

March 26, 1946.

F. B. CROSBY

2,397,339

BILLET CHARGING MECHANISM

Filed Aug. 7, 1944

3 Sheets-Sheet 1

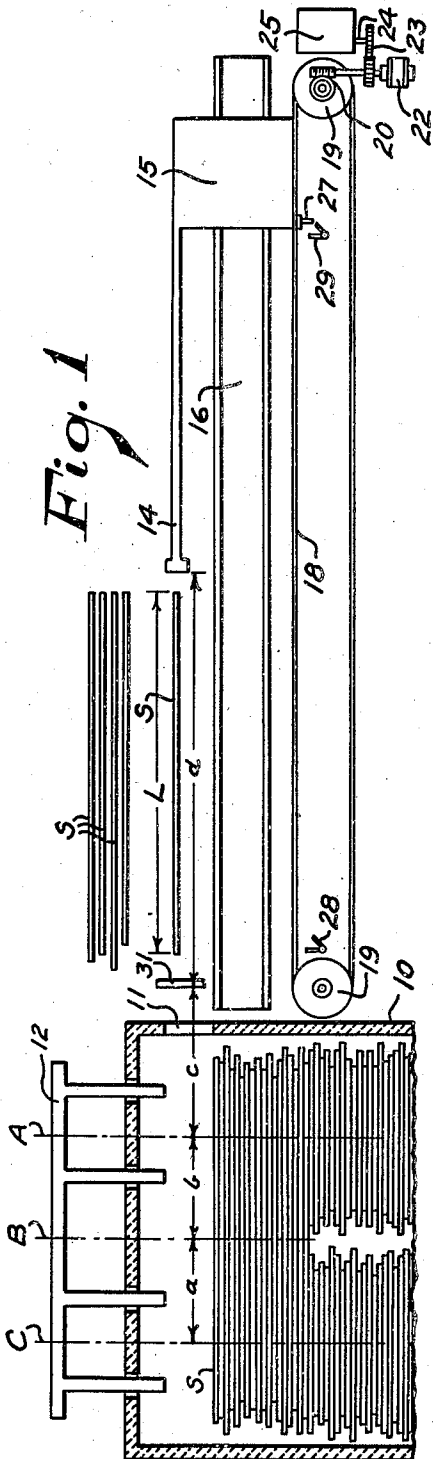


Fig. 1

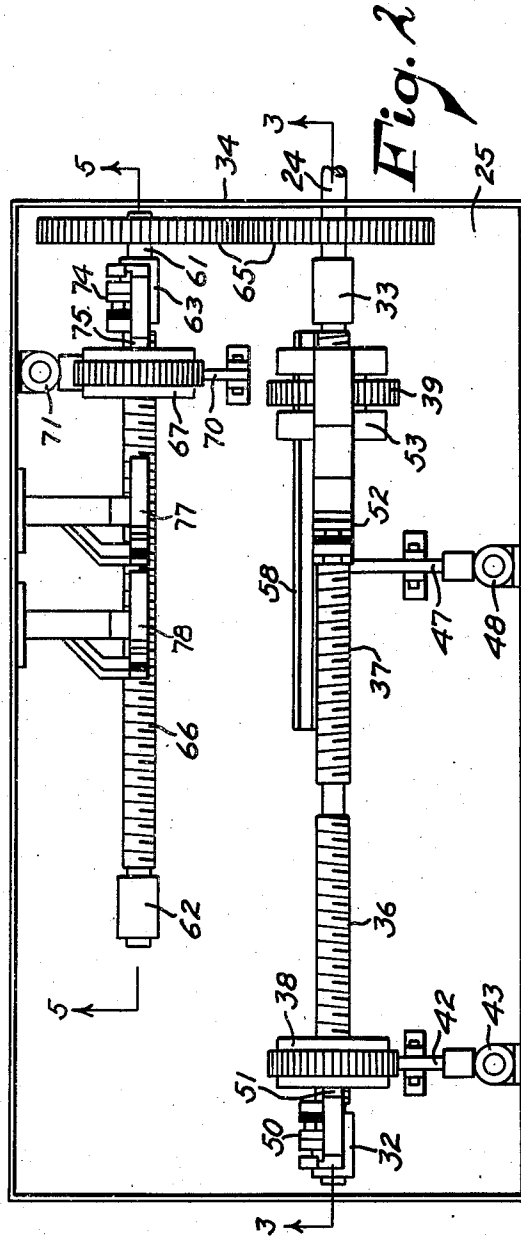


Fig. 2

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3 Sheets-Sheet 2

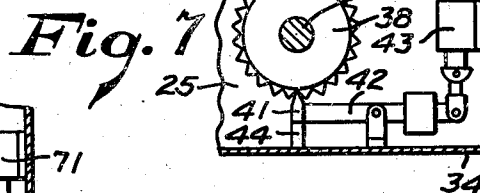
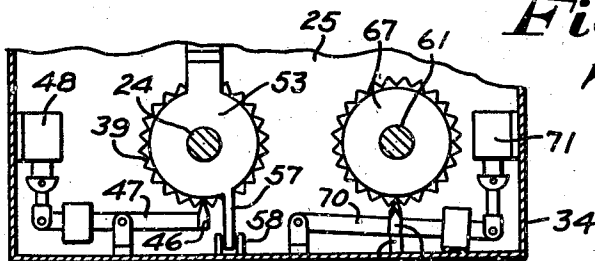
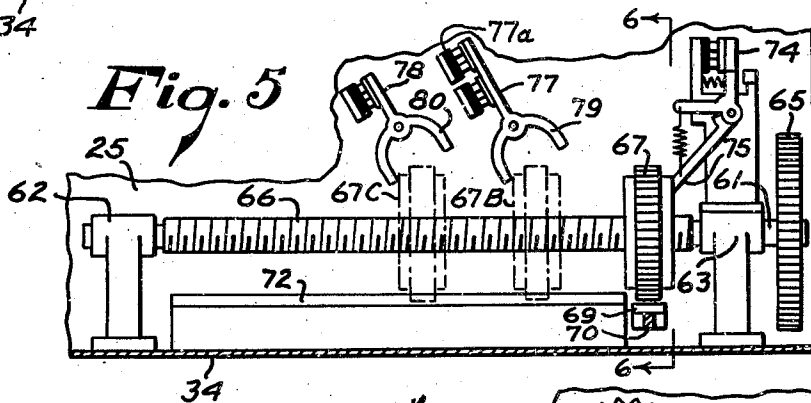
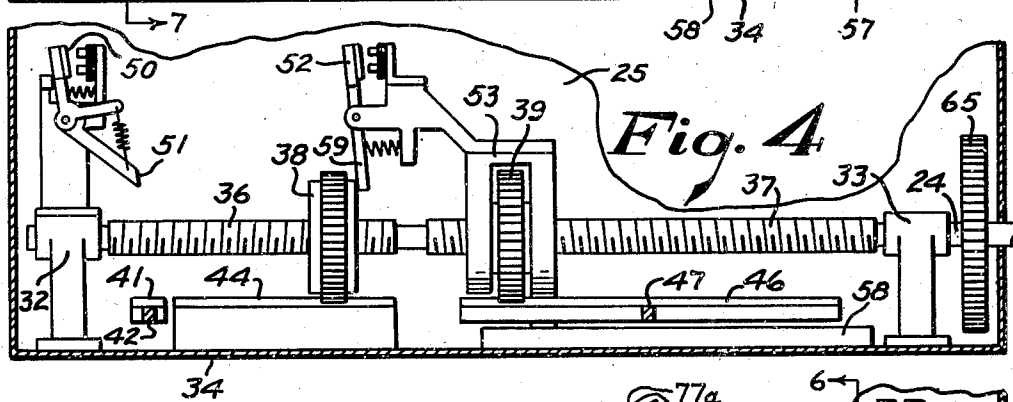
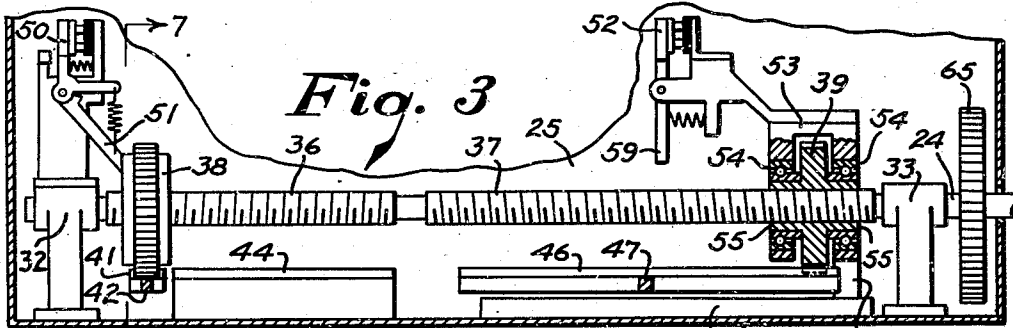


Fig. 6

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3 Sheets-Sheet 3

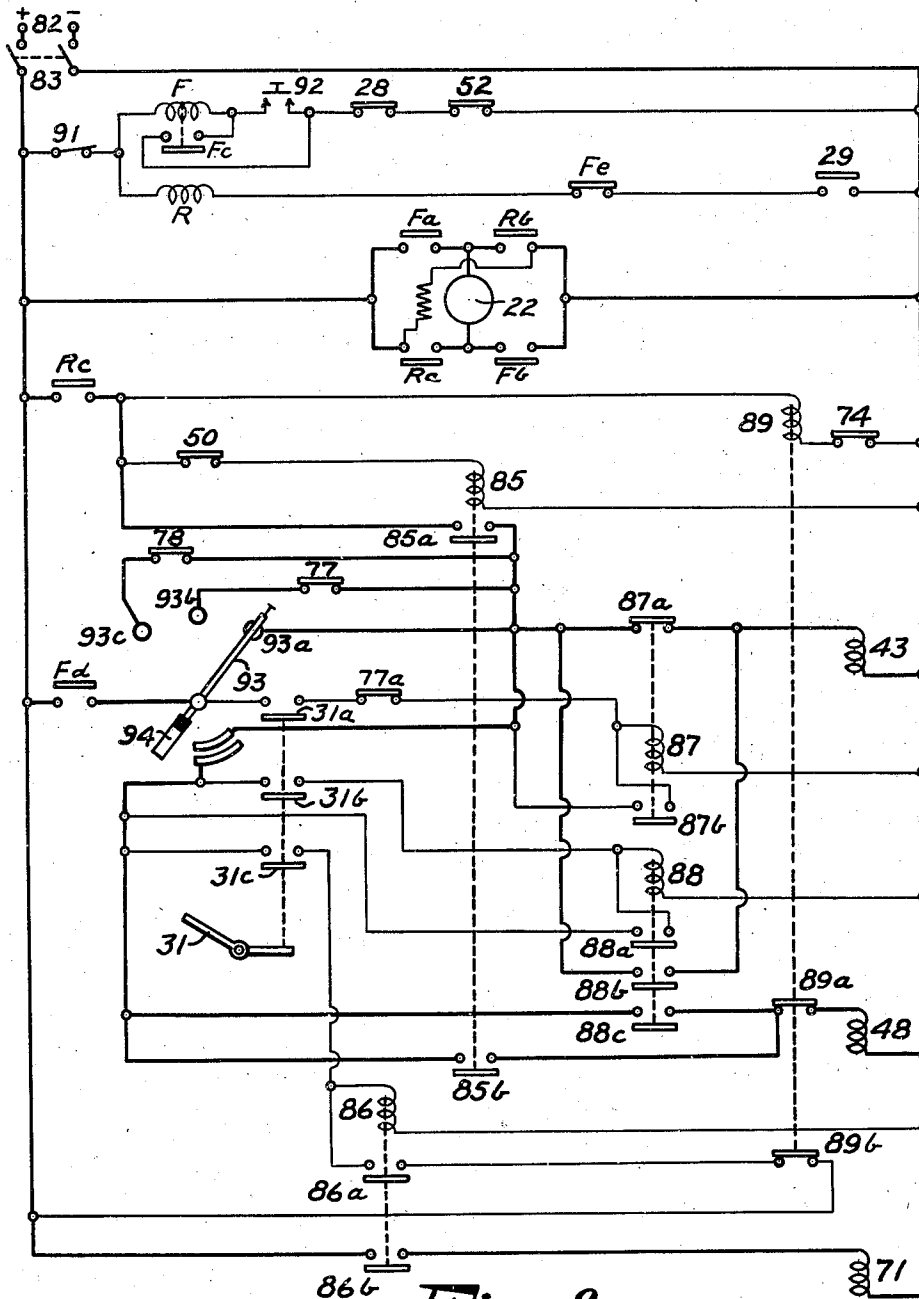


Fig. 8

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UNITED STATES PATENT OFFICE

2,397,339

BILLET CHARGING MECHANISM

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Application August 7, 1944, Serial No. 548,362

6 Claims. (Cl. 214—23)

This invention relates to billet charging mechanisms, and more particularly to a mechanism for charging billets of different lengths into a furnace and positioning them therein in a symmetrical arrangement.

The patent to Dahlstrom No. 1,880,374, granted October 4, 1932, discloses a charging mechanism whereby billets of different lengths may be charged endwise into a furnace and positioned symmetrically with respect to the center line of the furnace. This prior mechanism thus arranges the billets in a single row for broadside movement through the furnace. Such a single row arrangement is satisfactory with relatively long billets, but if the length of the billets is less than half the width of the furnace it would be preferable to arrange them in two or more rows and thereby utilize the furnace space more efficiently.

It is accordingly one object of the invention to provide a relatively simple and dependable mechanism whereby billets may be charged endwise into a furnace and arranged in a plurality of rows therein.

It is a further object of the invention to provide a relatively simple and dependable mechanism whereby billets may be charged endwise into a furnace and positioned symmetrically with respect to any selected one of a plurality of parallel center lines.

It is a further object of the invention to provide a relatively simple and dependable mechanism having a manually operable selector device which will enable the operator to select any one of a plurality of parallel center lines within a furnace, and a charging means which will automatically position each billet symmetrically with respect to the particular center line determined by the selector device.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawings illustrating one embodiment of the invention and in which like reference numerals indicate like parts,

Fig. 1 is a somewhat diagrammatic sectional plan view of a billet-heating furnace and a charging mechanism associated therewith;

Fig. 2 is an enlarged plan view of a control apparatus forming part of the charging mechanism;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 3 but showing

the parts in a different phase of the operating cycle;

Fig. 5 is a section on the line 5—5 of Fig. 2;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 is a section on the line 7—7 of Fig. 3; and

Fig. 8 is an electrical wiring diagram.

The embodiment illustrated comprises a heating furnace 10 having a charging opening 11 through which successive billets S of varying lengths are introduced in an endwise direction. After each billet has come to rest within the furnace, it is acted upon by the broadside pusher 12. This pusher is reciprocated in a known manner and serves to move all the billets broadside along the furnace hearth, thereby making room for the introduction of additional billets in a continuous succession.

The endwise charging movement of each billet is brought about by a pusher arm 14 which is reciprocated in line with the opening 11, the billets being moved one at a time from a stock pile to a position in front of this arm by any suitable means. The pusher arm 14 is mounted on a carriage 15 which is supported for reciprocation along a track 16. This carriage is connected to an endless cable 18 which passes around a pair of spaced wheels 19 one of which is driven through reduction gearing 20 by a reversible electric motor 22. This motor is also connected by gearing 23 to the shaft 24 of a control apparatus 25. The carriage 15 is provided with a projecting lug 27 arranged to engage and open a limit switch 28 when the carriage reaches the safe limit of forward travel, and to engage and open a limit switch 29 when the carriage reaches a predetermined position during its rearward travel. A flag 31 is located adjacent the charging opening 11 in position to be depressed by each billet passing thereover. The pusher arm 14 is positioned slightly above the flag and cannot depress the same, so that the flag will rise when the rear end of the billet has moved out of contact therewith. The flag 31 actuates three normally open switches 31a, 31b, and 31c.

Referring now to Figs. 2 to 7 inclusive, it will be seen that the shaft 24 of the control apparatus 25 is rotatably supported in a pair of spaced bearings 32 and 33 which are mounted within a casing 34. Between these two bearings the shaft is formed with two portions 36 and 37 provided with external screw threads. On the portion 36 adjacent the bearing 32 the screw thread is left-hand, and on the portion 37 adjacent the bearing 33 the screw thread is right-hand. On the threaded portion 36 there is mounted a nut

38 having a toothed periphery, and on the threaded portion 37 there is mounted a nut 39 likewise having a toothed periphery. These various parts are so constructed and arranged that if the two nuts are prevented from rotating, and the shaft 24 is rotated in a direction corresponding to forward travel of the carriage 15, the nuts will move toward one another, whereas reverse movement of the carriage will cause them to move apart. When the nut 38 is in its normal or starting position near the bearing 32 (as shown in Fig. 3) its rotation is controlled by a tooth 41 carried by a lever 42 connected to the plunger of a solenoid 43. The lever is so weighted that when the solenoid is deenergized the tooth 41 will engage the toothed periphery of the nut to prevent rotation thereof. When the solenoid is energized, the tooth will be held downwardly out of contact with the nut to permit free rotation thereof. Whenever the nut 38 moves away from its normal position adjacent the bearing 32, its toothed periphery will engage a fixed rib 44 mounted on the bottom wall of the casing 34 and arranged to prevent rotation of the nut. The rotation of the nut 39 is controlled by an elongated tooth 46 carried by a lever 47 connected to the plunger of a solenoid 48. This lever is so weighted that when the solenoid is deenergized the tooth 46 will engage the toothed periphery of the nut to prevent rotation thereof. When the solenoid is energized, the tooth will be held downwardly out of contact with the nut to permit free rotation thereof.

The movements of the nuts 38 and 39 along the shaft 24 are utilized to control the operation of certain electrical switches. A normally open switch 50 is mounted on the bearing 32 and provided with a yieldable operating finger 51 arranged to be engaged by the nut 38 when the latter reaches its normal position shown in Fig. 3. A normally closed switch 52 is mounted on a forked bracket 53 which straddles the nut 39 and is carried on ball bearings 54 (Fig. 3) supported by hubs 55 on this nut. Rotation of this bracket is prevented by a finger 57 which extends downwardly therefrom between a pair of ribs 58 (Fig. 6) on the bottom of the casing 34. The switch 52 has an operating finger 59 in position to be engaged by the nut 38 when the two nuts approach within a predetermined distance of one another, as shown in Fig. 4.

The casing 34 contains a second shaft 61 which is rotatably supported in a pair of spaced bearings 62 and 63. This shaft is connected to the shaft 24 by means of gearing 65. The portion 66 of the shaft 61 located between the bearings is provided with a left-hand screw thread and carries a nut 67 having a toothed periphery. These parts are so constructed and arranged that if the nut 67 is prevented from rotating, and the shaft 61 is rotated in a direction corresponding to forward travel of the carriage 15, the nut 67 will move away from the bearing 63 and toward the bearing 62, whereas reverse movement of the carriage will cause the nut to move toward the bearing 63. When the nut is in its normal or starting position near the bearing 63, as shown in full lines in Fig. 5, its rotation is controlled by a tooth 69 carried by a lever 70 connected to the plunger of a solenoid 71. The lever is so weighted that when the solenoid is deenergized the tooth 69 will be out of engagement with the toothed periphery of the nut, and when the solenoid is energized the tooth will engage the said periphery and prevent rotation

of the nut. Whenever the nut 67 moves away from its normal position adjacent the bearing 63, its toothed periphery will engage a fixed rib 72 mounted on the bottom wall of the casing 34 and arranged to prevent rotation of the nut.

The movements of the nut 67 along the shaft 61 are utilized to control the operation of certain electrical switches. A normally open switch 74 is mounted on the bearing 63 and provided with a yieldable operating finger 75 arranged to be engaged by the nut 67 when the latter reaches its normal position shown in full lines in Fig. 5. In addition two normally closed switches 77 and 78 are provided with forked operating arms 79 and 80 respectively, these arms being located in the path of the nut 67 as it moves along its shaft. When the nut has traveled forwardly to the position 67B (indicated by broken lines in Fig. 5) it will open the switch 77, and when it reaches the position 67C it will open the switch 78. These switches will be closed in the reverse order during the return movement of the nut. The switch 77 is shown combined with a normally closed switch 77A.

The particular embodiment illustrated is arranged to center the billets on any selected one of three center lines marked A, B and C in Fig. 1. If the billets are greater in length than half the furnace width, they will be centered on line B, whereas if they are shorter they will be centered on lines A and C alternately to form two rows of billets within the furnace. The switches 77 and 78 are so located with respect to the switch 74 that movement of the nut 67 from its full line position to position 67B corresponds proportionately to movement of the carriage 15 through a distance equal to the distance *b* between centerlines A and B. Similarly, movement of the nut 67 from position 67B to position 67C corresponds proportionately to movement of the carriage through a distance equal to the distance *a* between centerlines B and C. The total distance through which the nuts 38 and 39 must move along the shaft 24 from their normal or starting positions shown in Fig. 3 until they are near enough to one another to open the switch 52, as shown in Fig. 4, corresponds proportionately to movement of the carriage through a distance equal to the distance *d* from the pusher arm 14 (in its rearmost position) to the flag 31, plus twice the distance *c* from the flag 31 to the center line A. The driving gears for the shafts 24 and 61, and the pitch of the screw threads on these shafts, are selected in accordance with the foregoing requirements. The actual scale of the various parts is not important, but the movements of the nuts should be greatly reduced in comparison with that of the carriage. For example, one fourth inch of nut travel might correspond to one foot of carriage travel.

Referring now to the electrical wiring diagram shown in Fig. 8, it will be seen that there is provided a suitable electrical supply 82 controlled by a main switch 83. Several magnetic contactors are also provided. One contactor coil F controls normally open switches Fa, Fb, Fc, and Fd, and a normally closed switch Fe. Another contactor coil R controls normally open switches Ra, Rb, and Rc. A coil 85 controls normally open switches 85a and 85b, a coil 86 controls normally open switches 86a and 86b, a coil 87 controls a normally closed switch 87a and a normally open switch 87b, a coil 88 controls normally open switches 88a, 88b, and 88c, and a coil 89 controls two normally closed switches 89a and 89b. There

is also provided a safety switch 91, a normally open push button 92, and a selector switch 93 having contacts 93a, 93b, and 93c. An auxiliary switch 94 is mounted on an insulated extension of the selector switch, the parts being so arranged that the switch 94 will be closed whenever either of contacts 93b and 93c is engaged by the selector switch, but not when contact 93a is engaged.

The electrical connections to the various coils and switches are clearly shown in the diagram. The coil F is connected in series with the safety switch 91, the push button 92, the switch 28 and the switch 52. The switch Fc is connected in parallel with the push button 92. The coil R is connected in series with the safety switch 91, the switch Fe, and the switch 29. The switches Fa and Fb are connected in circuit with the motor 22 to energize the same for forward rotation, and the switches Ra and Rb are connected in circuit with the said motor to energize the same for reverse rotation. A series circuit is provided through the switch Rc, coil 89, and switch 74. A series circuit is provided through the switch Rc, switch 50, and coil 85, and a further series circuit is provided through the switch Rc, switch 85a, switch 87a and solenoid 43. The negative side of the switch 85a is connected directly to the contact 93a, through the switch 77 to the contact 93b, and through the switch 78 to the contact 93c. The switch 87a is connected in parallel with the switch 85b. A series circuit is provided through the switch Fa, switch 31a, switch 77a, and coil 87, the selector switch 93 being connected to the negative side of the switch Fa. Series circuits are provided from the contact 93a through the switch 87b, and the coil 87; from the contact 93a through the switch 94, the switch 31b, and the coil 88; from the contact 93a through the switch 94, the switch 88a, and the coil 88; from the contact 93a through the switch 94, the switch 31c, and the coil 86; and from the contact 93a through the switch 94, the switch 85b, the switch 89a, and the solenoid 48. The switch 85b is connected in parallel with the switch 88c. The switches 89b and 86a are connected in series with the coil 86. The switch 86b is connected in series with the solenoid 71.

The operation of the invention will now be apparent from the above disclosure. A billet of length L will be moved by any suitable means to a position in front of the pusher arm 14. Assuming that the billet is to be centered with respect to the centerline A within the furnace, the operator will place the selector switch 93 in engagement with contact 93a, as shown in Fig. 8. He will then close the main switch 83 and thereafter close push button 92 momentarily. This will energize coil F, closing switches Fa, Fb, Fc, and Fa, and opening switch Fe. Closing Fc will shunt the push button 92 and maintain a holding circuit for the coil F upon release of the push button. Closing Fa will energize solenoid 43 through switch 87a, holding tooth 41 out of engagement with nut 38, so that this nut will be free to turn with the shaft 24. Since switch 94 is open, solenoids 48 and 71 remain deenergized, tooth 46 will engage nut 39 to prevent it from turning, and tooth 69 will be out of engagement with nut 67 so that it will be free to turn. Closing Fa and Fb will start the motor 22 and the carriage 15 in a forward direction and close the limit switch 29, the nut 39 moving to the left in Fig. 3. When the carriage has moved a distance (d-L), the front end of the billet will depress the flag 31, closing switch 31a, energizing coil 87,

opening switch 87a and closing switch 87b to maintain a holding circuit for coil 87. This will deenergize solenoid 43, tooth 41 will engage nut 38, this nut will move to the right toward the approaching nut 39, and switch 50 will open. As nut 38 leaves tooth 41 it will engage rib 44 which will continue to prevent rotation of the nut. When the two nuts meet, as shown in Fig. 4, nut 38 will engage the finger 53 and open the switch 52. As switch 52 opens, coil F will be deenergized, opening switches Fa, Fb, Fc, and Fa, and closing switch Fe, thus energizing coil R and closing switches Ra, Rb, and Rc. Opening the switch Fa will deenergize coil 87, closing switch 87a, the solenoid 43 remaining deenergized. The motor 22 will be reversed, the pusher arm 14 will be withdrawn, and the nuts 38 and 39 will move apart, closing switch 52. As nut 38 reaches its original position shown in Fig. 3, it will close switch 50, energizing coil 85 and closing switch 85a. This will energize the solenoid 43 through switch 87a, releasing tooth 41 from nut 38, so that the nut will turn freely with the shaft while nut 39 continues to move laterally toward its original position and the carriage lug 27 eventually opens the limit switch 29. This will deenergize coil R, opening switches Ra, Rb, and Rc, and stopping the motor 22. The limit switch 28 serves merely as a safety stop to prevent overtravel of the carriage in a forward direction. The switch 31 permits emergency stopping of the carriage in either direction.

It will now be apparent that the forward movement of the carriage 15 required to bring the front end of the billet into engagement with the flag 31 is (d-L), and that during this movement the nut 39 will travel a distance proportionate to (d-L). Since the total travel of the nuts 38 and 39 required to open the switch 52 is by construction proportionate to the distance (d+2c), it follows that the movement of both nuts after the flag 31 is depressed will be proportionate to (d+2c)-(d-L), or (L+2c). During such movement through a distance proportionate to (L+2c), each of the nuts 38 and 39 will move through a distance proportionate to

$$\frac{L+2c}{2}$$

and the carriage 15 will therefore travel through the distance

$$\frac{L+2c}{2}$$

before it is reversed. The total travel of the carriage will therefore be

$$(d-L) + \frac{L+2c}{2}, \text{ or } d + c - \frac{L}{2}$$

and the pusher arm 14 will stop at a point one-half the length of the billet from the center line A. The billet will therefore be symmetrically positioned with respect to the center line A, and can thereafter be advanced broadside along the furnace by a stroke of the pusher 12.

If now a billet is to be centered on the line B, the operator will place the selector switch 93 in engagement with the contact 93b, thus closing the switch 94. He will then close the push button 92 momentarily, energizing coil F, closing switches Fa, Fb, Fc, and Fa, and opening switch Fe. Closing switch Fc will shunt the push button and complete a holding circuit for the coil F. Closing switch Fa will energize solenoid 43 through switches 77 and 87a, leaving nut 38 free

to rotate. Solenoids 48 and 71 will remain de-energized, nut 39 will be locked against rotation, and nut 67 will be free to turn. Closing switches Fa and Fb will start the motor 22 and the carriage 15 forwardly and close the limit switch 29, the nut 39 moving to the left in Fig. 3. The pusher arm 14 will advance the billet endwise until its front end depresses the flag 31 and closes switches 31a, 31b, and 31c, thus energizing coils 87, 88 and 86, opening switch 87a and closing switches 87b, 88a, 88b, 88c, 86a, and 86b. The closed switch 87b completes a holding circuit for coil 87, the closed switch 88a completes a holding circuit for coil 88, and the closed switch 86a completes a holding circuit for coil 86. The closed switch 88b maintains the energization of solenoid 43 despite the opening of switch 87a, so that nut 38 will remain free to rotate. The closed switch 88c energizes the solenoid 48, so that nut 39 will be free to rotate and hence will stop its lateral movement toward the left. The closed switch 86b will energize the solenoid 71, causing the tooth 69 to engage the nut 67 and cause this nut to move to the left in Fig. 5, and open the switch 74, the rib 72 preventing rotation of the nut as it leaves the tooth 69. When the tail end of the billet leaves the flag 31, switches 31a, 31b, and 31c will open. When the nut 67 has traveled through a distance proportionate to the distance b and reached the position 67B, it will open the switches 77 and 77a and deenergize the solenoid 43, so that nut 38 will be locked against rotation and start to move to the right. Opening the switch 77 will also break the holding circuits for coils 87 and 88, deenergizing these coils, closing switch 87a and opening switches 87b, 88a, 88b, and 88c. Opening switch 88c will deenergize solenoid 48, and nut 39 will be locked against rotation and will start to move to the left again to meet nut 38. Nut 67 will continue to move to the left, being locked by the rib 72. When nuts 38 and 39 meet, and the switch 52 is opened, coil F will be deenergized, switches Fa, Fb, Fc, and Fd will open, and switch Fe will close. This will energize coil R, closing switches Ra, Rb, and Rc. The motor 22 will be reversed, the pusher arm 14 will be withdrawn, the nuts 38 and 39 will move apart, closing switch 52, and the nut 67 will move to the right. When nut 67 reaches position 67B it will close switch 77, and at the same time nut 38 will reach its rest position shown in Fig. 3 and close switch 50. This will energize coil 85, and close switches 85a and 85b, energizing solenoids 43 and 48. Nuts 38 and 39 will thus be free to turn with the shaft 24 while the nut 67 continues to move laterally from its position 67B to its rest position shown in Fig. 5, closing switch 74. This will energize coil 89 and open switches 89a and 89b, deenergizing solenoid 48, breaking the holding circuit for coil 86, opening switches 86a and 86b, and deenergizing solenoid 71. Nut 67 will then be free to turn without lateral motion, and nut 39 will be locked against rotation and caused to move laterally to its rest position. At the same time the carriage 15 will reach its rest position, opening the limit switch 29, stopping the motor and deenergizing all the coils and solenoids.

It will be seen that the movement of the nuts 38 and 39 toward one another is exactly the same as when centering billets on the line A, except that these nuts remain stationary while the nut 67 travels from its rest position to the position 67B. By construction this amount of travel of the nut 67 is proportionate to the distance b from center line A to center line B. Hence the car-

riage and pusher arm will travel, before reversal, a distance b further than they would if the billet were to be centered on the line A. Consequently the billet will be accurately centered on the line B.

If the operator wishes to center a billet on the line C, he will place the selector switch 93 in engagement with the contact 93c and thus close the switch 94. The subsequent operation will be exactly the same as when centering on the line B, except that the switch 78 will be effective in place of the switch 77. Since the distance between the switches 77 and 78 is by construction proportionate to the distance a between the center lines B and C, it necessarily follows that the movement of the carriage before reversal will be increased by the distance a, and the billet will be symmetrically placed with respect to the center line C. If it is desired to provide for more than three center lines in the furnace, all that is required is the provision of additional contacts on the selector switch 93, similar to the contacts 93b and 93c, and additional switches, similar to the switches 77 and 78, suitably positioned in the path of the nut 67 and connected to the corresponding additional selector switch contacts. Obviously, as many additional switches and contacts may be provided as is required in any particular case.

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

1. Billet charging mechanism comprising a reciprocable charging member having a predetermined rest position, means to reciprocate said member and to effect, by the forward travel thereof from the said rest position, the endwise charging movements of successively-presented billets of different lengths, an adjustable selector device for predetermining the location of a point in the path of the billets, a control device located in a fixed position and arranged to be actuated in response to the arrival adjacent thereto of the front end of each billet during its charging movement, and automatic means controlled jointly by the position of the selector device and by the actuation of the measuring device for terminating the forward travel of the charging member when the center of each billet reaches the said point.

2. Billet charging mechanism comprising a reciprocable charging member, means to reciprocate said member and to effect, by the forward travel thereof, the endwise charging movements of successively-presented billets of different lengths, automatic means normally effective to terminate the forward travel of said member when the center of the billet being charged reaches a predetermined point, and selectively operable means to postpone such termination until the said member has moved forwardly through a predetermined further distance.

3. Billet charging mechanism comprising a reciprocable pusher having a predetermined rest position and arranged to engage the rear ends of successively-presented billets of different lengths and to effect, by its forward travel from the said rest position, endwise charging movements of such billets, means to reciprocate said pusher, a pair of members for controlling the forward stroke of said pusher, said members having their maximum separation when the pusher is in its rest position and approaching each other during the said forward stroke for termination thereof when they meet, means to restrain the approach movement of one of said members until the front end of the billet reaches a predeter-

mined position, and selectively operable means to restrain the approach movement of both of said members while the pusher moves forwardly through a predetermined further distance.

4. Billet charging mechanism comprising a reciprocable pusher having a predetermined rest position and arranged to engage the rear ends of successively-presented billets of different lengths and to effect, by its forward travel from the said rest position, endwise charging movements of such billets, means to reciprocate said pusher, a pair of members for controlling the forward stroke of said pusher and movable at speeds proportionate to the speed of the pusher, said members having their maximum separation when the pusher is in its rest position and approaching each other during the said forward stroke for termination thereof when they meet, means to restrain the approach movement of one of said members until the front end of the billet reaches a predetermined position, a third member movable at a speed proportionate to that of the pusher, means to restrain movement of the third member until the front end of the billet reaches the said predetermined position, and selectively operable means to restrain the approach movement of both the members of the said pair while the third member moves through a predetermined distance.

5. Billet charging mechanism comprising a reciprocable pusher having a predetermined rest position and arranged to engage the rear ends of successively-presented billets of different lengths and to effect, by its forward travel from the said rest position, endwise charging move-

ments of such billets, a reversible electric motor connected to the pusher to reciprocate the same, a pair of members actuated by the motor and having their maximum separation when the pusher is in its rest position, the members approaching each other during the forward stroke of the pusher and reversing the motor when they meet, means to restrain the approach movement of one of said members until the front end of the billet reaches a predetermined position, a third member actuated by the motor, means to restrain movement of the third member until the front end of the billet reaches the said predetermined position, and selectively operable means to restrain the approach movement of both the members of the said pair while the third member moves through a predetermined distance.

6. Billet charging mechanism comprising a reciprocable charging member, means to reciprocate said member and to effect, by the forward travel thereof, the endwise charging movements of successively-presented billets of different lengths, a control device arranged to be actuated by the passage of the front end of each billet during the charging movement thereof, automatic means controlled jointly by the control device and by the length of the billet arranged to terminate the forward travel of the charging member when the center of the billet has reached a point at a predetermined distance beyond the control device, and selectively operable means to postpone such termination until the said member has moved forwardly through a predetermined further distance.

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