means permitting the motor to operate the indicator after the stopping device has returned to its inoperative position and the momentum of the motor and connecting parts is being overcome, against the action of said locking means.

4. In an indicating and adjusting mechanism, the combination of a motor for moving parts to be adjusted, an indicator and a stopping device operated through the medium of an epicyclic train consisting of three parts, one of which is connected to the motor, another to the indicating device and the third to the stopping device whereby the motor is arrested as the parts to be ad-

justed are moved in one direction, locking means for those parts of the epicyclic train that are connected, respectively, to the indicator and to the stopping device, mechanism for operating the locking means of the stopping device as the parts to be adjusted are moved in one direction, and means for operating the locking means on the indicator as the parts to be adjusted move in the other direction.

5. In a rolling mill, the combination of a pair of rolls adapted to operate on a piece to be rolled, and means, adapted to be set in a position for operation during the rolling of said piece, for securing a predetermined relative adjustment of the axes of said rolls, whereby the passes are changed for a subsequent rolling operation.

6. In a rolling mill, the combination of a pair of rolls adapted to operate on a piece to be rolled, means, adapted to be set in position for operation during the rolling of said piece, for securing a predetermined relative adjustment of the axes of said rolls, whereby the passes are changed for a subsequent rolling operation, and means, operable, in conjunction with the aforesaid means for adjustment, during the first rolling operation and without affecting the rolls, for indicating said adjustment.

7. In a rolling mill, the combination of a pair of rolls, means for adjusting the distance between said rolls for a certain rolling operation, means, operable during said rolling operation, for indicating a predetermined adjustment of said rolls for a subsequent rolling operation, and means operated with the indicating means, which are adapted to stop the adjusting means when the rolls shall have assumed the position indicated, whereby said rolls may be moved to the said predetermined position after the completion of the first rolling operation.

8. In a rolling mill, the combination of a pair of rolls, means operable during the passage of a piece through the rolls for indicating a predetermined adjustment of said rolls, and mechanism for effecting the said predetermined adjustment of the rolls.

9. In a rolling mill, the combination of a pair of rolls, means coöperating with said rolls for adjusting them for a certain rolling operation, and means operable during said rolling operation for indicating a predetermined adjustment of the rolls for a subsequent rolling operation.

10. In a rolling mill, the combination of a pair of rolls, means for adjusting them for a certain rolling operation, and manually controllable means operable during said rolling operation for indicating a predetermined adjustment of the rolls for a subsequent rolling operation.

11. In a rolling mill, the combination of a pair of rolls, means for adjusting them for a certain rolling operation, means, operable during said rolling operation, for indicating a predetermined adjustment of said rolls for a subsequent rolling operation, and means coöperating with said adjusting means and with the indicating means for automatically stopping the adjusting means at the predetermined position shown by the indicating means.

12. In a rolling mill, a pair of rolls, means operable, during the passage of a piece through the rolls for indicating an adjustment of said rolls for a subsequent passage of the piece, a device for effecting said adjustment, and means for controlling the operation of said device, said controlling means being operable conjointly with the indicating means.

13. In a device of the class described, the combination of a motor for moving members to be adjusted, a controller coöperating with said motor adapted to stop the motor when the members reach the desired position, means for indicating the adjustment to be given the members, and means comprising an epicyclic train composed of three elements, the first one of which is constructed and arranged to be driven from the motor, the second connected to the indicating means so that both will move together and permit the indicator to be set, and the third to operate the controller so as to stop the motor at the position indicated, said last mentioned means also comprising a means adapted to lock the third element while the indicating means is being set, and another means adapted to lock the second element while the motor is being operated.

14. In an indicating and adjusting mechanism, means for operating members to be adjusted, a device for controlling the operation of said means, means for indicating the desired adjustment of the members, and means coöperating with said indicating and controlling means, respectively, whereby the indicating means is set to indicate the desired adjustment and the controlling means is placed in readiness for operation.

15. In an indicating and adjusting mechanism, means for operating members to be adjusted, means for indicating such adjustment of the members to be adjusted, and a set of gears having members coöperating with the operating means and the adjusting means, said set of gears including a member operable at will for setting the indicating means and including, also, means for locking the indicating means so as to preclude movement of said indicating means when the means for operating the members to be adjusted are set into a position for a subsequent operation of said members.

16. In an indicating and adjusting mechanism, electrically-operated means for actuating members to be adjusted, a stopping

device for said electrically-operated means, means for indicating the adjustment of said members, and setting mechanism including a member operable at will for setting the indicating mechanism and for moving the stopping device into a position for operating the aforesaid electrically-operated means.

17. In an indicating and adjusting mechanism, power-operated mechanism for moving the members to be adjusted, a controller for said power-operated mechanism, means for indicating the adjustment of said members, and a setting mechanism coöperating with said controller and the indicating mechanism for adjusting the same to predetermined positions.

18. In an indicating and adjusting mechanism, power-operated mechanism for moving the members to be adjusted, a controller for said power-operated mechanism, means for indicating the adjustment of said members, and setting mechanism for said controller and said indicating mechanism, said setting mechanism including a member operable at will for primarily adjusting the indicating means and setting the controller.

19. In an indicating and adjusting mechanism, power-operated mechanism for moving the members to be adjusted, a controller for said power-operated mechanism, means for indicating the adjustment of said members, manually operative devices coöperating with the controller and the indicating means for primarily setting the same to determined positions, and means for locking the indicating mechanism when the controller is adjusted into a position for controlling the subsequent operation of said power-operated mechanism.

20. In an indicating and adjusting mechanism, means for indicating the adjustment of members to be operated, power-operated mechanism for securing a relative movement of the members to be adjusted, a controller for said power-operated mechanism, and setting mechanism including gears connected operatively with said indicating means, the controller, and the power-operated mechanism, said setting mechanism including, also, a rotatable member operable at will for primarily adjusting the indicating means and the controller.

21. In an indicating and adjusting mechanism, means for indicating the adjustment of members to be operated, power-operated mechanism for securing a relative movement of the members to be adjusted, a controller for said power-operated mechanism, setting mechanism including gears connected operatively with the indicating means, the power-operated mechanism, and the controller, said setting mechanism including a rotatable member operable at will for primarily adjusting the indicating means and the controller, and means for locking against rotation that gear which operates the indicating means when the controller is being set to a position for controlling the subsequent operation of the power-operated mechanism.

22. In an indicating and adjusting mechanism, means for indicating the adjustment of members to be operated, power mechanism for securing a relative movement of the members to be adjusted, a controller for the power mechanism, setting mechanism including gears connected operatively with said indicating means and with said controller, said setting mechanism including, also, a rotatable member operable at will for adjusting the indicating means and the controller, and means for locking said rotatable member and the controller against rotation in either direction when the power mechanism acts to restore the members to be adjusted and the indicating means to a predetermined position.

23. In an indicating and adjusting mechanism, power-operated means for operating the members to be adjusted from a first position to a plurality of successive positions, means for indicating each adjustment of said members, a controller for said power-operated means, and setting mechanism including a member operable at will for simultaneously adjusting the indicating means and for setting the controller in a position for controlling the power-operated means, said setting mechanism being operable, also, by the power mechanism to restore the indicating means and the members to be adjusted to a predetermined position.

24. In an indicating and adjusting mechanism, power-operated means for adjusting the members to be adjusted, means for indicating the adjustment of said members, a controller for said power-operated means, setting mechanism including a member operable at will for simultaneously adjusting the indicating means and for setting the controller in a position for operating the power-operated means, and means for locking the indicating mechanism against movement during the operation of restoring the controller to a predetermined position by the power mechanism acting upon the members to be adjusted in moving them to one of a plurality of positions.

25. In an indicating and adjusting mechanism, power-operated means for operating the members to be adjusted, means for indicating the adjustment of said members, a controller for said power-operated means, a train of setting gears coöperating with said indicating means and the controller, said setting gears including a member operable at will for simultaneously adjusting the indicating means and for setting the controller in a position for operating the power-operated means, and means for lock-

ing one of the setting gears and the indicating means from movement during the operation of the power-operated means in moving the members to be adjusted to a predetermined position.

26. In an indicating and adjusting mechanism for rolling mills, power-operated mechanism for adjusting a roll of said mill, a controller for said power-operated mechanism, means for indicating the adjustment of said roll, setting mechanism for adjusting the indicating mechanism and the controller to predetermined position, and means actuated by the roll adjusting mechanism for returning the setting and indicating mechanisms to normal positions.

27. In an indicating and adjusting mechanism for rolling mills, power-operated mechanism for adjusting a roll of said mill, a controller for said power-operated mechanism, means for indicating the adjustment of said roll, setting mechanism for adjusting the indicating mechanism and the controller to predetermined positions, means for locking the indicating means during the adjustment of the roll from one predetermined position to successive predetermined positions, and means actuated by the roll adjusting mechanism for returning the setting and indicating mechanisms to normal positions.

28. In an indicating and adjusting mechanism for rolling mills, power-operated mechanism for adjusting a roll of said mill, a controller for said power-operated mechanism, means for indicating the adjustment of said roll, setting mechanism for the indicating mechanism and the controller, said setting mechanism including a member shiftable at will and adapted to operate the indicating means and the controller while the mill rolls are operating upon a piece passing through the mill, means for locking the indicating means at a time when the power mechanism is acting to adjust the roll to a successive position, and means operated by the roll adjusting mechanism for returning the setting and indicating mechanisms to normal positions.

29. In an indicating and adjusting mechanism for rolling mills, power-operated mechanism for adjusting a roll of said mill to a plurality of successive positions, a controller for said power-operated mechanism, means for indicating the adjustment of said roll, setting mechanism including a member shiftable at will for adjusting the indicating mechanism and the controller, a device for locking the indicating means while the roll is being adjusted to one of a plurality of successive positions, and means operated by the roll adjusting mechanism for returning the setting and indicating mechanisms to normal positions.

30. In an indicating and adjusting mechanism for rolling mills, means for indicating the relative adjustment of members to be adjusted, power mechanism for adjusting said members, a controller for said power mechanism, setting mechanism for the indicating means and said controller, said setting mechanism including a train of gears and a rotatable member, the latter acting to adjust both the indicating means and the controller at a time when the members to be adjusted are occupying one of a plurality of successive positions.

31. In an indicating and adjusting mechanism for rolling mills, means for indicating the relative adjustment of a roll to be adjusted, power mechanism for adjusting said roll, a controller for said power mechanism, a first shaft connected to the indicating means, a second shaft connected to the controller, a rotatable setting member carried directly by the second shaft for operating the controller, a third shaft operated by the roll adjusting mechanism, gears on the first shaft and the third shaft, a gear mounted on said setting member and meshing with the gears on the first and third shafts, and means for locking the first shaft and the indicating means when the roll adjusting mechanism and the third shaft are operated to rotate the second shaft for restoring the controller to a position for cutting off the power mechanism.

32. In an indicating and adjusting mechanism for rolling mills, means for indicating the relative adjustment of a roll to be adjusted, power mechanism for adjusting said roll, a controller for said power mechanism, a plurality of shafts, two of which are connected with the indicating means and the controller respectively, gears on said two shafts, means for locking the gear which operates the indicating means, a setting member carried directly by that shaft which connects with the controller, and a gear mounted on the setting member and meshing with said gears for adjusting the controller by the movement of the roll adjusting mechanism when setting the roll to one of a plurality of positions.

33. In an indicating and adjusting mechanism for rolling mills, power mechanism for adjusting a roll of the mill, an indicator, a controller for said power mechanism, three shafts, one of which is connected with the roll adjusting mechanism and another to the indicator, gears on said shafts which are connected to the indicator and the roll adjusting mechanism, respectively, a rotatable setting member on the third shaft which is connected to the controller, means for locking the setting member from rotation, means for locking the indicator against movement, and a gear mounted on the setting member and meshing with the aforesaid gears connected

respectively to the shafts operating the indicator and operated by the roll adjusting mechanism.

34. In an indicating and adjusting mechanism for rolling mills, power mechanism for adjusting a roll to be adjusted, an indicator, a controller for said roll adjusting mechanism, three shafts, one of which is connected with the indicator and another to the roll adjusting mechanism, gears on said first and second shafts, a rotatable setting member on the third of said shafts and which is connected to the controller, means for arresting the rotation of the setting member, and a gear mounted on the setting member and meshing with the aforesaid gears to restore the indicator to a first position simultaneously with the movement of the roll to a similar position.

35. In an indicating and adjusting mechanism for rolling mills, power mechanism for adjusting a roll to be adjusted, an indicator for showing the position of said roll upon a subsequent adjustment thereof, a controller for said roll adjusting mechanism, three shafts, one of which is connected with the roll adjusting mechanism and a second to the indicator, gears on said first and second shafts, a rotatable setting member on the third of said shafts, which shaft is connected to the controller, means for arresting the rotation of the setting member in one direction, means controllable by the roll adjusting mechanism for locking the setting member from rotation in the other direction, and a gear mounted on the setting member and meshing with said gears on the shafts connected with the roll adjusting mechanism and the indicator, respectively.

36. In an indicating and adjusting mechanism for rolling mills, power mechanism for adjusting a roll to be adjusted, an indicator, a controller for said power mechanism, a rotatable setting member connected to the controller, a gear on said setting member, other gears meshing with the aforesaid gear and connected operatively with the roll adjusting mechanism and with the indicator, respectively, means for locking the indicator-operating gear, and separate means for locking the setting member.

37. In an indicating and adjusting mechanism for rolling mills, power mechanism for adjusting a roll to be adjusted, an indicator, a controller for said power mechanism, a rotatable member for operating the controller, a gear on said rotatable member, means for locking said member, two other gears meshing with said gear on the rotatable member, one of said two gears operating the indicating means and the other of said two gears being connected with the roll adjusting mechanism, means for locking the rotatable member when the indicator and the roll are adjusted to a first position, and means for locking the indicator while the roll is being adjusted to one of a plurality of successive operative positions.

38. In an indicator, a rotatable and slidable indicating drum having a continuous indicating element and other indicating elements which intersect with the continuous element, an index coöperating with said drum, means comprising a shaft slidably connected to said drum for imparting rotary motion to the drum, and means for imparting sliding motion to the drum simultaneously with the rotary motion thereof.

39. In an indicator of the class described, electrically operated means for effecting the adjustment of members relatively to each other, a controller drum, contacts rotatable with said drum, electric circuits having contacts adapted to be engaged with, and disengaged from, the contacts which are rotatable with said drum, and means for imparting sliding and rotary motion to said drum, whereby the circuits are closed or opened by the successive engagement of their contacts with, or disengagement of said contacts from, the contacts of the drum upon the sliding movement thereof.

40. In an indicator of the class described, electrically operated means for effecting the adjustment of members relatively to each other, a sliding and rotating controller drum, a plurality of contacts rotatable and slidable with said drum, electric circuits having contacts adapted to be successively engaged with, and successively disengaged from, the aforesaid contacts, respectively, upon the slidable and rotatable movement of the drum, a shaft connected to said controller drum for imparting rotary movement thereto, a nut secured to the drum for rotation therewith, and a screw coöperating with the nut for imparting sliding movement to said controller drum.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES M. GREY.

Witnesses:
H. I. BERNHARD,
V. E. MARKMANN.