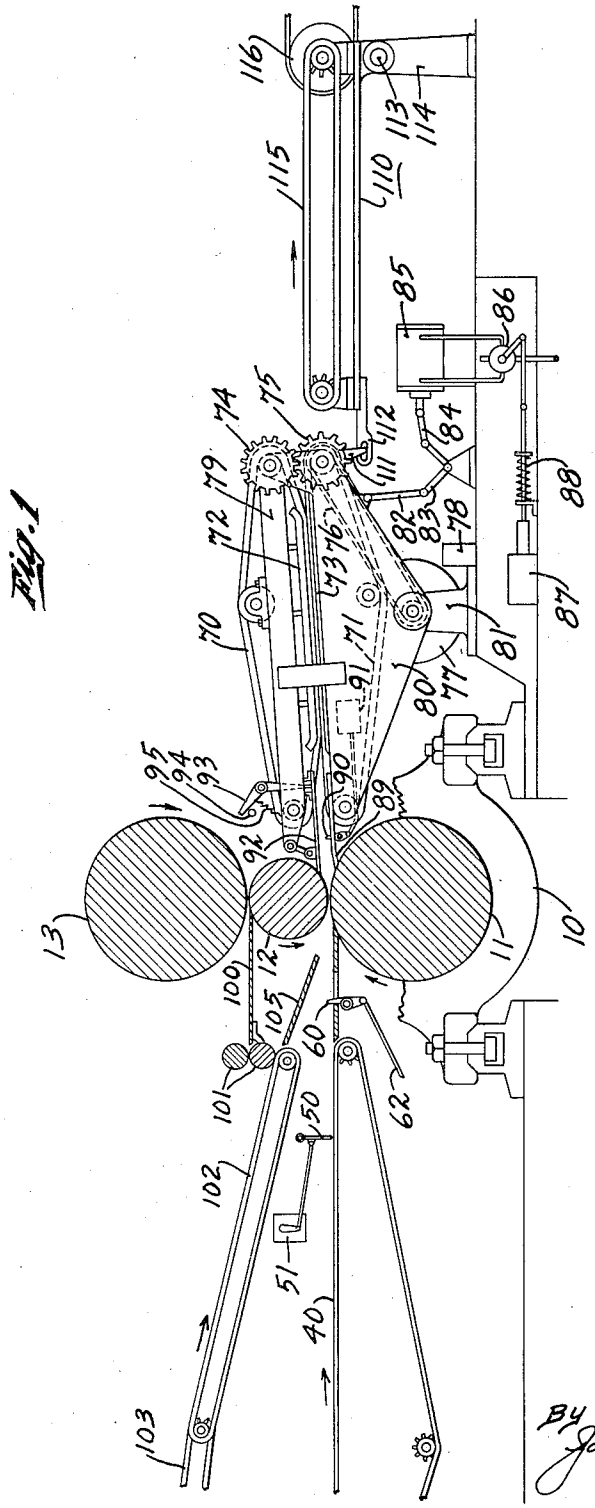
Aug. 6, 1935. A. G. DELANY ET AL 2,010,715

AUTOMATIC SHEET ROLLING MILL

Filed May 4, 1932 6 Sheets-Sheet 1



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AUTOMATIC SHEET ROLLING MILL

Filed May 4, 1932 6 Sheets-Sheet 2

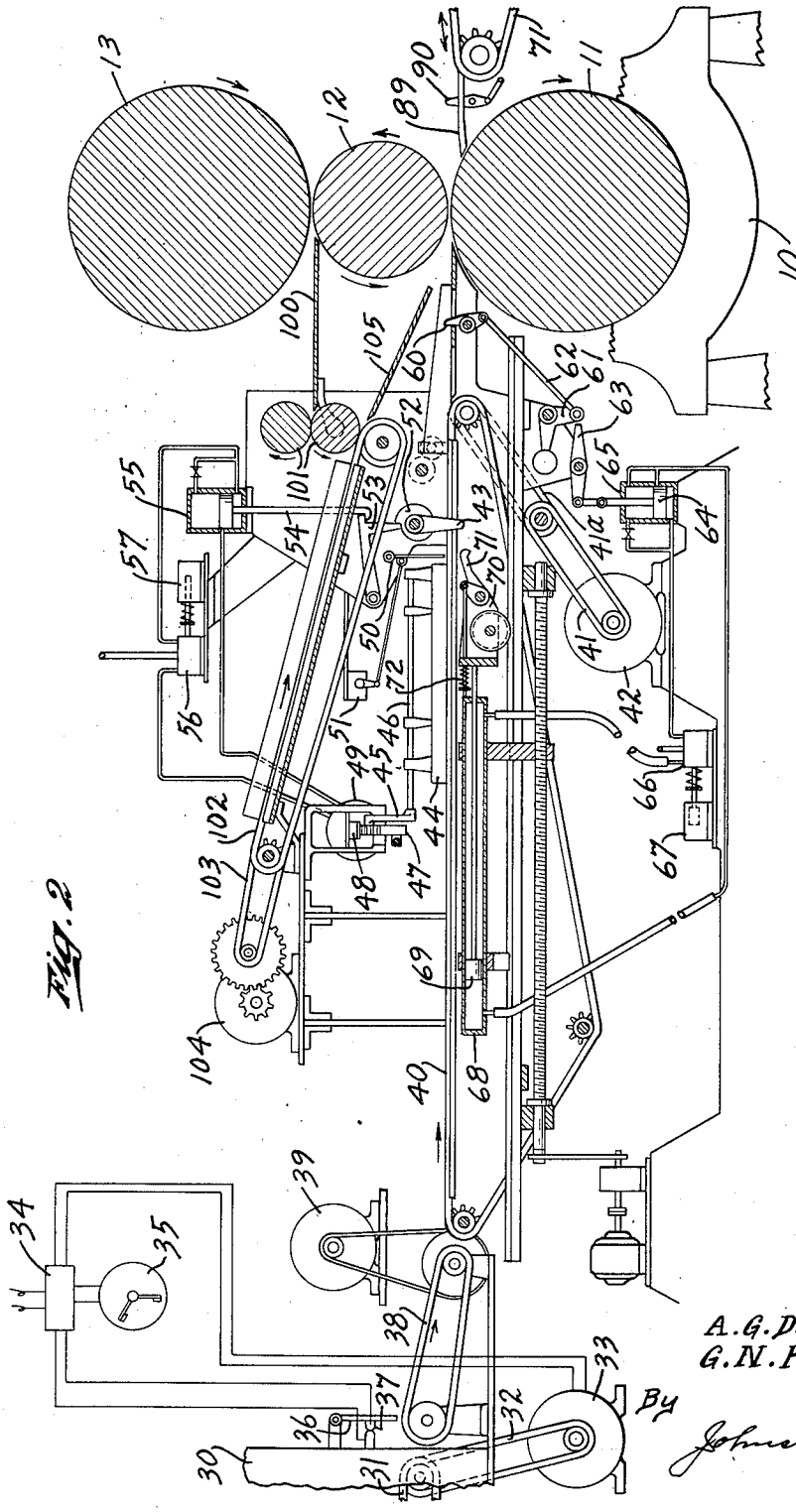


Fig. 2

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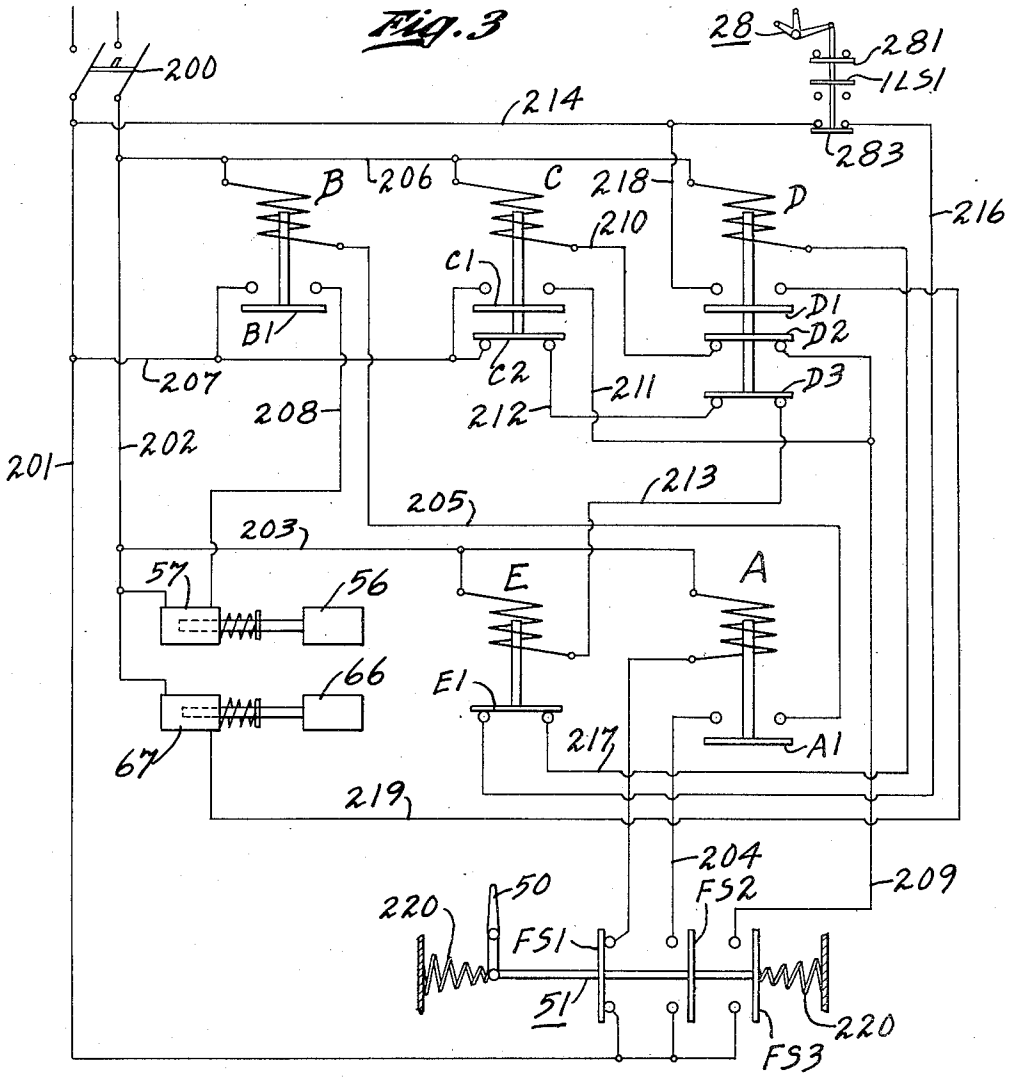
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AUTOMATIC SHEET ROLLING MILL

Filed May 4, 1932 6 Sheets-Sheet 3

Fig. 3



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AUTOMATIC SHEET ROLLING MILL

Filed May 4, 1932 6 Sheets-Sheet 4

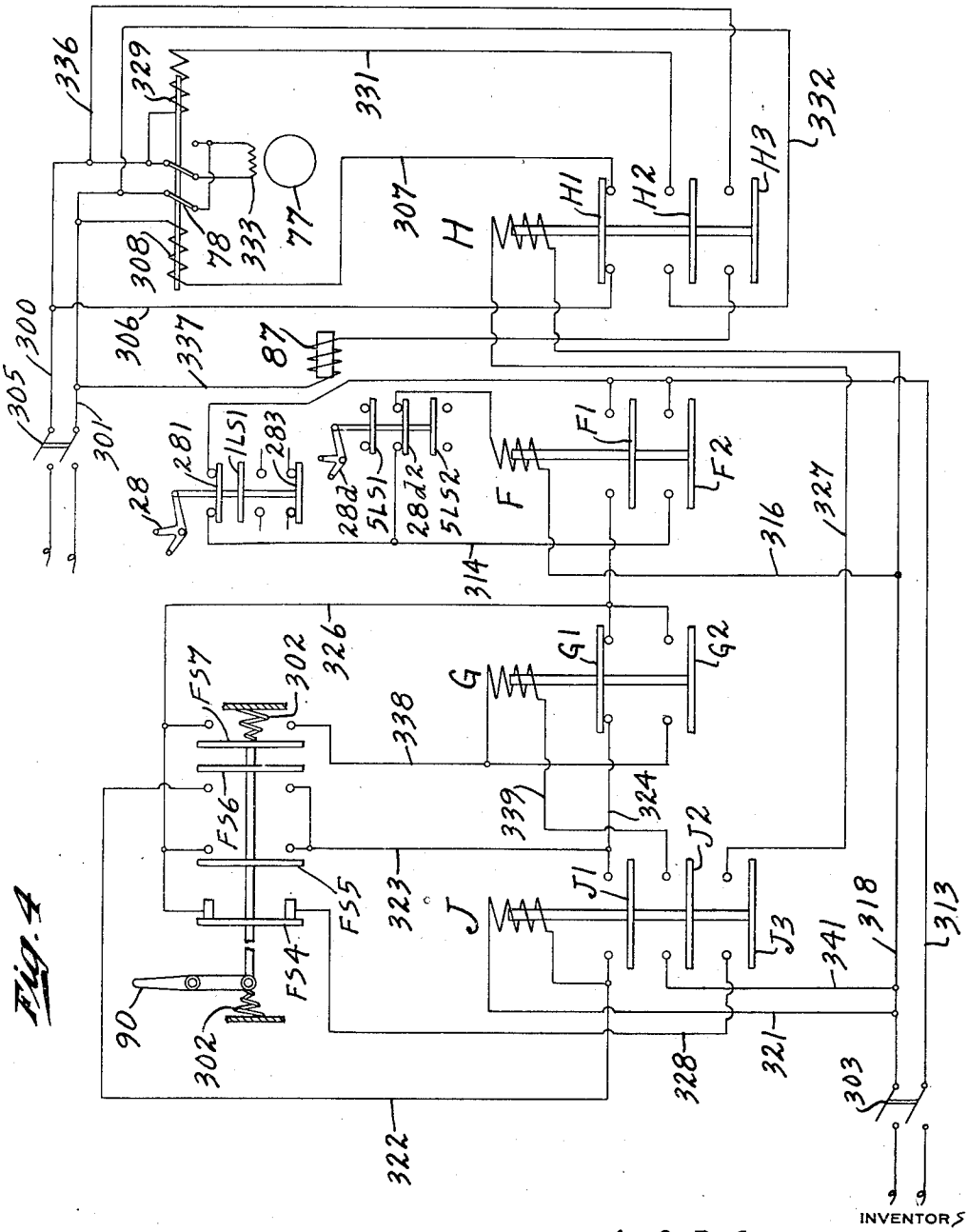


Fig. 4

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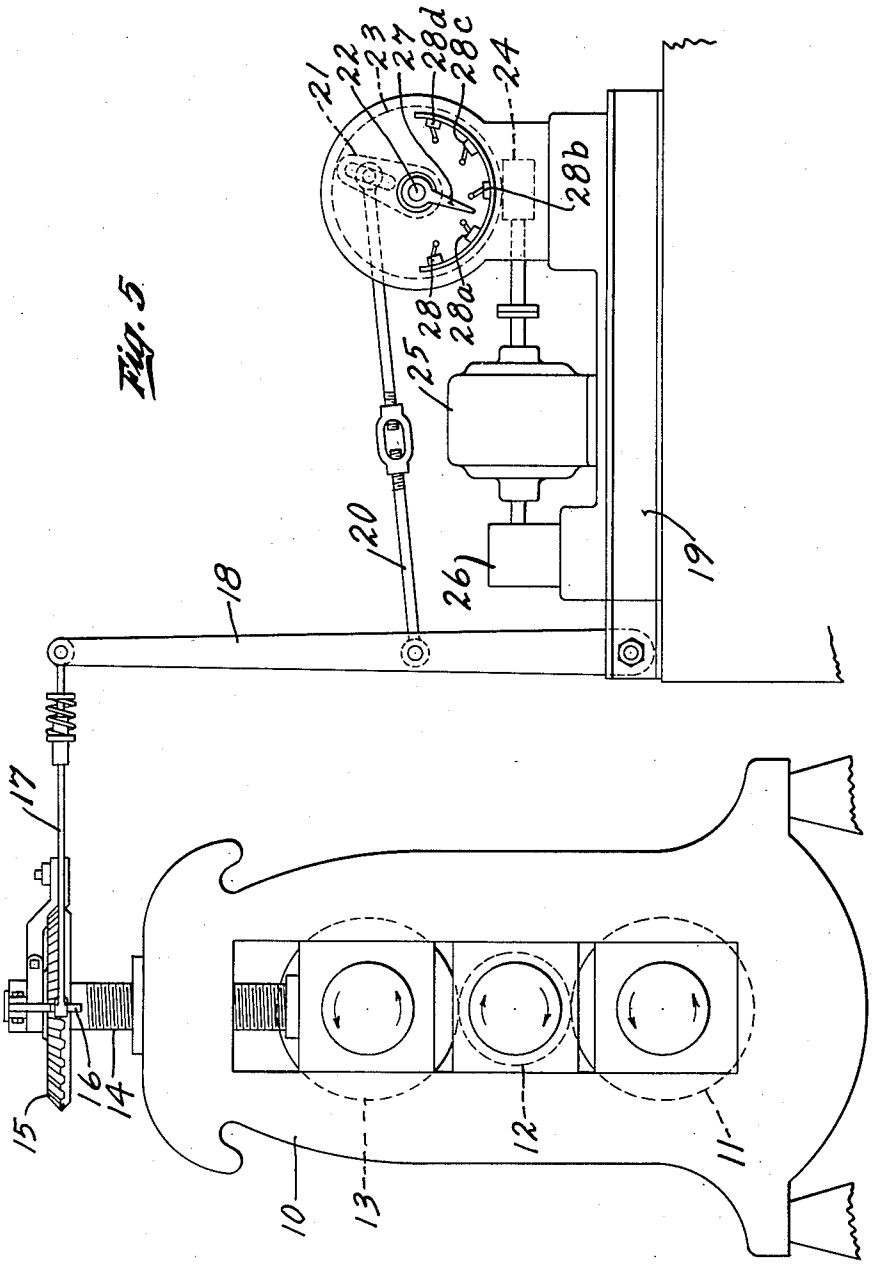
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AUTOMATIC SHEET ROLLING MILL

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Fig. 5



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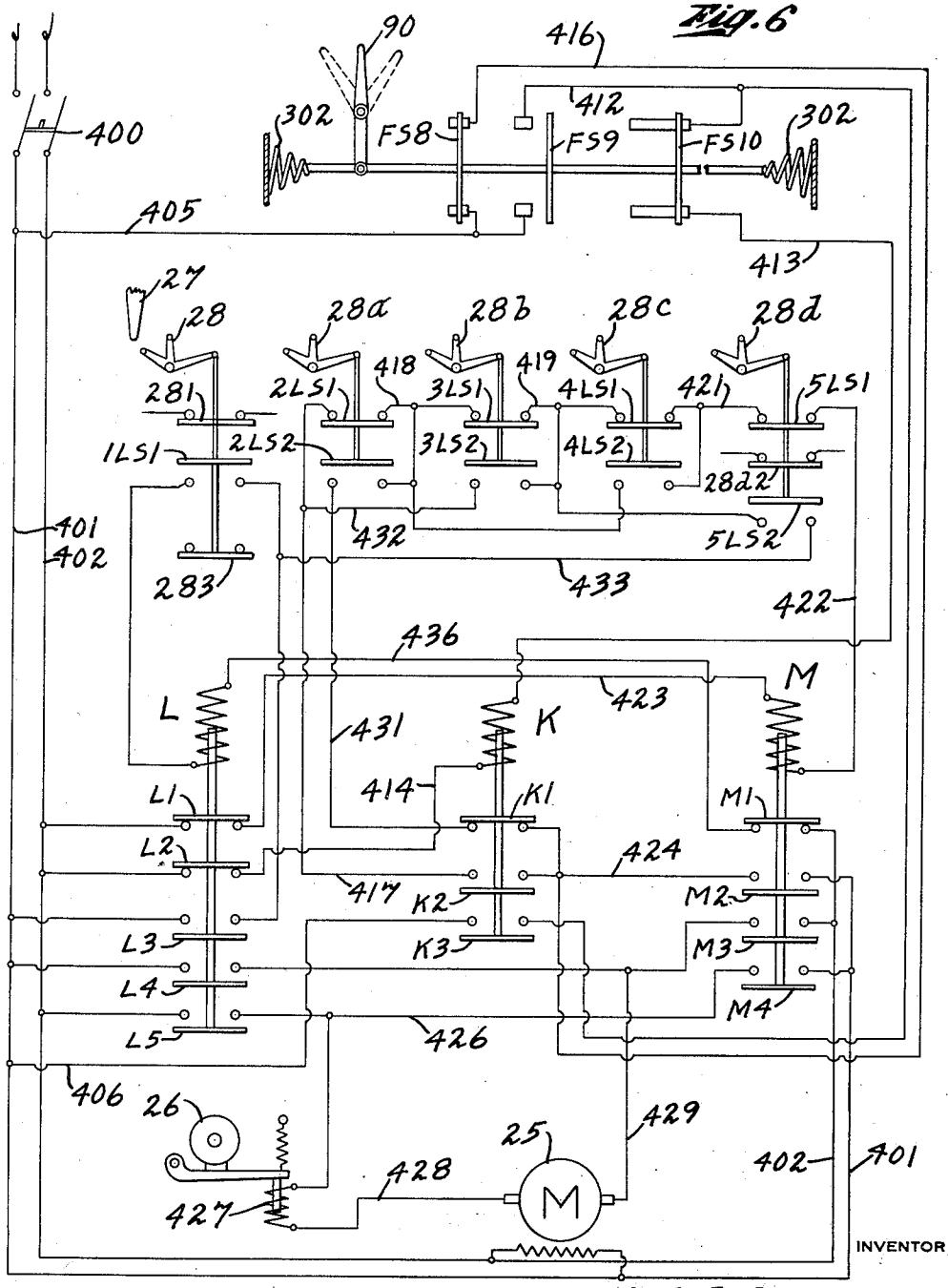
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Fig. 6



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Patented Aug. 6, 1935

2,010,715

UNITED STATES PATENT OFFICE

2,010,715

AUTOMATIC SHEET ROLLING MILL

Albanus Groome Delany and Guy Newton Hughes, Alabama City, Ala., assignors, by mesne assignments, to The American Rolling Mill Company, Middletown, Ohio, a corporation of Ohio

Application May 4, 1932, Serial No. 609,064

11 Claims. (Cl. 80—44)

Our invention relates to a rolling mill for the production of sheets and plates, and has for its object to provide a mill which is entirely automatic in its functioning and is capable of effecting large economies in the cost of the rolled product while at the same time materially increasing the output of rolled product per stand of rolls and insuring accuracy in thickness of the rolled sheets or plates.

Our invention relates more particularly to rolling mills of the type known as two-high or three-high to which the sheet or plate stock to be rolled is delivered by a feed table. An automatic catcher receives the stock from the rolls and either returns it through the upper or second mill pass of the three-high mill, or passes it over the two-high mill, to the feed table which again delivers the stock to the mill, this back and forth passage of the stock being rapid and continuous for the predetermined number of passes until the finished stock is discharged.

An object of our invention being to render the complete operating cycle of the mill automatic, we contemplate utilizing a time clock controlled delivery of the stock to be rolled to the feed table which has stops to hold back the stock ready for its delivery into the rolling mill automatically responsive to the completion of the preceding rolling cycle which occurs contemporaneously with the return by the screw-down adjustment of the mill rolls to their initial position.

Our invention further contemplates utilizing automatic controls for the catcher which will adapt it to receive the stock and return it to or over the mill the requisite number of times until it is ready to be discharged onto a suitable delivery table which delivers it to piling mechanism, not shown.

Our invention further contemplates utilizing automatic means for manipulating the screw-down mechanism responsive to stock actuated controls, the screw-down being itself adapted, at the completion of each rolling cycle, to control the delivery of new stock for the next rolling cycle.

While, in the interest of maximum production, it is desirable to so control the delivery of the stock from the furnace to the rolls that it is effected immediately upon the screw-down resuming initial position, our invention in its broader aspect contemplates the utilization of any automatic stock feed, such for instance as might be accomplished by a periodic delivery thereof direct to the rolling mill from the furnace, with a sufficient interval allowed between the successive discharges of sheet stock from the furnace to make sure that the preceding rolling cycle has been completed before each new batch of sheet stock is thus delivered to the mill.

Our invention further comprises the novel steps or combination of steps constituting a process or method by which a continuous and automatic rolling operation can be carried out with a single stand of rolls so as to obtain therefrom a production of rolled sheet or plate stock comparable to that heretofore obtained by a sequence of roll stands under continuous rolling methods but at greatly reduced cost, due to the relatively small investment in rolling equipment required in the practice of our invention as compared with the multiplicity of roll stands and interposed heating furnaces required for the operation of the continuous rolling process.

Our invention further contemplates so coordinating the automatic control features of the various sheet handling mechanisms which coact with the rolls that the mill is capable of operation almost without idling time, whereby it is capable of rolling the stock in five passes without reheating and to deliver a production of rolled stock very greatly increased over any production records heretofore attained by manually operated or semi-automatic, rolling mills. By eliminating all skilled labor, except one supervising operator, our mill, despite its higher rate of production, can be operated at the absolute minimum for labor cost, and due to the screw-down mechanism being mechanically actuated, its successive adjustments of the rolls can be effected with a speed and degree of accuracy that insures a uniformity in the rolled product not heretofore attainable from manual operated screw-down means.

Our invention further comprises the means for coordinating the functioning of the catcher, screw-down mechanism and the feed table, which respectively form the subject matters of pending applications Serial Nos. 566,230; 586,223; and 605,765, all of which are assigned to the Gulf States Steel Company, the assignee of this application.

Our invention further comprises the novel details of construction, the arrangements of parts, and the methods of operation which are hereinafter more particularly described and claimed, reference being had to the accompanying drawings which form a part of this specification, and in which:—

Fig. 1 is a side view showing the rolls in section,

the catcher and delivery table in side elevation, and parts of the feed table in outline.

Fig. 2 is a detail view partly in section and partly in elevation of the feed table, and time clock control mechanism for the delivery of stock thereto.

Fig. 3 is a diagrammatic layout of the circuits which control the automatic functioning of the feed table.

Fig. 4 is a diagrammatic layout of the circuits which control the automatic functioning of the catcher and the delivery table.

Fig. 5 is a view in side elevation of the roll stand and its mechanically operated automatically controlled screw-down mechanism.

Fig. 6 is a diagrammatic layout of the circuits which control the automatic functioning of the screw-down mechanism.

Similar reference numerals refer to similar parts throughout the drawings.

In the embodiment of our invention illustrated, we have selected a three-high mill as illustrative of a suitable rolling mill for our purposes, the mill comprising a conventional stand 10, a lower roll 11, an intermediate roll 12, and an upper roll 13, all having their end bearings suitably guided in the stand and controlled as to the pass clearances between the rolls by screws 14 having top gears 15 fast thereon and adapted to be turned by the connected gear actuated arm 16 operated by an arm 17 connected to the upper end of a rocker arm 18 journaled at its lower end on a base 19 and having an intermediate connecting rod 20 leading to a crank 21 on a shaft 22 driven by worm gearing 23, 24 from a motor 25 mounted on the base 19 and having a suitable electrically controlled brake 26. The shaft 22 carries a switch trip arm 27 coacting with a series of switches 28, 28*a*, 28*b*, etc. The operation of the motor and its automatic control of the adjustments of the screw-down mechanism, which will be hereinafter briefly described, form the subject matter of pending application Serial No. 586,223 hereinabove referred to, to which reference is made for a more complete and detailed description of both the screw-down mechanism and its operation.

In Fig. 2 is shown fragmentally a heating furnace 30 wherein the sheet or plate stock or sheet bars, hereinafter referred to as sheet stock, are heated by any suitable means and from which the sheet stock is delivered by means of a conveyor 31 driven by a belt 32 from a motor 33, the electric circuits for which lead to a standard motor starter box 34 and are adapted to be closed at predetermined time intervals by means of a time clock 35 of any suitable type and character. Opposite the discharge from the furnace we arrange a swinging trip 36 which when engaged by the sheet stock being discharged will open contacts 37 controlling a circuit to the starter box 34 so as to stop the motor 33, after the stock has passed onto a short endless conveyor 38 driven continuously by the motor 39 so as to feed the sheet stock, as periodically delivered thereto, to the feed table for the mill. As each unit of stock passes out of the furnace it will trip the trip 36 which will act through electrical devices well understood in this art and therefore unnecessary to be illustrated to interrupt the motor circuit.

The feed table, for a more detailed description of which reference is made to pending application Serial No. 605,765 aforesaid, may be briefly described as comprising an endless conveyor means 40, driven by the chains 41 and 41*a* from a motor 42 continuously in a direction to deliver stock to the mill. The stock received on this conveyor passes forward until arrested by the stops 43 opposite the side matching bars 44.

These bars 44, arranged on each side of the table, are reciprocated laterally by crank arms 45 on their respective rocker shafts 46 that are so connected to a gear 47 that as it is rocked by a reciprocable rack bar 48, actuated by the piston of an air motor 49, these bars move inwardly to match the sheets and then outwardly to release the sheets. Before engaging the stops 43, the stock unit will actuate the trip arm 50 for flag switch 51 of the feed table circuits. The stops 43 are latched in operating position by a cam 52 with which a dog 53 coacts and is adapted to be disengaged from the cam by a trip on piston rod 54 of an air cylinder 55. Air from a three-way valve 56, under control of a magnet 57, flows through the motor 49 to effect the side matching movement of the bars 44 while the stock is held by the stops 43. When magnet 57 is de-energized, the air is reversed, withdrawing the bars 44 and flowing through cylinder 55, where it acts to trip rod 54, raise the dog 53 and release stops 43, whereupon the stock is free to continue its travel toward the mill on the conveyor means 40 until it strikes the second stops 60 which are normally held in operative position by the counter-weighted bell crank 61 through a connecting link 62. A latch 63 normally locks the stops 60 in operative position and is adapted to be tripped to release said stops by means of the piston 64 in a cylinder 65 through which air flows from the three-way valve 66 under control of the magnet 67 and thence to the cylinder 68 where it drives forward the piston 69 carrying the ram head 70 with its pivotally mounted sheet engaging dogs 71 and trip means for same.

The trip means when the ram head is retracted act to rock the dogs below the path of the stock and when the ram head is advanced spring means 72 will raise the dogs into operative position to engage the stock then held by the stops 60.

The circuits controlling the magnet 67 will not operate until the screw-down mechanism has reset the rolls to initial position when the lower pass is ready to receive the next unit of stock for its first pass through the mill. The plunger motion thrusts the stock endwise against the counter-weighted stops 60 until it is matched endwise, after which the stops yield and permit the stock to pass with a quick movement into the lower mill pass over the guide table 68. Meanwhile the elements 50, 51, 52, 53 and 54 have resumed initial position in which they are shown ready for the next unit of stock from the furnace and the stock unit being rolled will be delivered after its first pass to the catcher.

The catcher, which is fully described in application Serial No. 566,230, to which reference is made for details of construction and operation, may be briefly described as comprising upper and lower coacting sets of conveyor chains 70 and 71, respectively mounted to travel in suitable upper and lower channel guides 72 and 73 which are spring-pressed together to cause these conveyors to frictionally grip the sheet stock between them. The conveyor chains are driven through meshing gears 14 and 15 by means of a sprocket chain 76 from a motor 77 having a reversing control box 78.

The conveyors 70 and 71 are supported on a suitable frame work comprising an upper frame 79 for the chains 70 and a lower or main catcher

frame 80 for the chains 71 which supports the upper frame 79 and in turn, near its lower center, is pivotally mounted on the stand 81 so as to permit the catcher to be rocked into position to coact with the upper or lower pass of the mill.

The catcher is rocked by connections comprising a link 82, a bell crank 83, and a link 84 which is connected to the piston of an air motor 85 having a three-way valve 86 for the admission of air pressure therethrough under control of a magnet 87 and an opposed coil spring 88. The stock delivered from the lower pass moves over a guide 89 and trips the arm 90 for flag switch 91 that controls the catcher circuits. As soon as the stock passes beyond the arm 90 and releases it, the flag switch will energize the magnet 87, actuate motor 85 to swing the table upwardly into position opposite the upper pass, and reverse the motor 77 and chains 70 and 71 so as to return the stock over guide 89 into the upper mill pass. The upper frame 79 carries a retractable top stock guide 92 controlled by a trip arm 93 and a stop 94 on the mill stand, a spring 95 acting to retract this guide sufficiently to clear roll 12 as soon as the trip 93 moves away from its actuating stop 94.

The stock thus reversed and returned from the catcher will again trip and release switch arm 90 causing the catcher to be swung to lowered position and its conveyor chains reversed so that they are ready to receive the stock when it is again returned to the catcher through the lower pass.

The stock emerging from the upper pass is carried over a guide 100 through pinch rolls 101 and delivered onto a conveyor 102, constantly driven in the direction of the arrow by a suitable drive 103 from the motor 104, which will return the stock under the lower pinch roll and over guide 105 to the lower pass of the mill. After making the third pass, assuming that the three passes are all that are required, the finished sheets again enter the catcher and trip and release switch 90 for the third time in a cycle. This movement of the arm 90 will be without effect through the flag switch on the motor for tilting the catcher and driving the conveyor chains thereon, and hence the latter will continue to be driven in a direction to discharge the finished sheets onto a receiving table 110 connected by means of elements 111 and 112 to the catcher table and pivotally mounted at 113 on a stand 114.

This table 110 carries an endless conveyor chain 115 driven in the direction of the arrow by a driving connection 116 and this conveyor will receive the finished stock and carry it to any suitable piling mechanism, not shown.

If the stock is to be given five passes, the trip and release of the arm 90 by the stock entering the catcher after the third pass will, in conjunction with the screw-down mechanism, set up circuits which again act to rock the catcher upwardly, reverse the motor 77 and chains 70, 71 and return the stock for its further pass through the mill. The stock after its final pass again trips and releases arm 90, but this time without effect on the catcher or its conveyors, so that delivery of the stock is made to table 110, as above described.

The delivery and return of the stock for the various passes makes necessary the provision of means to operate the screw-down mechanism so that the rolls will be quickly and accurately set to give the roll clearance required for each pass. We propose to control the screw-down operating mechanism so that the adjustments of the rolls will be automatically and accurately effected.

In application, Serial No. 586,223, a detailed description is given of the automatic control for the screw-down. It may be briefly described as follows, reference being had to Fig. 5. As the stock is carried by the feed table to the lower rolls, the screws are in their raised, or first position, and are lowered to their second position when the flag switch 91 is actuated by the stock passing into the catcher table. The switch 91 on release of arm 90 sets up a circuit to the motor 25 which continues to operate until the arm 27 opens switch 28 and moves on far enough to open the switch 28*a*. As the stock returns to the upper feed table through the upper rolls, it again actuates the switch 91 which sets up a circuit to the motor to lower the screws to their third position ready for the third pass of the stock back through the lower rolls, the motor being stopped by the arm 27 opening the switch 28*b*.

As the stock moves into the catching table after the third pass, it again actuates the switch 91 to set up a circuit to the motor 25 to lower the screws for the fourth pass of the stock through the upper rolls, the motor circuit being broken by the arm 27 opening the switch 28*c*.

As the stock leaves the catcher table for the fourth pass through the upper rolls, the switch 91 is actuated to set up a circuit to the motor 25 to lower the screws for the fifth and final pass of the stock through the lower rolls and onto the catcher table, the circuit to the motor 25 being broken by the arm 27 opening the switch 28*d*.

As the stock moves into the catching table after the fifth and final pass, it actuates the switch 91 to set up a circuit in a reverse direction through the armature of motor 25 to move the screws upwardly to their first position. As the control arm 27 travels back in the reverse direction it resets each of the switches 28*d*, 28*c*, 28*b*, 28*a* and 28 successively, causing the motor to stop when the switch 28 is actuated.

It will be observed that the motor 25 is started up immediately after the stock leaves the lower pass, but a delayed action is necessary to prevent the motor starting up after the release of the switch arm 90 on the return passes, until the stock will have had time to clear the upper pass. All these control operations are timed so that no time will be lost and the stock can be given as many as five passes without being reheated.

The circuits and automatic control mechanism for the feed table are illustrated in Fig. 3 and briefly described as follows:—When flag switch 51 is in its normal position shown and main switch 200 is closed, relay A is energized through a circuit 201, switch FS1, relay A, and leads 203 and 202, and being of the retarded type it will hold switch A1 closed a sufficient length of time, after switch FS1 is opened, to permit a circuit to be completed to relay B and through switch B1 to the magnet 57. When the stock trips arm 50 it opens switch FS1 and closes switches FS2 and FS3. FS2 on closing completes a circuit to relay B through 201, FS2, 204, A1, 205, B, 206 and 202, closing switch B1 to complete a circuit to magnet 57 through leads 201 and 207, B1, lead 208, magnet 57, and lead 202. After this magnet solenoid 57 operates the side matching bars 44 to align the sheet stock, the retarded relay A will open A1 deenergizing relay B opening B1 and deenergizing magnet 57, whereupon the spring resets valve 56 causing matching bars 44 to be retracted and

stops 43 to be unlatched, so that the stock will advance to stops 60. The ram operation then occurs as follows:—When the stock actuated flag switch 51, a circuit was completed to energize relay C through 201, FS3, 209, D2, 210, C, 206, and 202. A holding circuit is provided for the relay C through 201, 207, C1, 211, 209, D2, 210, C, 206 and 202, to hold this relay energized after the stock has passed and released arm 50 and the flag switch 51 has been returned by springs 220 to its normal position.

Retarded relay E, normally energized through circuit 201, 207, C2, 212, D3, 213, E, 203 and 202 will close switch E1, at a predetermined time after switch C2 opens, to energize relay D through a circuit 201, 214, screw-down control switch 283, 216, E1, 217, D, 206 and 202. Relay D then closes a circuit to the pusher valve control magnet 67 through leads 201, 214, 218, D1, 219, magnet 67 and lead 202. This causes the pusher valve to be operated to actuate the ram head. After the stock completes the first pass it actuates the screw-down and when arm 27 on the screw-down opens switch 283 the relay D is deenergized, pusher valve 66 is reset by its spring, the ram head is retracted, and the automatic control is set for the next cycle, and cannot resume operation until the screw-down mechanism returns to initial position and again closes switch 228.

A suitable mechanism for carrying out under automatic control the various operations of the catcher in each cycle is illustrated in Fig. 4, which shows in diagrammatic form the switch and circuit mechanism which operate responsive to switches controlled by catcher trip arm 90 and the screw-down trip arm 27 as follows:—

Assuming main switches 303 and 305 closed and screw-down switch 28 in the position shown closing switches 281 and 28*d*2, the relays G, H and J are deenergized and relay F is energized through the circuit 313, 281, 314, 28*d*2, F, 316, 318 and closes its switches F1 and F2. When F2 closes a holding circuit for F is established through 313, F2, 314, 28*d*2, F, 316, 318.

When the main line switch 305 is closed, current flows over circuit 300, 306, H1, 307 solenoid 308 of reversing switch 78 to 301, causing switch 78 to supply current to motor 77 to drive the catcher chains 70 and 71 so as to move the sheets away from the mill.

The sheets entering the catcher throw arm 90 clockwise, closing the catcher flag switch FS6 to close a circuit 318, 321, J, 322, FS6, 323, 324, G1, F1 and 313. Relay J closes its three switches. When arm 90 is released by the passing sheets, it is returned to normal position by springs 302, opening FS6 before which a holding circuit for relay J is established through 318, 321, J, J1, 324, G1, F1 and 313, and switches J1, J2 and J3 are held closed. This return of arm 90 to normal position also closes a circuit through 318, retarded relay H, 327, J3, 328, FS4, 326, F1, 313 to cause relay H to open H1, deenergizing solenoid 308, and to close H2 and H3. Whereupon, H2 closes a circuit to solenoid 329 through circuit 331 and 332, and actuates switch 78 to reverse the current to the fields 333 of motor 77 and effect a reverse drive of the chains 70, 71. At the same time H3 completes a circuit to the table tilting solenoid 87 through circuit 336, 337 and actuating valve 86 to cause motor 85 to tilt the catcher upwardly to return the sheets to the upper pass of the mill.

The reversely driven sheets throw arm 90 counterclockwise to close FS5 and FS7, FS4 remaining closed. FS5 will close a circuit to relay J through 313, F1, 326, FS5, 323, J1, J, 321 and 318. This holds relay J energized and its switches closed.

FS7 on closing will energize relay G through a circuit 313, F1, 326, FS7, 338, G, 339, J2, 341 and 318, whereupon relay G opens G1 and closes G2. When G2 closes a holding circuit is established to relay G through 313, F1, 326, G2, G, 339, J2, 341 and 318. When J3 and F1 close, relay H is energized over 313, F1, 326, FS4, 328, J3, 327, H, 318.

When trip arm 90 resumes normal position after the sheets clear it on their return through the upper or second pass, it opens FS5 and FS7. When FS5 opens, it deenergizes relay J opening all of its switches with the following results: J2 breaks the circuit to relay G opening G2 and closing G1; J3 breaks a circuit to retarded relay H which, after an interval allowing the sheets to clear the upper pass, opens H2 and H3 and closes H1; H3 opens a circuit to table tilting magnet 87 causing catcher to tbe lowered; H2 opening, deenergizes the motor reversing coil 329; H1 closing energizes motor reversing coil 308 reversing the motor 77 and chains 70 and 71.

All relays except F are now deenergized and the catcher will repeat the operations described for the third and fourth passes of the stock. On the fifth or last pass however, the screw-down trip arm 27 will have opened switch 28*d*2 deenergizing relay F so that the arm 90 as it moves responsive to the passage of the finished stock over it will not act on the relays G, H and J and as a result the motor 77 will not be reversed, magnet 87 will not be energized and the chains 70, 71 will continue to travel away from the mill so that they will deliver the finished stock to the delivery table conveyor 115 for piling.

The release of arm 90 will act to reverse the screw-down motor 25, as will be later described, causing trip arm 27 to reset switches 28 and 28*d* to the position shown in Fig. 4 and thus leave the catcher control ready for the next rolling cycle.

The circuits for effecting the automatic adjustment and reversal of the screw-down mechanism are fully described in application No. 586,223 and will be briefly described by reference to Fig. 6 in which the trip arm 90 is shown associated only with those switches of flag switch 91 which control the screw-down circuits.

The switches and relays stand in the position assumed when the screw-down is set for the initial pass. On closing main line switch 400, all relays K, L and M are deenergized, and remain so during the first pass. When the stock enters the catcher from the first pass, it throws arm 90 clockwise, opening switch FS8, closing FS9, and leaving FS10 closed. This energizes relay K through circuit 401, 405, FS9, 412, FS10, 413, K, 414, L2, 402, whereupon relay K is held energized by a holding circuit 401, 406, K3, 412, FS10, 413 to relay K. Upon release of trip 90 by the passing stock, switches FS8 and FS10 stand closed and FS9 is open. Through FS8 the relay M is energized by the circuit 401, 405, FS8, 416 K2, 417, 2LS1, 418, 3LS1, 419, 4LS1, 421, 5LS1, 422, relay M, 423, L1, 402, and upon closing relay M establishes its own holding circuit through 401, M2, 424, K2, 417, 2LS1, 418, 3LS1, 419, 4LS1, 421, 5LS1, 422, relay M, 423, L1, 402.

The switches M3 and M4 when closed establish a circuit to motor 25 over 401, M4, solenoid 427

of magnetic brake 26, 428, motor 25, 429, M3, 402, causing the motor to set the screw-down for the second pass and in doing so to move trip 27 to open switches 28 and 28a.

The switches 1LS1 and 2LS2 will now be closed and 2LS1 will be opened, breaking the circuit to relay M, opening M3 and M4, and causing the motor 25 to stop and brake 26 to be applied.

As the stock is returned from the catcher for the second pass, it throws trip arm 90 counter-clockwise, opening FS8 and FS10 and leaves FS9 open.

Upon the opening of FS10, the circuit to relay K is broken, opening switches K2 and K3. When trip arm 90 resumes normal position, it closes FS8 and FS10. Whereupon FS8 closes a circuit to relay M through 401, 405, FS8, 416, K1, 431, 2LS2, 418, 3LS1, 419, 4LS1, 421, 5LS1, 422, relay M, 423, L1, 402. The relay M then again closes M3 and M4 and the motor 25 is again started to set the rolls for the third pass. Trip arm 27 then throws switch 28b to open 3LS1 and close 3LS2. When 3LS1 opens, it breaks the circuit to relay M, and by opening M3 and M4 the motor is stopped with the rolls set for the third pass.

The stock, after the third pass, trips arm 90 clockwise and energizes relay K as described, and when arm 90 resumes normal position, relay M is energized over circuit 401, 405, FS8, 416, K2, 417, 432, 3LS2, 419, 4LS1, 421, 5LS1, 422, relay M, 423, L1, 402. The motor 25 is started again and sets the rolls for the fourth pass, and is cut out by trip arm 27 throwing switch 28c and opening 4LS1 to deenergize relay M.

The return of stock for the fourth pass first moves trip arm 90 counter-clockwise to open FS10 and deenergize relay K. When arm 90 is released, relay M is energized over circuit 401, 405, FS8, 416, K1, 431, 2LS2, 418, 4LS2, 421, 5LS1, 422, relay M, 423, L1, 402. This energizes motor 25 to set the rolls for the last pass and trip arm 27 stops the motor by throwing switch 28d to open 5LS1 and deenergize relay M.

On the last pass, the stock throws arm 90 clockwise to complete a circuit to relay K and then releases the arm 90 to resume normal position and energize relay L over circuit 401, 405, FS8, 416, K2, 417, 432, 3LS2, 419, 5LS2, 433, 1LS1, 434, relay L, 436, M1, 402.

When relay L is energized it closes switches L4 and L5 and through them establishes a reverse circuit to the motor 25 through 401, L4, 429, motor 25, 428, 426, L5, 402, which resets the rolls for the initial pass and causes trip arm 27 to reverse all the switches 28d, 28c, 28b, 28a and 28. When switch 28 is reversed, it opens the circuit to relay L and stops the motor, leaving the relays and rolls set as first described.

It will thus be seen that by the instrumentalities described, we obtain a full automatic control of the complete multipass rolling of stock by a single stand of rolls, and since the timing of the clock is such that there will be but little delay of the hot stock on the feed table before the screw-down is ready to release the stock to enter the first pass, and since this feed of the stock is accomplished very quickly by the power ram, and its subsequent passing back and forth through the mill is accomplished quickly and without any delays, the complete rolling cycle can be completed even for five passes without necessitating a reheating of the stock. We have sought to describe herein only one suitable system of automatic control mechanism, but we are aware that the control system may be widely varied as to its details without, however, departing from the essentially novel features of our invention and its cycle of operations.

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

What we claim is:—

1. A continuous rolling mill comprising in combination a continuous heating furnace for the stock to be rolled, automatic means for periodically discharging heated stock from said furnace, a feed table for the rolling mill disposed to receive and operable to deliver the stock to the rolls, a stand of adjustable rolls, a screw-down mechanism for regulating the pass clearance between the rolls, a catcher mechanism adapted to receive and return the partly rolled stock to the feed table and to discharge the finished stock, and control means to accomplish the automatic operation and cooperation of the screw-down and catcher mechanisms.

2. A mechanism according to claim 1, in which the feed table comprises means to restrain the initial delivery of heated stock to the rolls, and the control means comprise elements adapted to release said stock restraining means responsive to the return of the screw-down mechanism to initial position.

3. A mechanism for the automatic back and forth movement of stock for a series of passes through a stand of rolls, comprising a mechanical stock feed mechanism on the front side of the mill, a mechanical catcher on the back side of the mill, a screw-down mechanism for adjusting the pass clearance for the mill rolls, and means responsive to the screw-down mechanism for automatically and selectively controlling the return or discharge of stock by the catcher.

4. A mechanism for the back and forth passage of stock through a rolling mill, comprising in combination a catcher having reversible means to discharge rolled stock or return it to the feed side of the mill, a screw-down mechanism for regulating the roll pass clearance for each pass of the stock, and means automatically controlled by the screw-down mechanism and the movement of the stock to cause the catcher to return or discharge the stock.

5. In a mechanism for the continuous rolling of sheet stock by a single stand of rolls, a feed table, mechanism to arrest the stock on said table, mechanism to match the stock, mechanism to release the matched stock for initial delivery to the rolls, mechanism to receive stock returned from the catcher side of the mill and return it to the mill for another pass, a screw-down mechanism, and mechanism automatically responsive to the screw-down mechanism for controlling the release of the new stock by the feed table and the discharge of finished stock.

6. In combination, in a sheet hot rolling mill, a continuous heating furnace for supplying heated stock for the mill, automatic means for effecting a periodic discharge of heated stock from said furnace, a screw-down mechanism for the rolls, and means for delivering the heated stock to the mill pass automatically responsive to the screw-down mechanism resuming position for the initial pass.

7. In combination, in a sheet hot rolling mill, a continuous heating furnace for supplying heated stock for the mill, automatic means for effecting a periodic discharge of heated stock from said furnace, a screw-down mechanism for the rolls, means for delivering the heated stock to the mill pass automatically responsive to the screw-down mechanism resuming position for the initial pass, means to arrest the heated stock adjacent to the rolls, and means to receive rolled stock returned to the feed side of the mill and again deliver same to mill in a manner to avoid interference with heated stock waiting to enter the mill for its initial pass.

8. In combination a multiple-pass mill and means located on the entering and exit side of said mill for feeding stock thereto in one pass and returning said stock in another pass during the continuous unidirectional movement of the rolls of said mill, automatic means operable in connection therewith for discharging a piece at the end of a predetermined number of passes, power means for operating the screw-down of said mill and automatic means for controlling the operation of said power means, in accordance with the passage of the piece through said mill; means for delivering a piece into a position for entrance in the said mills and means for releasing said piece to said mill and automatic means for actuating said releasing means automatically responsive to the completion of a cycle for the preceding piece.

9. In combination a multiple-pass mill and means located on the entering and exit side of said mill for feeding stock thereto in one pass and returning said stock in another pass during the continuous unidirectional movement of the rolls of said mill, automatic means operable in connection therewith for discharging a piece at the end of a predetermined number of passes, power means for operating the screw-down of said mill and automatic means for controlling the operation of said power means, in accordance with the passage of the piece through said mill, a furnace, means for removing a second piece from said furnace and for delivering said piece in position for entrance into said mill, means for restraining the entrance of said piece into said mill pending the completion of a foregoing cycle, and automatic means for causing said restraining means to be responsive to the return of said screw-down, to initial position.

10. In a multiple-pass mill for the continuous rolling of sheet stock by a single stand of mills, having means located on the entering side of the mill for feeding heated stock thereto, and means located on the exit side to catch said stock after its passage through the mill and return it through a different pass, means distinct from said first mentioned feeding means to return the stock through the mill in the direction of the first pass comprising a tilted table provided with a feed belt continuously moving in a direction contrary to that of the stock approaching it.

11. In a multiple-pass mill for the continuous rolling of sheet stock by a single stand of mills, having means located on the entering side of the mill for feeding heated stock thereto, and means located on the exit side to catch said stock after its passage through the mill and return it through a different pass, means distinct from said first mentioned feeding means to return the stock through the mill in the direction of the first pass comprising a tilted table provided with a feed belt continuously moving in a direction contrary to that of the stock approaching it, a guide and pinch rolls to conduct the stock from the rolls onto said feed belt, one of said pinch rolls coacting with the said feed belt to provide additional means for urging the stock back into the original pass.

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