July 25, 1933. D. L. SUMMEY 1,920,133

BILLET FEEDING AND HEATING APPARATUS

Original Filed Feb. 20, 1928 11 Sheets-Sheet 1

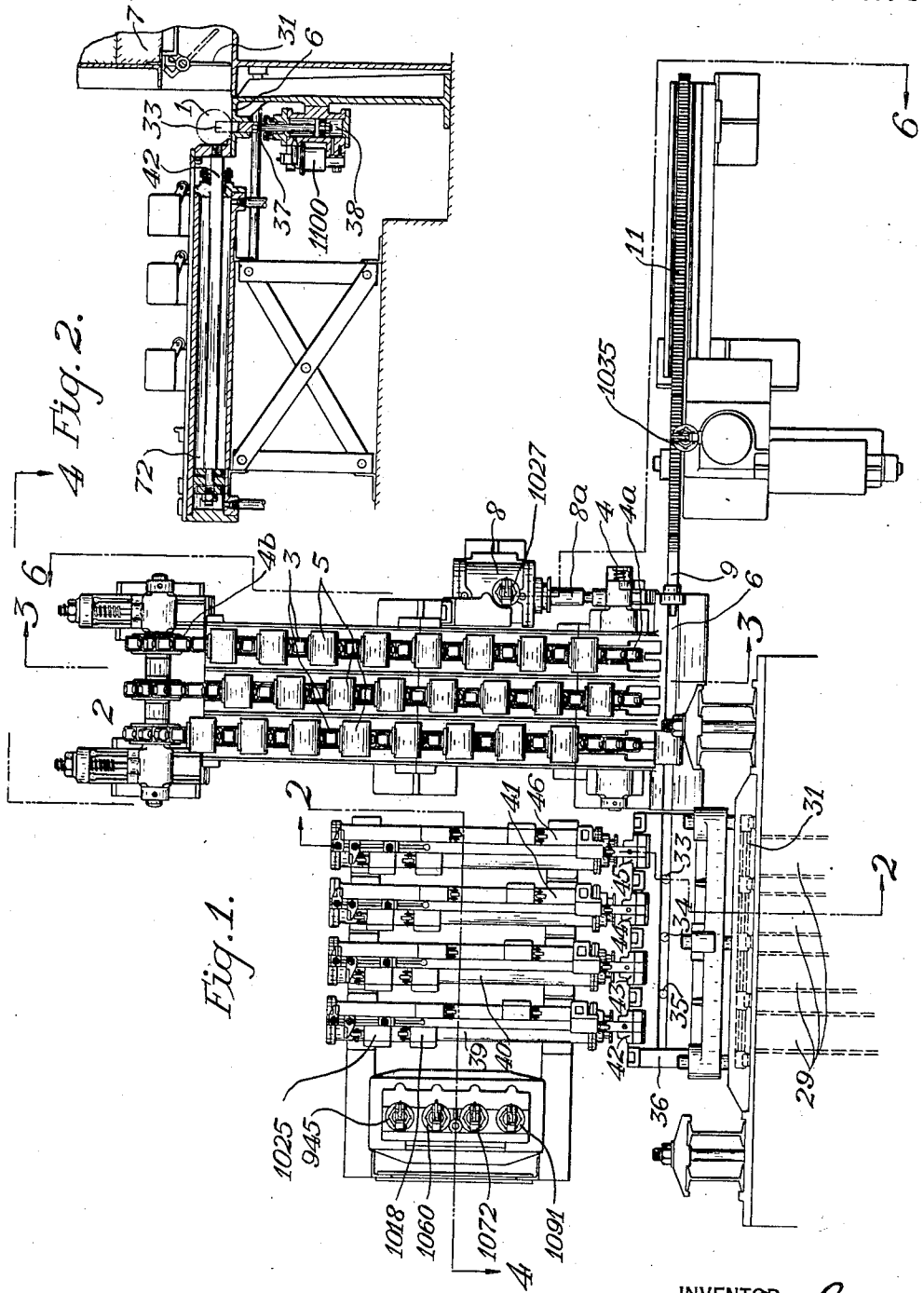


Fig. 1.

Fig. 2.

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BILLET FEEDING AND HEATING APPARATUS

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Fig. 3.

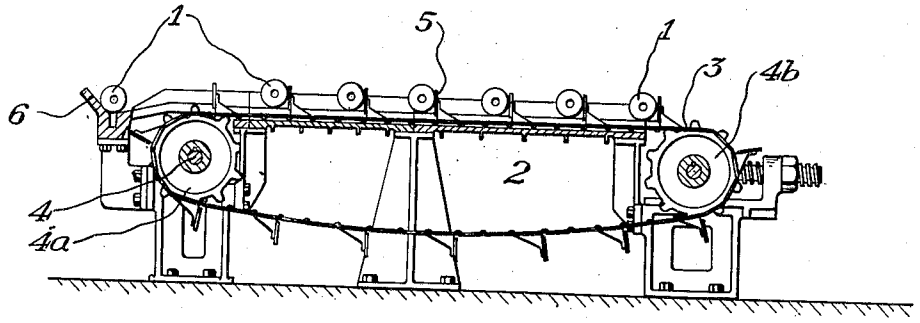
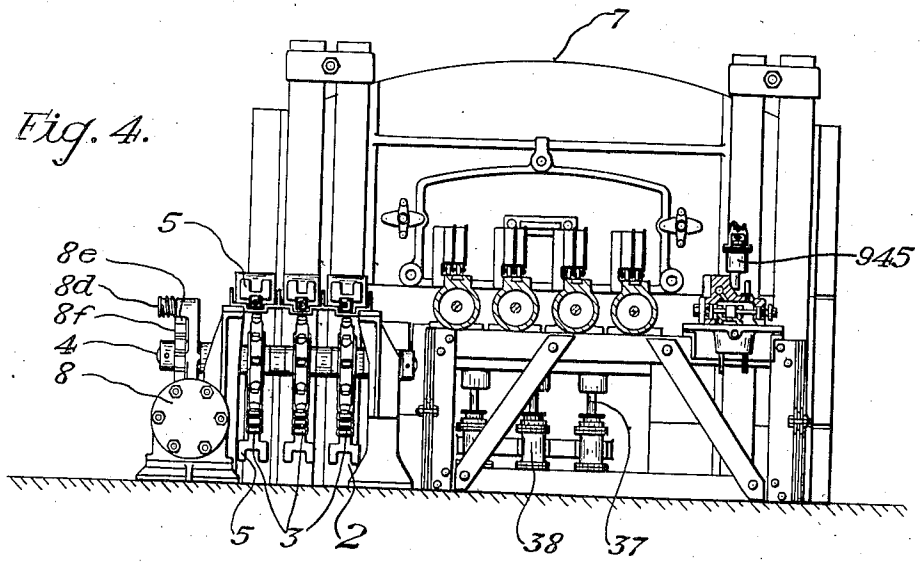


Fig. 4.



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BILLET FEEDING AND HEATING APPARATUS

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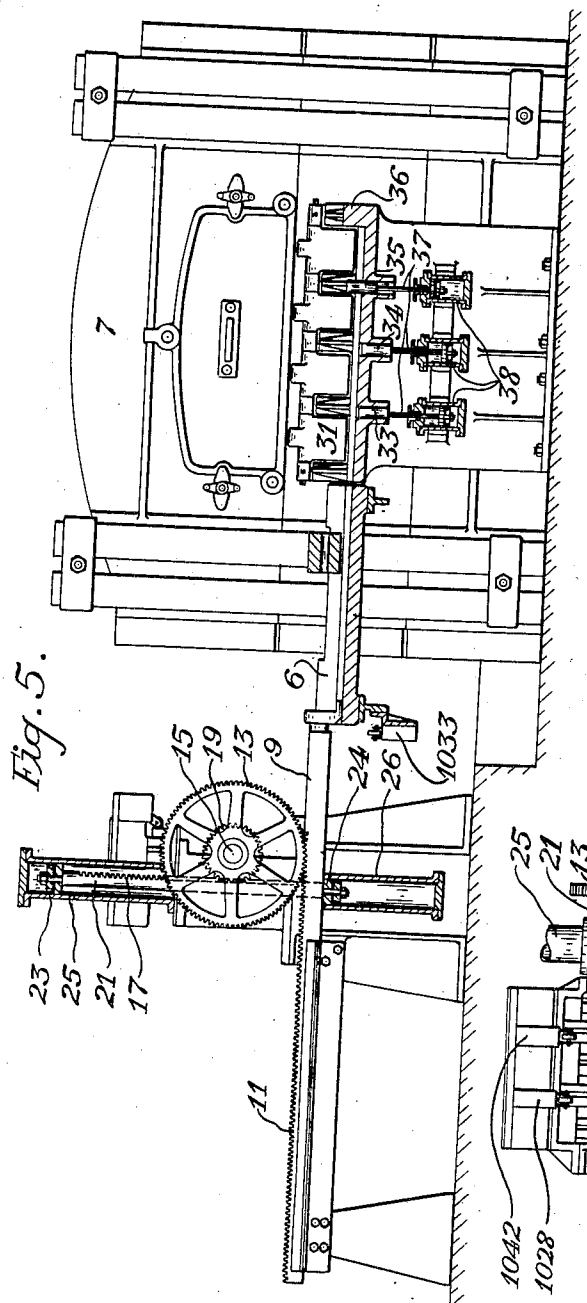


Fig. 5.

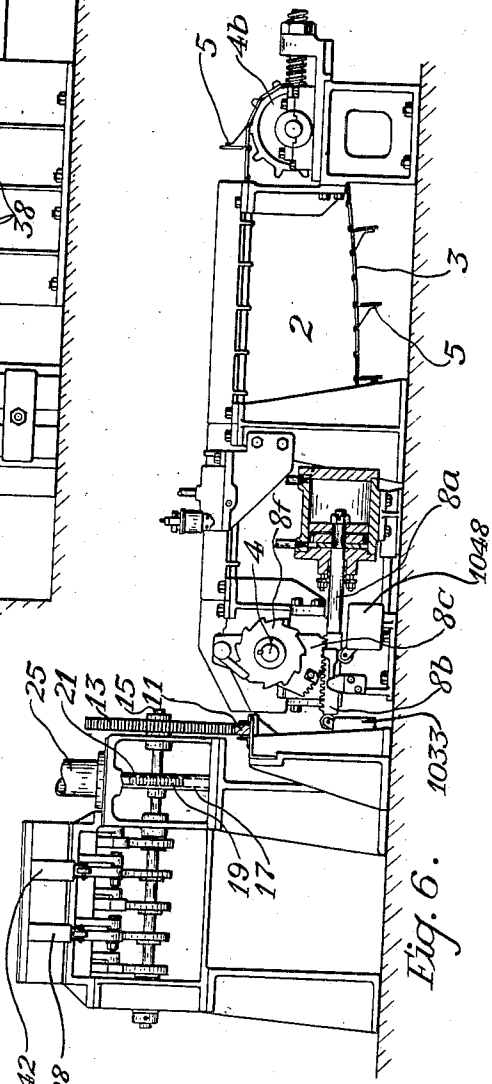


Fig. 6.

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BILLET FEEDING AND HEATING APPARATUS

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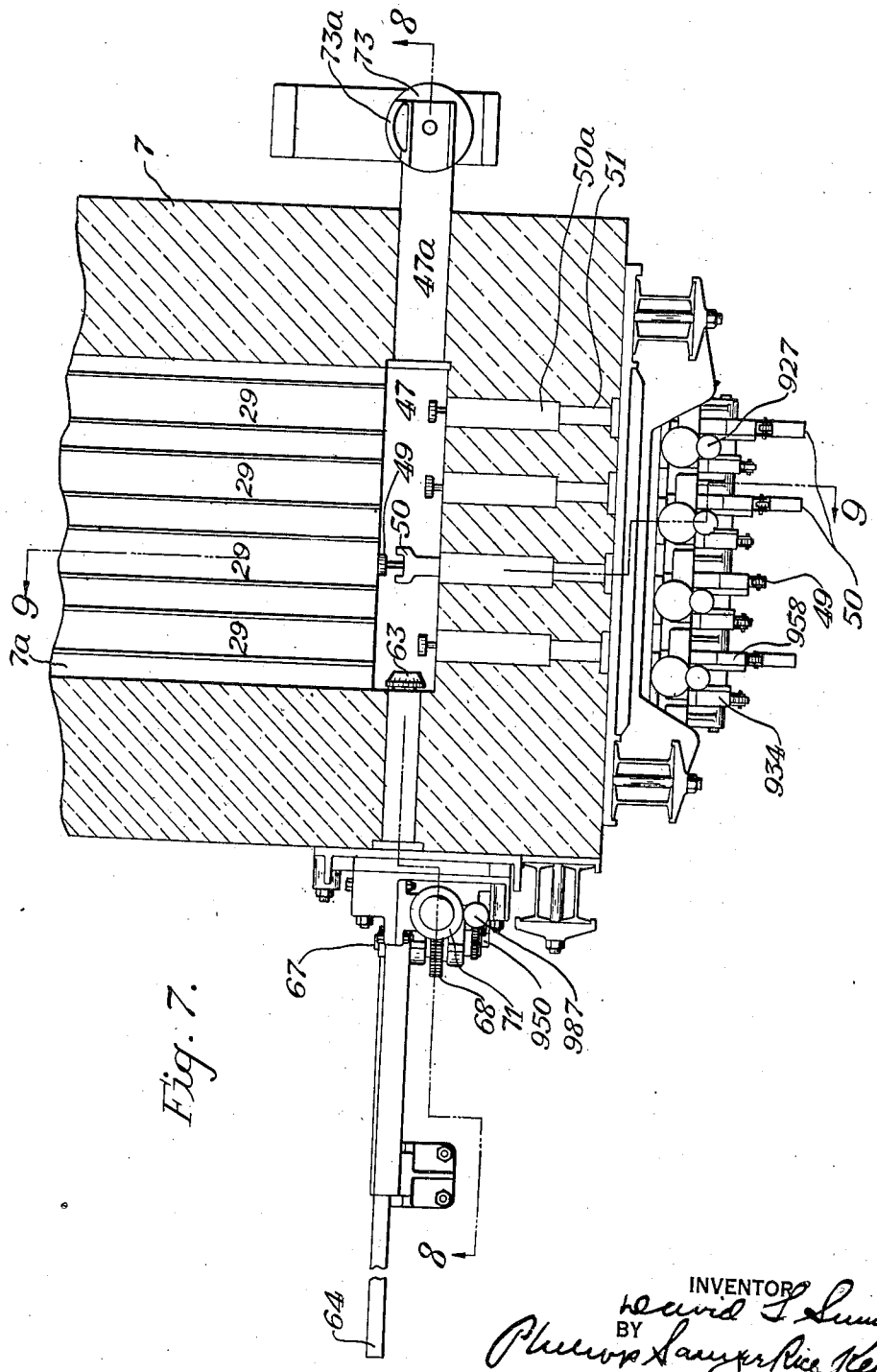


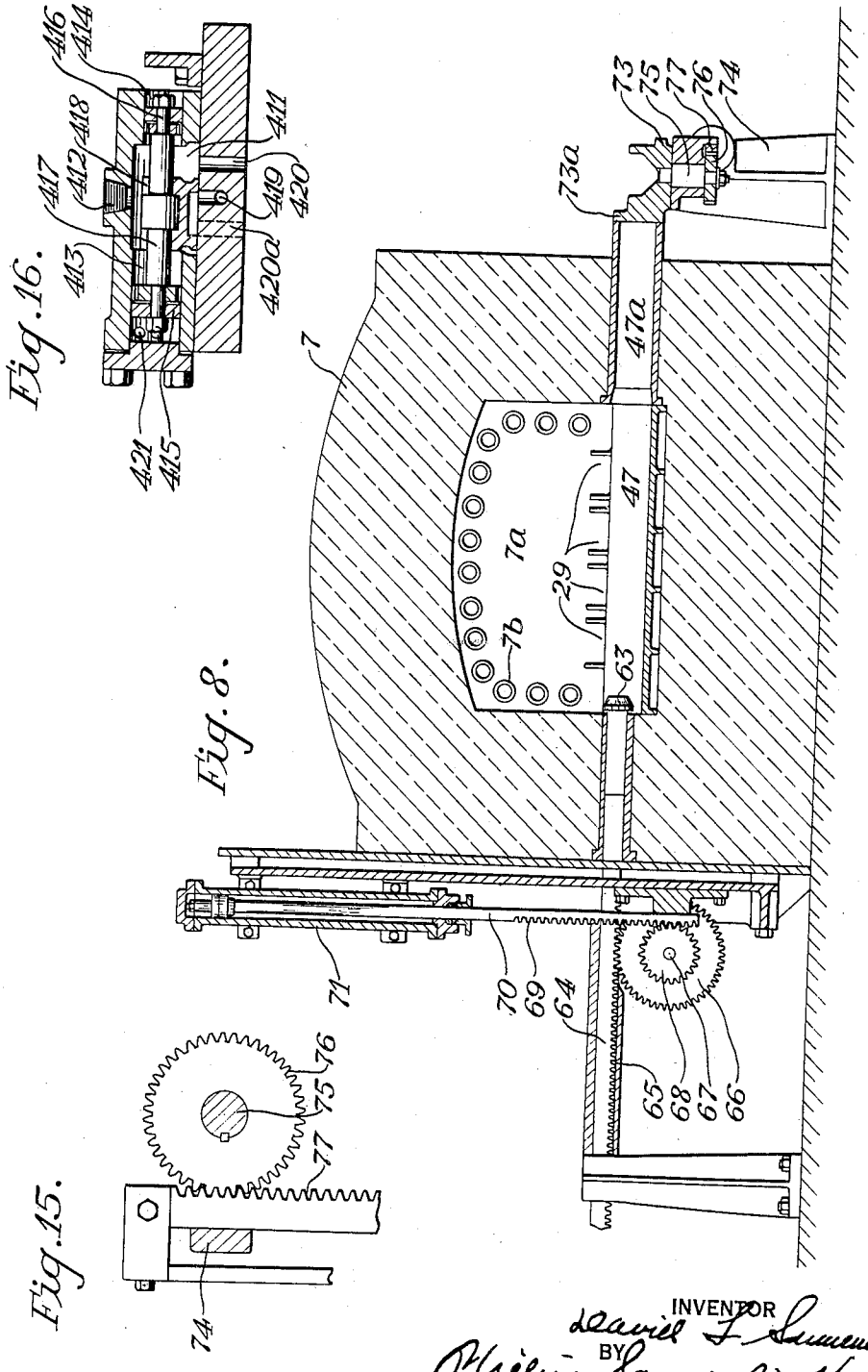
Fig. 7.

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BILLET FEEDING AND HEATING APPARATUS

Original Filed Feb. 20, 1928 11 Sheets-Sheet 5



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BILLET FEEDING AND HEATING APPARATUS

Original Filed Feb. 20, 1928 11 Sheets-Sheet 6

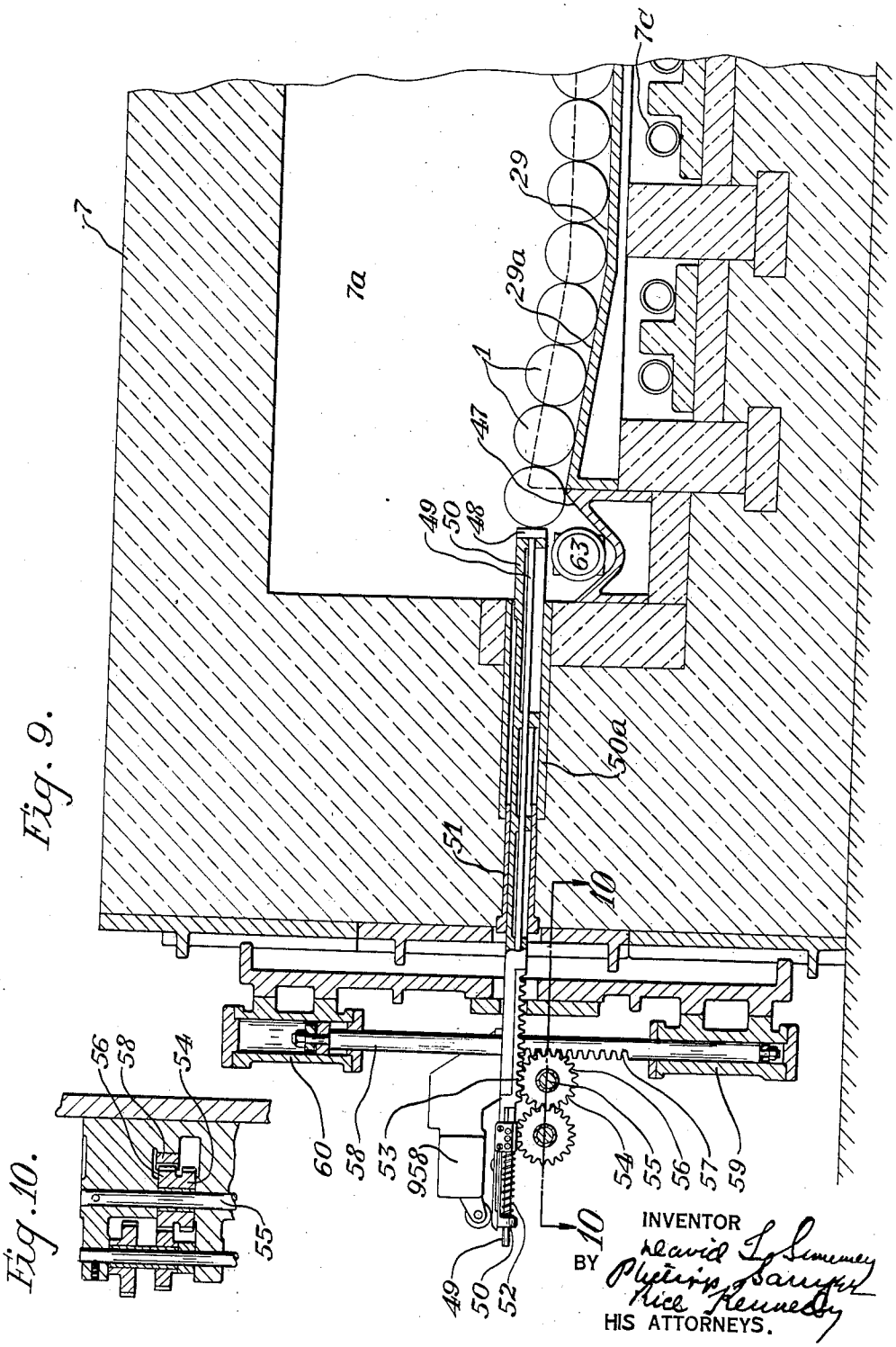


Fig. 9.

Fig. 10.

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BILLET FEEDING AND HEATING APPARATUS

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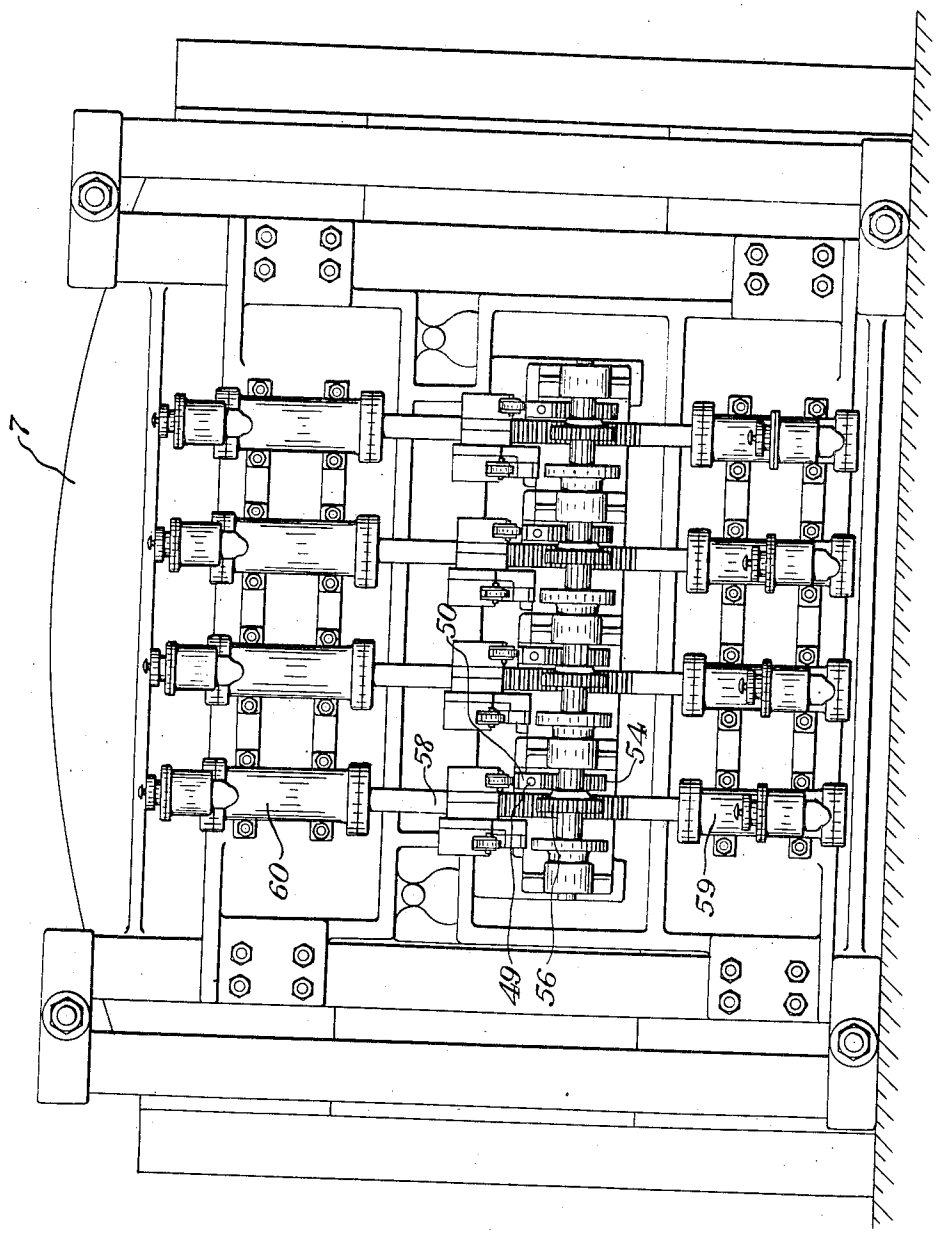


Fig. 11.

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BILLET FEEDING AND HEATING APPARATUS

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Fig. 13.

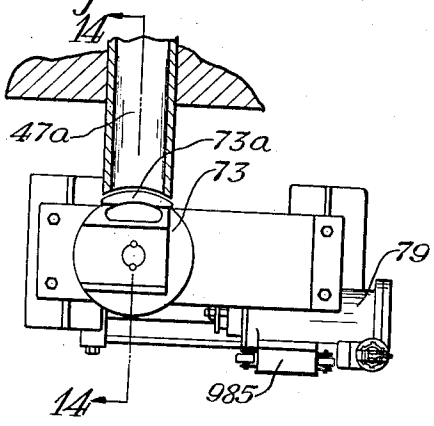


Fig. 12.

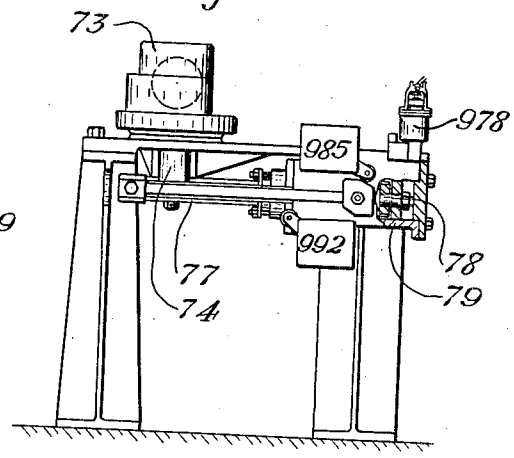
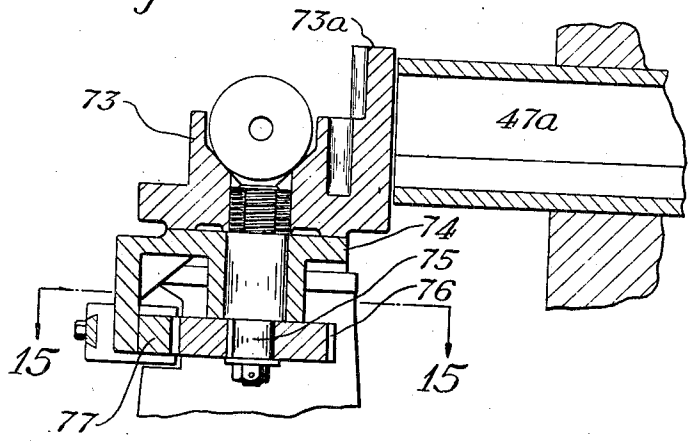


Fig. 14.



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July 25, 1933. D. L. SUMMEY 1,920,133

BILLET FEEDING AND HEATING APPARATUS

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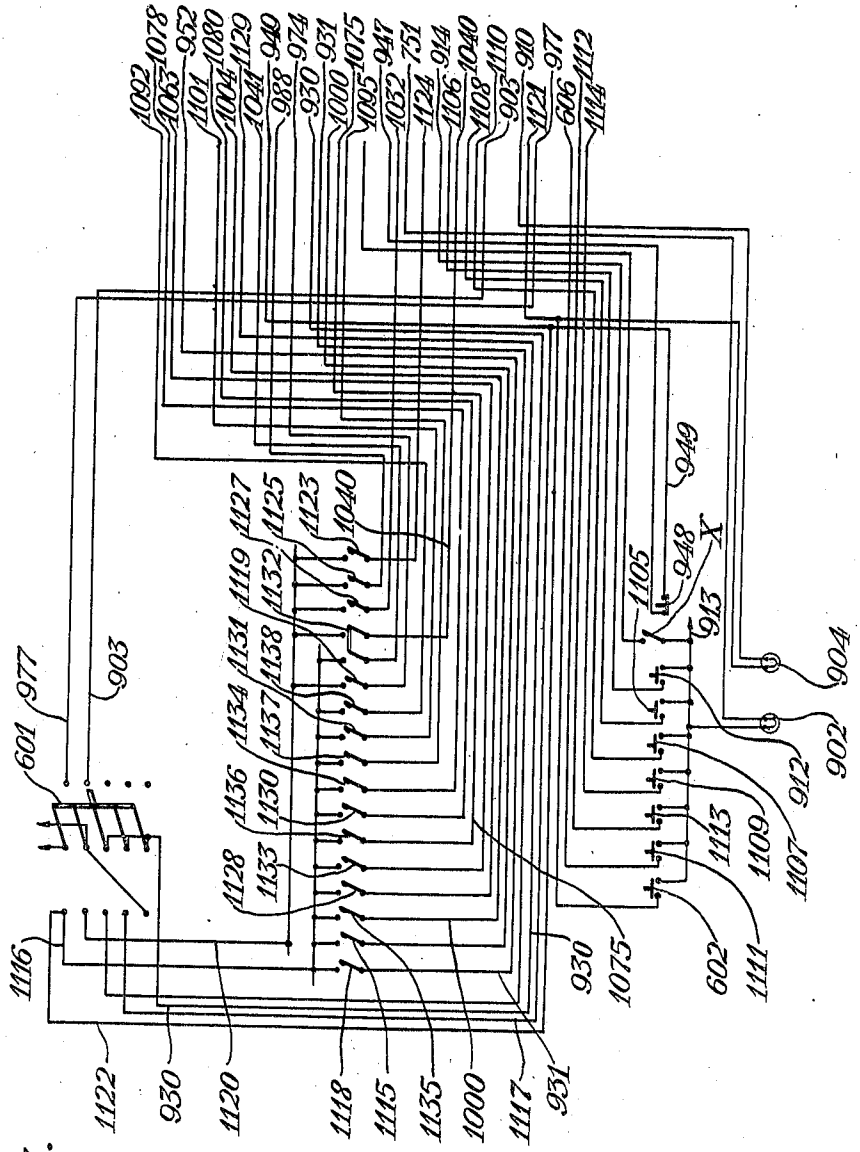


Fig. 17.

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BILLET FEEDING AND HEATING APPARATUS

Original Filed Feb. 20, 1928 11 Sheets-Sheet 10

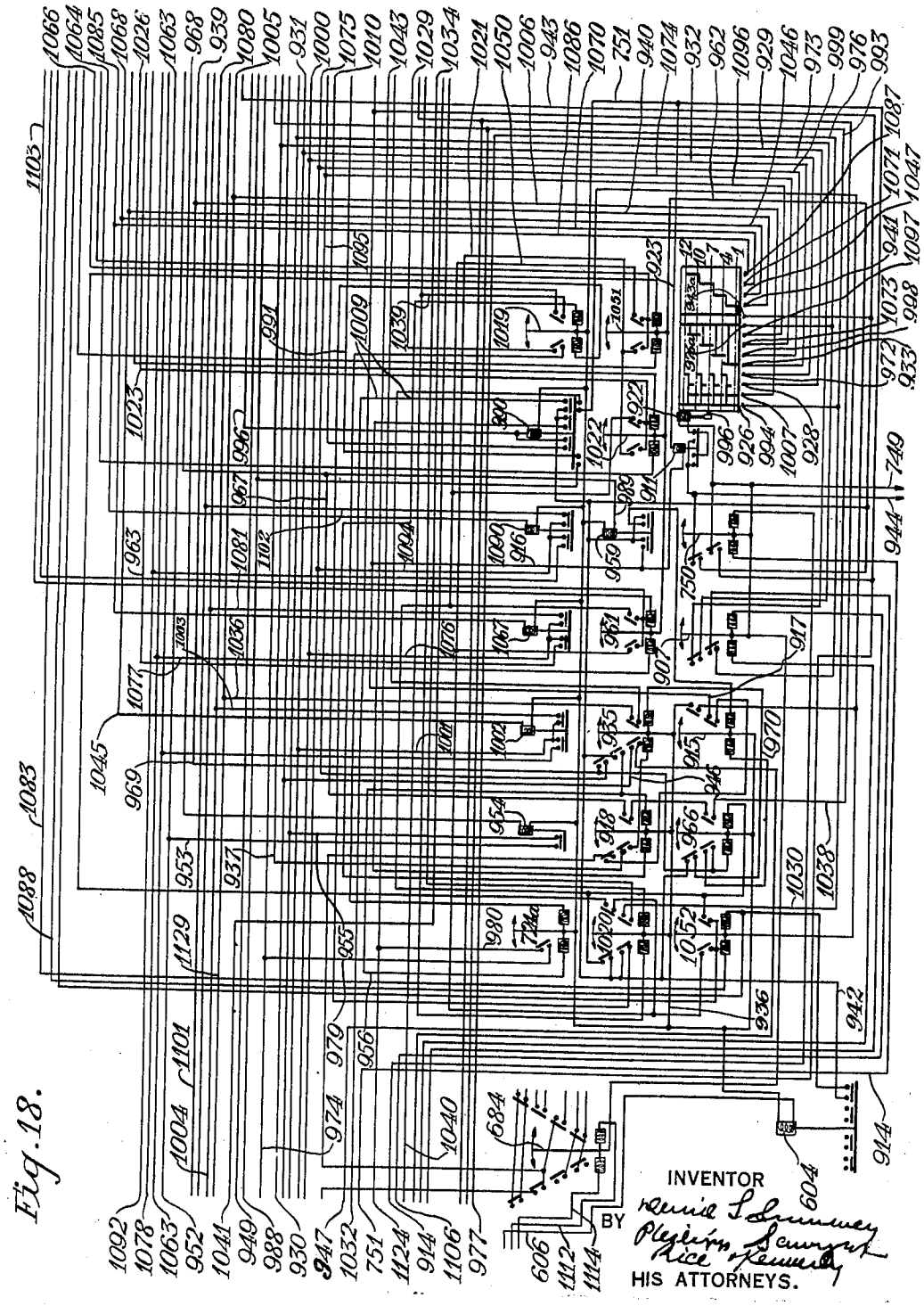


Fig. 18.

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BILLET FEEDING AND HEATING APPARATUS

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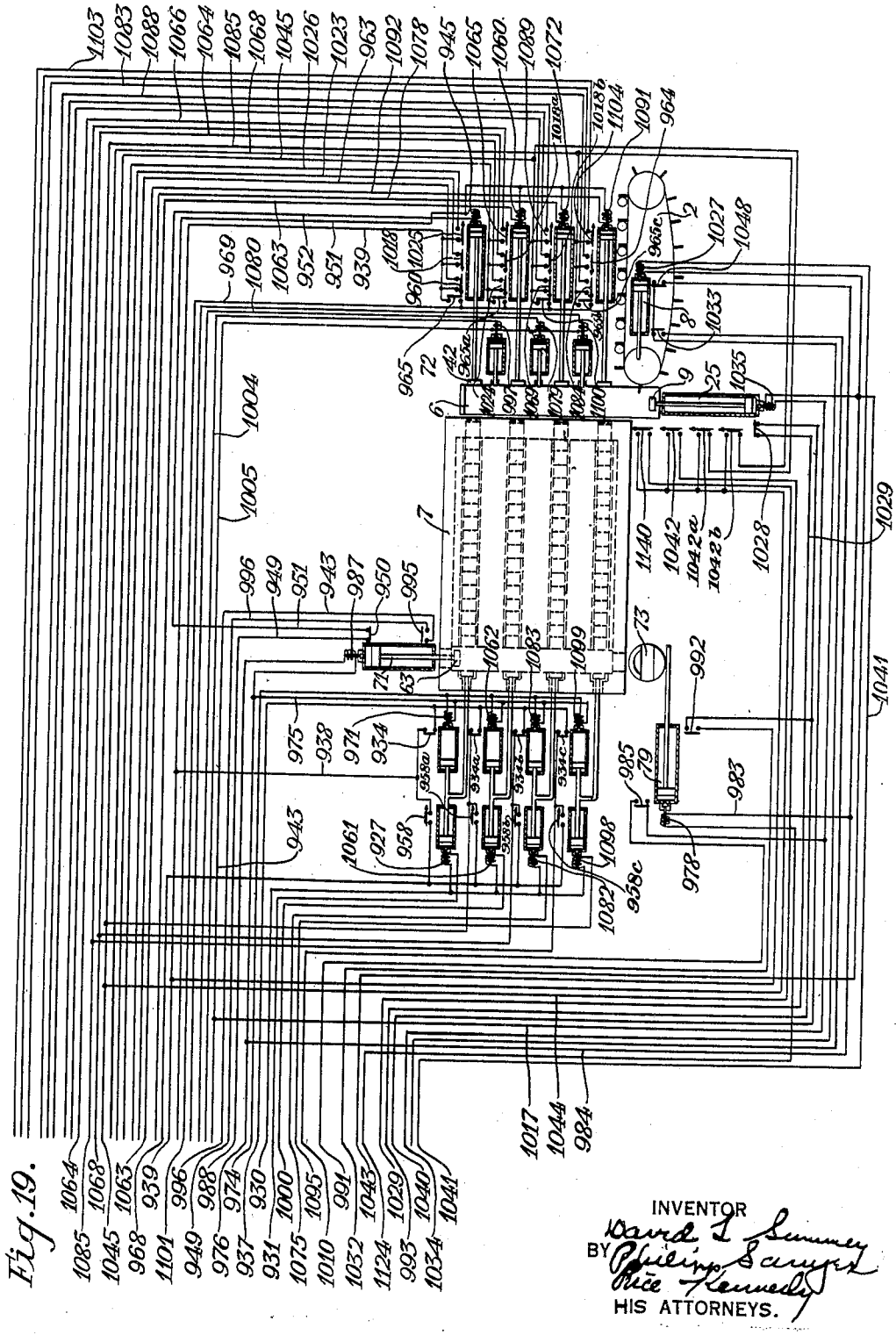


Fig. 19.

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UNITED STATES PATENT OFFICE

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BILLET FEEDING AND HEATING APPARATUS

Original application filed February 20, 1928, Serial No. 255,644. Divided and this application filed July 25, 1929, Serial No. 380,805. Renewed March 16, 1932.

This invention relates to billet feeding and heating apparatus.

The present application is a division from an application filed February 20, 1928, Serial No. 255,644, now Patent No. 1,768,866.

It is an object of the invention to provide a billet feeding and heating apparatus such that the supply, heating and delivery of successive billets is carried on automatically and in an economical manner.

With this general object in view, the invention consists in the features, combinations, details of construction and arrangement of parts which will first be described in connection with the accompanying drawings and then more particularly pointed out.

In the drawings:—

Figure 1 is a plan view of the charging end of an apparatus constructed in accordance with the invention;

Figures 2, 3 and 4 are sectional views taken on the lines 2—2, 3—3 and 4—4, respectively, of Figure 1;

Figure 5 a view in end elevation with parts in section of the charging end of the furnace;

Figure 6 is a sectional view taken on the line 6—6 of Figure 1;

Figure 7 is a view partly in plan and partly in horizontal section of the discharge end of the furnace;

Figure 8 is a sectional view taken on the line 8—8 of Figure 7;

Figure 9 is a sectional view taken on the line 9—9 of Figure 7;

Figure 10 is a sectional view taken on the line 10—10 of Figure 9;

Figure 11 is a view in end elevation (enlarged) of the discharge end of the furnace;

Figure 12 is a view in elevation with parts in section of a portion of the apparatus at the discharge end of the furnace;

Figure 13 is a plan view, with parts in section, of billet transfer mechanism;

Figure 14 is a sectional view taken on the line 14—14 of Figure 13;

Figure 15 is a sectional view taken on the line 15—15 of Figure 14;

Figure 16 is an explanatory view of a type of air control valve adapted for use with the apparatus;

Figures 17–19 are wiring diagrams.

While many features of the invention are capable of a wide range of uses, the drawings illustrate, by way of example, an apparatus for feeding and heating billets, and automatic means for causing operation of the various parts in a predetermined cycle. In this exemplification, the various movements are effected by fluid pressure power units, and these power units are so controlled that the apparatus functions automatically, each step being dependent on the successful completion of one or more preceding steps, from the placing of a cold billet in a magazine to the delivery of a hot billet.

For convenience, the mechanical features of the apparatus will be first described apart from the automatic controls.

Referring to the drawings, there is provided means for heating billets and this may conveniently be an electric furnace capable of such heat control as to make possible uniform heating of successive billets. In the present embodiment the furnace is illustrated more or less conventionally and comprises a housing 7, enclosing a furnace chamber 7*a*. This chamber may be heated in any suitable manner, for example, by electric resistors such as are described in applicant's copending application filed June 5, 1926, Serial No. 113,852. On Fig. 8 are indicated resistor coils 7*b* and additional coils 7*c* are indicated in Fig. 9. The temperature may be controlled in any suitable manner. Extending lengthwise of this furnace are a plurality of billet paths, in this instance four, formed by troughs 29 (Figs. 7–9) of a suitable material, for example, nickel chromium alloy. The billets 1 here provided for are short lengths of cylindrical stock and the troughs 29 are arranged to receive and guide the billets in sidewise movement. That is, the billets lie transversely in their passage through the furnace. At the entrance end, the furnace has a plurality of inwardly swinging self-clos-

ing hinged doors 31 (Figs. 2 and 5), one door being provided for each path.

There is provided means for feeding billets to the furnace paths in predetermined order, for example, to the several paths in rotation. This may be accomplished by individual infeed pushers for the various paths and means for positioning the billets for these pushers. Although capable of various constructions, in that here shown as an example, in line with the four billet troughs 29 are four infeed pushers 42, 43, 44 and 45 (Figures 1 and 2). These pushers are formed as parts of piston rods of fluid pressure units 39, 40, 41, 46 (Figures 1 and 2).

These fluid pressure units, as well as others herein referred to, comprise cylinders and pistons of suitable construction and are connected in the pressure line in any suitable manner. That end of the cylinder opposite the larger piston area is connected through suitable valve means by which that end of the cylinder may be put under either pressure or exhaust. This may be termed the variable pressure end of the cylinder. The other end, having the smaller piston area, has a direct connection with the pressure line and may be termed the constant return pressure end. Owing to the piston differential, when the variable pressure end of the cylinder is connected in the pressure line the piston is advanced against the ineffective constant pressure. When the variable pressure end is connected with exhaust the constant pressure becomes effective and the piston is automatically returned. Throughout this description of the furnace the fluid pressure units referred to are of this type unless otherwise noted. In this exemplification, the cylinders of the furnace are air-operated.

As an infeed pusher advances under pressure it pushes the waiting billet, positioned as later described, through the swinging door into the corresponding furnace path. By the force of this advance stroke acting on the new billet all the preceding billets in that path are pushed ahead one step. Assuming the path to be full, this discharges the leading billet as hereinafter described. As the infeed pusher withdraws, the door swings shut to close the entrance.

While the billet positioning means may vary, it may include a delivery pusher working past the furnace doors and selective stop means for automatically determining which furnace path is to receive a billet. Although capable of various constructions, in the present embodiment, extending across the entrance end of the furnace is a delivery groove 6 (Figs. 1 and 2) arranged to receive the billets endwise. Paralleling this transverse groove is a delivery push rod 9 (Figs. 5, 6). This push rod has a rack 11 meshing with a gear 13 mounted on a shaft 15. Motion is imparted to this shaft by means of a pinion 19 mounted on the shaft and meshing with a vertical rack 17. This rack is formed as part of a piston rod 21 having, at one end, a piston 23 working in a fluid pressure cylinder 25 and, at its other end, a piston 24 working in a fluid pressure cylinder 26. These two cylinders and pistons form, in effect, the usual fluid pressure unit. That is, cylinder 25, which is the larger in cross section, is connected, at its upper end, either with the pressure line or exhaust. Cylinder 26 is direct-connected, at its lower end, with the pressure line. When cylinder 25 is under pressure, rod 21 is forced downwardly due to the differential between the piston areas. This down stroke of rod 21 causes push rod 9 to advance along the groove 6 to push a billet, supplied as later described, across the delivery end of the furnace. The push rod is withdrawn by the upstroke of piston rod 21 under the constant pressure of cylinder 26, cylinder 25 being at exhaust.

While the selective stop means may vary, in the embodiment here shown as an example, below groove 6, and in front of the far side of the first three doors, are stops 33, 34, 35 (Figs. 1, 2 and 5) vertically slidable in the floor of the groove. When one of these stops is elevated it projects upwardly into the groove and so into the path of the billet being delivered along the groove. As shown, these stops are mounted on duplicate piston rods 37 working in the cylinders of fluid pressure units 38. When one of these stops is advanced it determines the stroke of push rod 9 and positions the delivered billet in front of the corresponding door and in line with the corresponding infeed pusher. For the fourth door, that is, the last one counting from the delivery pusher, a permanent stop 36 is provided. When all the movable stops are retracted the delivery pusher makes a full stroke and the billet is positioned in front of the last door.

The automatic control of these stops is hereinafter described. While the furnace paths may receive billets in any predetermined order, in the present embodiment billets are fed to the four paths in rotation.

There is provided means for supplying billets to the delivery push rod and in structures embodying the invention to the best advantage this supply means is in the nature of a billet magazine capable of holding an excess supply.

Although capable of various constructions, in that here illustrated as an example, extending at right angles to groove 6 are a plurality of supply units, in this instance three (Fig. 1). Each unit comprises an endless chain 3 having a number of spaced

billet-propelling arms 5 and arranged to receive the billets crosswise. The chains pass over suitable sprockets, 4*a* and 4*b*, those at the forward end (Fig. 3) being keyed to a drive shaft 4. To give the supply means a step-by-step motion, as here shown, (Figs. 4 and 6) keyed to shaft 4 is a ratchet 8*f*, the teeth of which are engaged by a pawl 8*e* mounted on a toothed sector 8*c*. This sector is pivoted on shaft 4 and meshes with a rack 8*b* formed as an extension of a piston rod 8*a* working in the cylinder of a fluid pressure unit 8. Operation of this unit causes the shaft 4, and consequently the supply chains, to be moved ahead one step.

In order that only one billet at a time will be supplied to delivery groove 6, the arms 5 on the several chains are staggered, with relation to each other. The chains being filled with billets in any suitable manner, as by an attendant, upon each forward step of shaft 4 one billet is brought into a position where it may roll into delivery groove 6 (Fig. 3), the several chains supplying billets in rotation. The supply means described makes it possible for the attendant to load up billets for a considerable run without regard to the timing of the other parts. The chains are in the nature of a magazine and may be extended in length to give as large a waiting supply as may be desired.

In the present embodiment the hot billets are discharged from the furnace paths by the insertion of a cold billet. That is, every time a cold billet is inserted, the leading hot billet of that path (assuming the path to be full) is discharged by the movement of the entire line of billets under the force of the infeed pusher. There is provided means for controlling the movement of the billets at the discharge end of the furnace. As here shown as an example, at the discharge end, each trough 29 has an upward incline 29*a* (Fig. 9) up which the billets ride. Extending across the discharge ends of the several paths, and located below the crests of these inclines, is a discharge groove 47 arranged to receive the billets endwise. Cooperating with each discharge incline is a billet hold back arranged to hold the leading billet at the crest of the incline, in order to keep the line of billets intact, prevent discharge of more than one billet, and, upon withdrawal, to control the billet to some extent in its movement into the discharge groove. As here shown as an example, each billet holdback comprises a channel-like element 50 reciprocating in guides 50*a*, 51 (Fig. 9).

To operate the billet hold-back, its rear end, which extends outside the furnace, is formed with a rack 53 (Figs. 9, 11) meshing with a pinion 54 mounted on a shaft 55. Also mounted on this shaft is a gear 56 (Fig. 10) meshing with vertical rack 57. Rack 57 is formed as part of a double ended piston rod 58 the pistons of which work in fluid pressure cylinders 59, 60. These units are like the units 25, 26 previously described, except that both cylinders are valve-controlled.

For the advance of an infeed pusher to insert a billet, the billet hold-back for that row is advanced by the downstroke of piston rod 58. This positions the holder (Fig. 9) to engage the leading billet, now on the crest of the incline.

There is provided means for causing the hold-back 50 to be withdrawn upon the arrival of a billet in a predetermined position. This may be accomplished by a detector actuated by the billet as it approaches contact with hold-back 50. Although capable of various constructions, in that here illustrated as an example, a billet detector comprises a billet engaging head 48 on a rod 49 which passes rearwardly through hold-back 50, being slidable in ribs in the latter. The head of the hold-back is recessed or cut away (Fig. 7) to receive detector head 48 but normally the detector head is held slightly advanced by a coiled spring 52 confined between part of rod 49 and part of hold-back 50. When the hold-back is advanced as above described the detector moves forward with it, its head 48 being slightly in advance of the end of the hold-back. As the leading hot billet is pushed up to the crest of incline 29*a* by the insertion of the cold billet, it engages detector head 48 and rod 49 is thrust back against its spring, head 48 being received by the recess in the end of hold-back 50 (Fig. 9). This movement of rod 49 operates a control mechanism, as later described, to cause reversal of piston rod 58 and consequent withdrawal of hold-back 50. As later described, the infeed pusher is withdrawn before the hold-back withdraws. As a result, pressure on the line of billets is removed while the hold-back is still holding the leading billet at the crest of the incline. When, therefore, the hold-back is withdrawn, the leading billet is free to roll into discharge groove 47 but only that one billet will leave the path. As soon as the hold-back leaves the billet, detector rod 49 is free to take its normal relative position again under expansion of spring 52.

There is provided means for discharging a billet from the furnace. This may include a discharge pusher working along groove 47. Although capable of various constructions, in that here illustrated as an example, a discharge pusher is mounted on a rod 64 having a rack portion 65 (Fig. 8) meshing with a pinion 66 mounted on a shaft 67. Also mounted on this shaft is a gear 68 meshing with the teeth of a rack 69 formed on a pis-

ton rod 70. The piston of this rod works in the cylinder of a fluid pressure unit 71. After a billet has been moved into groove 47, and under a control hereinafter described, piston rod 70 is caused to make its down stroke, thus advancing pusher 63 along groove 47 and through a tubular extension 47*a* passing through the furnace wall. This stroke of the pusher discharges the billet from the furnace.

In the present embodiment it is desired to move the discharged billet along a path at right angles to its path of discharge and there is provided means for turning the discharged billet through an angle of 90°. Although capable of various constructions, in that here shown as an example, adjacent the discharge end of extension 47*a* is a turntable 73 (Figs. 7, 8) formed to provide a seat for the billet. The discharge stroke of pusher 63 deposits the billet onto this seat. Extending downwardly from the turn-table is a shaft 75 journalled in a support 74 (Figs. 8, 14). Mounted on this shaft is a pinion 76 meshing with a rack 77. This rack is formed on the piston rod 78 of a fluid pressure unit 79 (Fig. 12). Operation of this unit gives the turntable a quarter turn after receiving a billet (Fig. 8) and later reverses it to billet-receiving position (Fig. 7).

The turntable has a side wall 73*a* which, when the turntable is in the position of Fig. 8, closes the end of extension 47*a* to prevent loss of heat.

The invention in its entirety includes means for automatically effecting the operation of the various fluid pressure units whereby each succeeding machine operation is dependent for its initiation upon the completion of a preceding operation or operations. This may be accomplished, generally speaking, by control valves for the pressure units, which valves are, in turn, automatically controlled by electric circuits. While such valves and their controlling circuits may vary in construction and arrangement, a suitable form of valve and a suitable electric control are disclosed in a copending application filed March 12, 1926, Serial No. 94,334, now Patent No. 1,849,044. For convenience, an example of one of these valve units is shown in Fig. 16. This valve comprises a valve chamber 411 having an inlet 412 connected with a pressure line, e. g. compressed air. The valve chamber has two cylindrical extensions 413, 414 of different diameter, the smaller one being opened to atmosphere and the larger one closed. In these extensions work pistons 415, 416 carried on a piston rod 417. Mounted on this piston rod is a D-slide valve 418. Opening out of the valve chamber 411 is an exhaust passage 419 leading to atmosphere and a passage 420*a* adapted for connection with the variable pressure end of an air-operated power cylinder. Under what may be termed normal conditions, the pressure in the valve chamber holds the D-slide valve moved to the left, as viewed in Fig. 16. In this position passage 420*a*, and so the controlled cylinder, is connected with exhaust so that the piston of the controlled cylinder reverses under constant pressure at the other end of the cylinder. The D-slide valve is moved in the opposite direction by admitting air pressure, as by a by-pass, through a passage 421, into closed extension 413. When this takes place the D-valve is moved to the right, due to the piston differential, and the valve connects passage 420*a* with valve chamber pressure, whereby the piston of the controlled cylinder is advanced against the ineffective constant pressure. Passage 420, shown in Fig. 16, for the arrangement just described is assumed to be plugged. When the passage 421 is again closed, the D-valve moves back to the left under chamber pressure.

As is more fully described in the application referred to, the admission of air via passage 421 is controlled by a solenoid-operated valve which connects the cylindrical extension either with the pressure line or exhaust. The circuit of the latter is controlled by a switch suitably placed to be actuated by some predetermined operation or at some predetermined time. A closed circuit may result in a closed solenoid valve or vice versa, according to the desired arrangement. Normally, an energized solenoid opens the solenoid-valve to admit air through passage 421 and the D-slide valve takes the normal position of Fig. 16 on a dead solenoid. This means that the controlled power unit is under variable pressure when the solenoid is energized and under return pressure when the solenoid is dead. If it is desired to have the controlled unit under variable pressure when the solenoid is dead, passage 420 is substituted and passage 420*a* is plugged.

For some purposes it is desired to operate the power unit in both directions by variable pressure. In that case, each end of the cylinder has one of these valve units, one end of the cylinder being at exhaust while the other end is connected with the pressure line or passages 420, 420*a* may be connected to the respective ends of the cylinder.

In the following description of the automatic operation, the several air power units are referred to as being actuated by opening valve number so-and-so. It is to be understood that the word "valve" in this connection is intended to cover the complete unit including the D-slide valve and its controlling solenoid-operated valve, or some equivalent construction. In the drawings the reference numerals have been applied, for con-

venience, to the solenoid of the valve unit. Unless otherwise specified, an energized circuit for the solenoid is referred to as "opening" the valve. This means that the D-valve is in such position as to connect the controlled end of the cylinder to main line pressure. Conversely, a "closed" valve, upon breaking of the circuit, means a D-valve in such position that the controlled end of the cylinder is at exhaust.

The solenoid-operated valves may be conveniently controlled by having the coils in D. C. lines in which are contactors or relays having their coils in A. C. lines. These latter may be controlled by one or more switches operated by the movement of some part of the apparatus. Examples of such switches are shown and described in the parent application above referred to (now Patent No. 1,768,866). As there described the several switches may be operated by means of cam elements carried or moved by various parts of the apparatus or by the parts themselves. By the formation and location of the cams, and the arrangement of the switches, the desired time, type and duration of switch contact may be obtained to effect the circuit conditions hereinafter described.

For the automatic cycle it is assumed that current source switch 601 is closed to the right. A. C. source controlling contactor 750 is moved to effective left position by closing hand switch 912, its circuit extending from main line 749 through its left magnet, conductor 914, switch 912, to line 913, which is a branch of main line 944. It may be moved right by closing hand switch 1105, the circuit extending from line 749, through its right magnet, conductor 1106, switch 1105 to line 913.

D. C. source controlling contactor 907 is moved to effective left position by closing hand switch 1107, the circuit extending from line 749, through its left magnet, conductor 1108, switch 1107 to line 913. It may be moved right by closing hand switch 1109, the circuit extending from line 749 through its right magnet, conductor 1110, switch 1109 to line 913.

Contactor 750 in its left hand position connects A. C. bus 943 with main line 944 and bus 751 with main line 749. Bus 943 connects with bus 942 and bus 936 connects with bus 751.

Contactor 907 in left hand position connects D. C. bus 993 with line 903 and bus 976 with line 977, lines 903, 977 being connected with the D. C. source through hand switch 601 closed to the right.

Contactor 684 is moved left by closing hand switch 1113, the circuit extending from line 749 through its left magnet, conductor 1114, switch 1113 to line 913. It may be moved right by closing hand switch 1111, the circuit extending from line 749 through the right magnet, conductor 1112, switch 1111, to line 913.

For the automatic operation contactors 750, 907 and 684 are moved left and there remain throughout.

In order to set various contactors hereinafter referred to, setting contactor 604 is raised by closing hand switch 602, the circuit extending from bus 751, magnet 604, conductor 606, switch 602, to line 913. This contactor 604 has a plurality of contacts connected respectively with the magnets of the several contactors in such a way as to cause these contactors to take their proper initial positions but for convenience only the connection to the right magnet of contactor 1052 is shown in Fig. 18.

It is assumed that the billet paths are all filled and that a billet is waiting in front of the last path, i. e. the path furthest from the magazine. The parts may be moved to this position by the hand control switches later referred to.

The automatic cycle is started by closing hand switch X to move controller 923, presently described, to position 1.

While the controller 923 may be of any desired construction which will make the contacts as shown, it conveniently comprises a shaft 924 magnetically driven in a step-by-step manner by means of magnet 922. Mounted on shaft 924 is a plurality of cam discs 925 adapted for closing a number of contacts 926. The shaft may be arranged to take any desired number of steps. In this case each step represents one-twelfth of a complete revolution of the shaft. There are, therefore, 12 steps representing 4 cycles, one for each of the four furnace lines, the controller moving through three steps for each cycle.

Controller contact 994 is connected to D. C. bus 993 and controller contact 976^a is connected to D. C. bus 976. Controller contact 943^a connects with A. C. bus 943.

These contacts 994, 976^a and 943^a are effective in all positions of the controller. On the D. C. side, contact 1007 is effective in controller positions 1, 3, 4, 6, 7, 9, 10, 12; contact 928 in positions 1, 4, 7, 10; contact 972 in positions 2, 5, 8, 11; contact 993 in positions 1, 2, 12; contact 998 in positions 3, 4, 5; contact 1073 in positions 6, 7, 8; and contact 1097 in positions 9, 10, 11.

On the A. C. side, contact 941 is effective in controller positions 1, 2, 12; contact 1047 in positions 3, 4, 5; contact 1071 in positions 6, 7, 8; and contact 1087 in positions 9, 10, 11.

The controller is stepped ahead by closing a circuit extending from line 944 through the upper contacts of contactor 911, controller magnet 922, to line 749. Thus, every

time contactor 911 lifts, the controller is moved ahead one position.

Closure of switch X causes contactor 911 to lift, its circuit extending from line 913 through switch X, left contacts of contactor 684, left contacts of contractor 918, right contacts of contactor 915, conductors 915, 917, 916, magnet of contactor 911, conductor 923 to bus 751. This lift of contactor 911 causes the controller to move to position 1, as just described.

Movement of the controller into position 1 effects the advance of billet holder 50 for the last furnace path. To this end, contactor 954 is raised by a circuit extending from conductor 751, magnet of contactor 954, conductor 940 to controller contact 941 in position 1. This energizes valve 927 controlling cylinder 60 of the last path by a circuit extending from contact 928 of the controller in position 1, conductors 929, 930, operating coil of valve 927, conductors 931, 932 to the other side of the line on controller contact 933. Valve 927 being opened, last holder 50 is advanced. Valve 971 for the holder reversing cylinder 59 being closed in this position of the controller.

This movement effects insertion of the waiting cold billet. To this end, upon the end of the stroke of holder 50, switch 934 is closed. This causes contactor 935 to move from its normal right hand position to the left, its circuit being traced from one side of the line on conductor 751, conductor 936, left magnet of contactor 935, left contacts of contactor 918, normally in its left hand position, conductor 937, contact of switch 934, conductors 938, 939, 940 to the other side of the line through contact 941 of the controller. Contactor 918 now moves to the right in a circuit traceable from one side of the line to conductors 751 and 936, right magnet of contactor 918, left contacts of contactor 935 to the other side of the line over conductors 942, 943, contactor 750 to conductor 944. Contactor 935 also completes a circuit controlling valve 945 for cylinder 39 of infeed pusher 42 of the last furnace path. This circuit extends from contact 928 on the controller, conductors 929, 930, 946, lower left contacts of contactor 935, conductor 947, contacts of hand switch 948 now closed, conductor 949, contacts of switch 950 on the hot billet discharger, which is closed at this time, conductor 951, operating coil of valve 945, conductors 952, 953, upper contacts of contactor 954, to the other side of the line at controller contact 933, over conductors 955, 931, 932. Opening of valve 945 admits pressure to cylinder 39 causing the cold billet to be pushed into the furnace.

The movement of contactor 935 to the left also moves contactor 724ª to the left in a circuit extending from bus 936, left magnet of contactor 724 conductor 956, left contacts of contactor 935 to bus 942. The movement of contactor 918 to right breaks the circuit for contactor 911 which drops.

Infeed pusher 42, on this stroke, passes and closes switch 960, whereupon contactor 961 moves to the left in a circuit extending from conductor 936, upper right contacts of contactor 915, conductor 962, left magnet of contactor 961, conductor 963, contacts of switch 960, to the other side of the line over conductors 939, 940, to controller contact 941.

Provision is made for causing the infeed pusher to be withdrawn while holder 50 is still advanced so that not more than one hot billet will be pushed into discharge trough 47 by the feeding stroke of the pusher. To this end, valve 945 is de-energized prior to operation of cylinders 59, 60.

As the leading hot billet is pushed, by insertion of the cold billet, against detector 48 the consequent back movement of rod 49 closes switch 958. The end of the feeding stroke of pusher 42 closes switch 965 for that path.

Closing of switch 958 causes contactor 966 to move to the left by a circuit extending from one side of the line on conductor 751, left magnet of contactor 966, left contacts of contactor 935, conductors 967, 968, switch 958, conductors 938, 939, 940, to the other side of the line on controller contact 941. Contactor 966, upon moving to the left causes contactor 915 to move to the left by a circuit extending from conductor 751, left magnet of contactor 915, left contacts of contactor 966, conductor 969, switch 965, just closed, to the other side of the line on controller contact 941 over conductors 939, 940. Contactor 966 also causes contactor 935 to move to the right by a circuit extending from conductor 751 through the right magnet of contactor 935, conductor 970 and left contacts of contactor 966, to the other side of the line over conductors 942, 943, 944.

By this movement of contactor 935 the energizing circuit for valve 945 is broken and infeed pusher 42 is withdrawn under return pressure in cylinder 39.

Meantime, the closing of switch 958 has closed a circuit for contactor 959 extending from conductor 751, through the magnet of contactor 959, conductor 968, switch 958, conductors 938, 939, 940, to controller contact 941. As presently described this movement of contactor 959 effects withdrawal of holder 50. To delay such withdrawal until the infeed pusher has been withdrawn, contactor 959 is given a delayed action. This may be accomplished by a dash-pot or other braking device. As a result, contactor 966 moves left, as just described, before contactor 959 lifts.

The lift of contactor 959 causes contactor 911 to lift, its circuit extending from bus

751 through its magnet, upper contacts of contactor 959 to bus 942. This steps the controller ahead, as above described, to position 2. As the controller leaves position 1 it breaks the circuit energizing the operating coil of valve 927 for cylinder 60, closing this valve and placing the cylinder at exhaust, and, when the controller reaches position 2, it closes the circuit for energizing the operating coil of valve 971 for cylinder 59, opening this valve. This circuit extends from controller contact 972, through conductors 973, 974, operating coil of valve 971, conductors 975, to bus 976. The closure of contactor 959 also moves contactor 915 to the right, the circuit extending from bus 751, through its magnet, the upper right contacts of contactor 959, to bus 942. Upon closing of valve 927 and opening of valve 971, rack 57 is moved upwardly to withdraw the holder, whereby the leading hot billet is lowered into the discharge groove, as described. As the holder withdraws, switch 958 opens, breaking the circuit for contactor 959 which drops. This breaks the circuit for contactor 911, which drops.

Movement of the controller to position 2 also causes movement of the turntable 73 to billet-receiving position. To this end a circuit is closed through the coil of valve 978 controlling cylinder 79. This circuit extends from contact 972 of the controller in position 2, through conductors 973, 974, 979, left contacts of contactor 724ª, conductor 980, conductor 1124, operating coil of valve 978, conductors 983, 984 to bus 976. Valve 978 being opened, pressure fluid is admitted to cylinder 79 to turn the turntable from the position of Fig. 8 to billet-receiving position. During this movement, the turntable unit closes switch 985.

Operation of the turntable effects discharge of the billet from the furnace. At the end of its movement, it closes switch 992 closing a circuit from bus 976, through coil of valve 987, conductors 988, 989, lower contacts of contactor 990 (normally down) conductor 991, contacts of switch 992, to bus 993. This opens valve 987 and admits pressure fluid to cylinder 71. This, in turn, causes advance of the discharge pusher 63 to push the billet out of the furnace onto the turntable.

Movement of the discharge unit opens switch 950 and, when it has reached the end of its stroke, it closes switch 995. Thereupon contactor 990 is energized to open its lower contacts and to close its upper contacts in a circuit extending from bus 943, contacts of switch 995, conductor 996, magnet of contactor 990 to bus 751. Contactor 990 makes a holding circuit for itself extending from its own upper contacts through conductor 1010, switch 985 to bus 943. The closure of the upper contacts of contactor 990 moves the controller into position 3 by lifting contactor 911 again, the circuit for the latter being traceable from conductor 751, magnet 911, conductor 916, through the upper right contacts of contactor 990 to conductor 942. Upon the movement of the controller out of position 2 contactor 954 becomes de-energized and falls and, upon the movement of the controller to position 3 a circuit is completed for energizing contactor 1002 to lift and close its upper contacts. This circuit extends from conductor 751, magnet of contactor 1002, conductor 1045, 1046, to controller contact 1047 in position 3.

The lift of contactor 1002 sets billet stop 35 for the third furnace path by opening valve 997, admitting fluid to cylinder 38 of that path. The circuit for the operating coil of this valve extends from contact 998 of the controller in position 3, conductors 999, 1000, 1001, upper contacts of contactor 1002, conductors 1003, 1004, operating coil of valve 997, conductors 1005, 1006, to the other side of the line on controller contact 1007.

Contactor 990, upon moving, breaks its lower contact, thereby breaking the circuit to the operating coil of valve 987, which causes this valve to close, whereupon the discharge pusher is withdrawn under constant pressure in cylinder 71. This closing of the upper contacts of contactor 990 also effects return of the turntable to the position of Fig. 8. To this end, contactor 724ª moves to the right, its circuit extending from conductor 751, right magnet of contactor 724ª, conductor 1009, upper contacts of contactor 990, to conductors 942, 943. Contactor 724ª, upon opening its left contacts, opens the circuit to the operating coil of turntable cylinder valve 978, which closes, whereupon the turntable is moved back under constant pressure in cylinder 79. During this movement it opens switch 992. Contactor 1008 is now moved to the left, its circuit extending from conductor 751, left magnet of contactor 1008, upper contacts of contactor 990 to conductors 942, 943.

The turntable reversing opens switch 985, thus breaking the holding circuit for contactor 990 which drops. This breaks the circuit for contactor 911 which again drops.

The above described operations, while necessarily described in succession, are more or less simultaneous. During this time, also the discharged billet is being removed as desired, for example, by transfer to a press as described in the parent application.

The infeed pusher 42, upon its return movement, passes and closes switch 1018, whereupon contactor 1019 moves to the left in an energizing circuit from bus 751, left magnet of contactor 1019, right contacts of contactor 1020, conductor 1021, left contacts of contactor 1022 (which was moved to the

left upon the closure of switch 1024 by the previous withdrawal of pusher 43 of the third path), conductor 1023, contacts of switch 1018, conductors 939, 940, to the other side of the line on controller contact 941.

This left movement of contactor 1019 opens valve 1027 of unit 8, the circuit extending from controller contact 994 through conductor 993, contacts of switch 1028, conductor 1029, left contacts of contactor 1019, right contacts of contactor 1020, conductors 1030, 1032, coil of valve 1027, conductor 984 to bus 976. Valve 1027 being thus opened admits fluid pressure to cylinder 8. This operates piston rod 8[a] to advance the billet supply chain one step and deposit a cold billet in groove 6.

Infeed pusher 42 continuing, passes and closes switch 1025 and opens switch 1018, whereupon contactor 1022 moves to the right in a circuit traceable from conductor 936, right contacts of contactor 915, conductor 962, right magnet of contactor 1022, conductor 1026, contacts of switch 1025, to the other side of the line over conductors 939, 940, at controller contact 941.

The supply unit movement effects operation of the delivery pusher. To this end, the advance of piston rod 8*a* closes switch 1033, whereupon contactor 1020 is moved to the left, its circuit extending from conductor 936, through its left magnet, conductor 1034, contacts of switch 1033, to the other side of the line on conductors 1017 and 943. Contactor 1020, upon moving to the left, causes contactors 1019 and 966 to move to the right, the circuit for contactor 1019 extending from conductor 751, right magnet of contactor 1019, left contacts of contactor 1020, to conductors 942, 943 and that for contactor 966 extending from conductor 936, through its right magnet, upper left contacts of contactor 1020 to conductors 942 and 943. Valve 1035 for cylinder 25 is now opened, its circuit extending from controller contact 1007, conductors 1006, 1005, 1036, right contacts of contactor 935, conductor 1009, lower contacts of contactor 990, conductor 1038, right contacts of contactor 966, right contacts of contactor 918, right contacts of contactor 1019, conductors 1039, 1040, operating coil of valve 1035, to conductors 984, 976. This admits fluid pressure to cylinder 25 and delivery pusher 9 moves forward, opening switch 1028, and pushing the new billet along the groove 6 until it is stopped by encountering stop 35 for the third furnace path.

The advance of the delivery pusher reverses the same by closing switch 1042 to cause contactor 918 to move left by a circuit extending from bus 936 through the left magnet of the contactor, conductor 1043, switch 1042, conductors 1044, 1045, 1046, to controller contact 1047. This breaks the circuit for valve 1035 which closes, the delivery pusher reversing under return pressure.

Upon the opening of switch 1028 on the advance of the delivery pusher, valve 1027 closes, its circuit broken, and piston rod 8*a* of the supply unit reverses under return pressure. This movement closes switch 1048, whereupon contactor 1020 moves right, its circuit extending from bus 936 through its right magnet, switch 1048, conductor 1017 to bus 943.

This completes what may be termed one billet cycle, which is a quarter of a furnace cycle. In succeeding billet cycles the operations are repeated but for different paths. Some of the steps and the controlling circuits are mere repetitions. Some involve different but analogous elements and circuits.

To start the second and subsequent billet cycles, the controller is moved to position 4, 7, 10 or 1 as the case may be. This takes place upon the above mentioned movement of contactor 918 to the lift, which causes contactor 911 to lift by the same circuit as that described for the first lift in the first cycle. The same applies to the start of all subsequent cycles.

Unless otherwise specified the circuits in subsequent billet cycles are the same as in the first cycle.

As previously described, each billet path has a holder and each advancing cylinder has its magnetic valve. Thus the three valves 1061, 1082, 1098 correspond to valve 927 for the 4th path. In referring to these analogous parts the order given will be 3rd, 2nd and 1st path, which means second, third and fourth cycle. As the controller takes positions 4, 7, and 10, corresponding to position 1, these valves are opened to advance the holder in question. All these valves are connected in parallel on one side of the coil, the common circuit including conductors 930, 929 to controller contact 928. At the other side, valve 1061 connects through conductors 1000, 999 to controller contact 998; valve 1082 through conductors 1075, 1074 to controller contact 1073; valve 1098, through conductors 1095, 1096 to controller contact 1097.

Upon movement of the controller to positions 4, 7, and 10 contactors 1002, 1067 and 1090 lift. The circuit for 1002 has been described. That for 1067 extends from bus 751 through the contactor magnet, conductors 1068, 1070 to controller contact 1071 and that for 1090 from bus 751 through the contactor magnet, conductors 1085, 1086 to controller contact 1087.

The holders in advancing close switches 934[a], 934[b], 934[c], corresponding to switch 934. In each case, this results in the movement of contactor 935 to the left. These

switches are connected in parallel on one side so that circuits for moving contactor 935 in the different cycles are the same from bus 751 to the switch in question. At the other side, the circuit for the second cycle is over conductors 1045, 1046, to controller contact 1047; for the third cycle over conductors 1068, 1070 to controller contact 1071; for the fourth cycle, over conductors 1085, 1086, to controller contact 1087.

In each cycle this movement of contactor 935 causes contactor 918 to move right, the circuit being the same in all cycles.

Upon each left movement of contactor 935 one of the valves for the infeed pushers is opened. These valves are 1060, 1072 and 1091, corresponding to valve 945. The circuits are the same from controller contact 928 to one side of the several valve coils. At the other side, the circuit for valve 1060 includes conductor 1063, left contacts of contactor 1002, conductors 1001, 1000, 999, to controller contact 998; for valve 1072, conductors 1078, 1077, upper contacts of contactor 1067, conductors 1076, 1075, 1074, controller contact 1073; for valve 1091, conductors 1092, 1093, upper contacts of contactor 1090, conductors 1094, 1095, 1096 to controller contact 1097.

In each cycle, the left movement of contactor 935 causes contactor 724ª to move left, the circuits being the same, contactor 911 dropping in each case.

The advance of the infeed pushers closes switches 1024, 1069 and 1084, corresponding to switch 960. In the second cycle, closing of switch 1024 causes controller 1022, corresponding to 961, to move left. The circuits extends from bus 936 through right contacts of contactor 915, conductor 962, the left magnet of the contactor, conductor 1064, switch 1024, conductors 1045, 1046, to controller contact 1047. In the third cycle, closing of switch 1069 causes contactor 1051 to move left, the circuit extending from bus 936, through right contacts of contactor 915, conductor 962, left magnet of the contactor, switch 1069, conductors 1068, 1070 to controller contact 1071. In the fourth cycle, closing of switch 1084 causes contactor 1052 to move left, the circuit extending from bus 936, upper contacts of contactor 915, conductor 962, left magnet of the contactor, conductor 1083, switch 1084, conductors 1085, 1086 to controller contact 1087.

At the end of the stroke of the infeed pushers, switches 965*a*, 965*b*, and 965*c*, corresponding to switch 965, are closed.

As the leading hot billets are pushed forward by the insertion of the cold billets, the corresponding detectors are actuated to close switches 958*a*, 958*b*, 958*c*.

In each case this causes left movement of contactor 966. The circuits are the same from bus 751 to the switch in question. At the other side of switch 958*a* the circuit includes conductors 1045, 1046 to controller contact 1047; of switch 958*b*, conductors 1068, 1070, to controller contact 1071; of switch 958*c*, conductors 1085, 1086 to controller contact 1087.

The left movement of contactor 966 causes right movement of contactor 935, the circuit being the same in each cycle. It also causes left movement of contactor 915. The circuits are the same as for the first cycle from bus 751 to conductor 969. From there, in the second cycle, through switch 965*a*, conductors 1045, 1046, to controller contact 1047; in the third cycle, through switch 965*b*, conductors 1068, 1070, to controller contact 1071; in the last cycle, switch 965*c*, conductors 1085, 1086, to controller contact 1087.

The right movements of contactor 935 break the circuits for valves 1060, 1072, 1091, which close, whereupon the infeed pushers reverse.

The closure of switches 958*a*, 958*b* and 958*c* causes contactor 959 to lift. These switches being in parallel on one side, the circuits are same from bus 751 to the switch. On the other side, in the second cycle the circuit includes conductors 1045, 1046 and controller contact 1047; in the third cycle, conductors 1068, 1070, controller contact 1071; in the last cycle, conductors 1085, 1086, controller contactor 1087.

In each cycle, this lift of contactor 959 causes the lift of contactor 911, the circuit in all cycles being the same. Thereupon the controller is moved to positions 5, 8, 11.

These movements of the controller break the circuits for valves 1061, 1082, 1098 which close. They also close parallel circuits for valves 1062, 1083, 1099, corresponding to valve 971. Thereupon the holders are withdrawn to release the leading hot billets. Switches 958*a*, 958*b*, 958*c*, are opened, whereupon contactor 959 drops and contactor 911 drops.

In each cycle the lift of contactor 959 also causes contactor 915 to move right, the same circuit being utilized in each cycle.

Upon the movement of the controller into positions 5, 8 and 11 the following steps are repeated in each cycle with no difference in circuits or otherwise: Valve 978 opens to advance the turntable, this movement closing switches 985, 992; valve 987 opens to advance the discharge pusher to push the hot billet onto the turntable; this opens switch 950 and closes switch 995; thereupon contactor 990 lifts, and, as a result, contactor 911 lifts. Thereupon the controller is moved to positions 6, 9, 12 and contactors 1002, 1067, 1090 drop.

These movements of the controller also cause the lift of contactors 1067, 1090, 954 by the circuits described.

In the second cycle, the drop of contactor

1002 breaks the circuit for valve 997 which closes, whereupon the billet stop for the 3rd path recedes. The lift of contactor 1067 causes valve 1079 to open to set the billet stop for the 2nd path. These billet stop valves are in parallel to conductor 1005 at one side of the coils.

At the other side, the circuit for valve 1079 includes conductors 1080, 1081, upper contacts of contactor 1067, conductors 1076, 1074, to controller contact 1073.

In the third cycle, the drop of contactor 1067 breaks the circuit for valve 1079 which closes, whereupon billet stop for the 2nd path recedes. The lift of contactor 1090 opens valve 1100 to advance the billet stop for the first path. The circuit for the other side of this valve includes conductors 1101, 1102, upper contacts of contactor 1090, conductors 1094, 1095, 1096 to controller contact 1097.

In the last cycle, the drop of contactor 1090 breaks the circuit for valve 1100 which closes, whereupon billet stop for the first path recedes. No stop is set in this cycle as the next cycle is a repetition of the first and the fourth path has a fixed stop, as described.

In each cycle, upon the lift of contactor 990, the following steps are repeated without any change in circuit or otherwise: Valve 987 closes, whereupon the discharge pusher reverses; contactor 724*a* moves right, breaking the circuit for valve 978 which closes, the turntable reversing; this movement opens switches 992, 985, whereupon contactor 990 drops, and thereupon contactor 911 drops.

The reverse strokes of the infeed pushers close switches 1018*a*, 1018*b*, 964, corresponding to switch 1018; close switches 1065, 1089, 1104, corresponding to switch 1025; and open switches 1018*a*, 1018*b*, 964.

The closing of switches 1018*a*, 1018*b*, 964 causes left movement of contactor 1019. In the second cycle the circuit extends from bus 751, left magnet of the contactor, right contacts of contactor 1020, conductor 1021, left contacts of contactor 1051, switch 1018*a*, conductors 1045, 1046 to controller contact 1047. In the third cycle it is the same to conductor 1021, thence through left contacts of contactor 1052, switch 1018*b*, conductors 1068, 1070 to controller contact 1071. In the fourth cycle, it is the same to conductor 1021, thence through left contacts of contactor 961, switch 964, conductors 1085, 1086, to controller contact 1087.

Upon closure of switch 1065 in the second cycle, contactor 1051 moves right, its circuit extending from bus 936 through right contacts of contactor 915, conductor 962, right magnet of the contactor, conductor 1066, switch 1065, conductors 1045, 1046 to controller contact 1047.

Upon closure of switch 1089 in the third cycle, contactor 1052 moves right. The circuit is the same as for 1051 to conductor 962, thence through the right magnet of the contactor, conductor 1088, switch 1089, conductor 1068, 1070 to controller contact 1071. Upon closure of switch 1104 in the last cycle, contactor 961 moves right, its circuit extending from conductor 962, through the right magnet of the contactor, conductor 1103, switch 1104, conductors 1085, 1086, to controller contact 1087.

Upon the left movement of contactor 1019 the following steps are repeated in each cycle without change in circuit or otherwise: Valve 1027 opens to advance the supply unit and deposit a billet; switch 1033 is closed whereupon contactor 1020 moves left, causing contactors 1019 and 966 to move right; the movement of contactor 966 causes valve 1035 to open to advance the delivery pusher and push the deposited billet to whatever stop is effective.

The advance of the delivery pusher closes switches 1042*a*, 1042*b*, 1140, corresponding to switch 1042 and in each cycle this causes contactor 918 to move left. The circuits are the same as before through the left magnet of the contactor to conductor 1043. In the second cycle, from that conductor the circuit extends through switch 1042*a*, conductors 1068, 1070 to controller contact 1071; in the third cycle, switch 1042*b*, conductors 1085, 1086 to controller contact 1087; and in the fourth cycle, switch 1140, conductors 939, 940 to controller contact 941.

Upon this movement of contactor 918, valve 1035 closes in each cycle and the delivery pusher reverses.

In each cycle the advance of the delivery pusher also opens switch 1028, breaking the circuit for valve 1027, which closes and the supply unit reverses, closing switch 1048 and thereupon contactor 1020 moves right.

This completes the four billet cycles, which is one furnace cycle. The next first billet cycle is the same as that first described except that instead of contactor 911 lifting by the closing of switch X (which remains closed throughout), its lifts, as at the start of the second and other cycles, upon the left movement of contactor 918.

If the billets should be changed from a smaller to a larger size, eventually a billet line becomes so long that that path does not need a new billet. In that case the cycle of operations is automatically modified to discharge billets from that line without feeding new billets. Let it be assumed that the furnace is operating on the second billet cycle (3rd path) and that this path is too full. On the advance of the infeed pusher, the detector is actuated by the leading hot billet to close switch 958*a* before switch 1024 closes. As a result, contactor 1022 remains

to the right. The furnace now operates, as normally, through the rest of this cycle, all of the third and fourth cycles and starts the first cycle again. When the infeed pusher for the 4th path reverses and closes switch 1018, contactor 1019 does not go left because contactor 1022 failed to go left and valve 1027 does not open because contactor 1019 did not move left. Consequently the supply unit skips its advance and no billet is supplied to the 3rd path.

In the normal cycle the advance of the supply unit closes switch 1033, causing contactor 1020 to move left and this in turn causes contactors 1019 and 966 to move right. In this special cycle, however, switch 1033 is not closed. Contactor 1020 remains right. Contactor 1019 is already right. Contactor 966 moves right upon closing of switch 1018, the circuit extending from bus 751, through its right magnet, conductor 1050, right contacts of contactor 1022, conductor 1023, switch 1018, to conductor 939. Thereupon the delivery pusher unit advances idly and reverses, contactor 918 moving left as normally. There is no reverse of the supply unit because it did not advance. Normally the reverse of the supply unit causes contactor 1020 to move right, but it is already right, never having been moved left.

This concludes the special cycle. The next cycle, for the 3rd path, proceeds to the advance of the infeed pusher. If the 3rd path still has an excess billet line the special cycle is repeated. If the excess has been taken care of the operation continues in the normal way.

If the 2nd path has an excess billet length, on the advance of the infeed pusher in the 3rd cycle switch 958*b* closes before switch 1069. As a result, contactor 1051 remains right. The furnace proceeds normally through the rest of the 3rd cycle, all of the 4th and 1st cycles and the next 2nd cycle as far as the reverse of the infeed pusher. Upon the closing of switch 1018*a*, contactor 1019 does not go left because contactor 1051 did not go left. Again the supply unit skips its advance and no new billet is supplied to the 2nd path. The special cycle is then the same as described except for the circuit for moving contactor 966 right which takes place upon closing of switch 1018*a*. This is the same as before to conductor 1050, thence through the right contacts of contactor 1051, switch 1018*a* to conductor 1045.

If the 1st path has an excess billet length, on the advance of the infeed pusher in the 4th cycle, switch 958*c* closes before switch 1084. As a result contactor 1052 remains right. The furnace proceeds normally through the rest of the 4th cycle, all of the 1st and 2nd cycles, and the next 3rd cycle to the reverse of the infeed pusher. Upon the closing of switch 1018*b*, contactor 1019 does not go left because contactor 1052 did not go left. Again the supply unit skips its advance and no new billet is supplied to the 1st path. The special cycle is then the same as described except for the circuit for moving contactor 966 right, which takes place upon the closing of switch 1018*b*. This circuit is the same as before to conductor 1050, thence through the right contacts of contactor 1052, switch 1018*b* to conductor 1068.

If the 4th path has an excess billet length, on the advance of the infeed pusher in the first cycle, switch 958 closes before switch 960. As a result, contactor 961 remains right. The furnace proceeds normally through the rest of the 1st cycle, all of the 2nd and 3rd cycles, and the next 1st cycle to the reverse of the infeed pusher. Upon the closing of switch 964, contactor 1019 does not go left because contactor 961 did not go left. Again the supply unit skips an advance and no new billet is supplied to the 4th path. The special cycle is then the same as described except for the circuit for moving contactor 966 right, which takes place upon the closing of switch 964. This circuit is the same as before to conductor 1050, thence through the right contacts of contactor 961, switch 904, to conductor 1085.

If the billet size is changed to smaller, a path eventually becomes so short that the infeed pusher makes its full stroke without discharging a billet, i. e. without causing the leading hot billet to actuate the detector. In that event, the cycle is automatically changed to feed one or more additional billets to that path until the length of line becomes normal.

Assuming that the 4th path is deficient, the infeed pusher in advancing closes switch 965 but switch 958 fails to close because the billet line is not advanced far enough to actuate the detector. Contactor 966 moves left, as normally, but by a different circuit, namely, bus 751, left magnet of contactor 966, conductor 969, switch 965, conductors 939, 940 to controller contact 941. As a result contactor 915 moves left and contactor 935 right as normally. The right movement of contactor 935 breaks the circuit for valve 945 which closes and the infeed pusher reverses.

Because switch 958 failed to close, contactor 959, and hence contactor 911, fail to lift; the controller fails to take position 2 and the billet holder is not withdrawn Also there is no operation of the turntable and the discharge pusher and no setting of the stop for the 3rd path.

The reverse of the infeed pusher closes switch 1018, whereupon contactor 1019 moves left as normally. It also closes switch 1025 and opens switch 1018 as normally. On the

closure of switch 1025 in the normal cycle contactor 1022 moved right, but in this special cycle it cannot do so because such movement depends on the right contacts of contactor 915 and this contactor remains left because contactor 959 failed to lift.

Upon the left movement of contactor 1019, valve 1027 opens as normally to advance the supply unit and deposit a billet. The cycle then continues as normally through the delivery of the billet, the reverse of the delivery pusher and the reverse of the supply unit, it being noted, however, that this billet also goes to 4th path because the billet stop for the 3rd path was not set.

Normally, the left movement of contactor 918, upon closure of switch 1042 by the advance of the delivery pusher, causes the lift of contactor 911 to step ahead the controller. But this circuit depends also on the right contacts of contactor 915 which has remained left in this special cycle. On this movement of contactor 918, however, switch 934 being still closed because the holder is still advanced, contactor 935 moves left to its normal cycle, causing contactor 918 to move right, as normally. This causes valve 945 to open normally and the infeed pusher for the 4th path again advances to insert the new billet. Also contactor 724*a* moves left, as normally.

Thereupon, if the line is still deficient, switch 958 will not be closed and the special cycle will continue to supply billets to the same path until the deficiency is made up. As soon as the line is normal, the advance of the infeed pusher causes the leading hot billet to actuate the detector to close switch 958. Thereupon the operation proceeds in the normal manner.

It is noted that contactor 1022 was prevented from going right in the special cycle because it must be left in the next normal cycle in order for contactor 1019 to go left.

If the 3rd, 2nd or 1st path is deficient, the infeed pusher for the path closes switch 965*a*, 965*b* or 965*c* without closing switch 958*a*, 958*b* or 958*c*. Contactor 966 moves left in each case. The circuit in the 2nd cycle (3rd path) extending from bus 751, left magnet of the contactor, conductor 969, switch 965*a*, conductors 1045, 1046, to controller contact 1047; in the 3rd cycle (2nd path) it is the same to conductor 969, thence switch 965*b*, conductors 1068 1070 to controller contact 1071; in the last cycle (1st path), the same to conductor 969, thence switch 965*c*, conductors 1085, 1086 to controller contact 1087.

Upon left movement of contactor 966, in each cycle, contactor 915 goes left and contactor 935 right, as described, the latter breaking the circuit for the valve of the infeed pusher. These valves are 1060, 1072, 1091, corresponding to valve 945.

Upon reverse of the infeed pushers, switches 1018*a*, 1018*b*, 964 are closed to move contactor 1019 left, the circuit being the normal one for the path. The reversing infeed pushers also close switches 1065, 1089, 1104, corresponding to switch 1025. Contactors 1051, 1052, 961, corresponding to 1022, remain left because in each case the circuits for the right magnets depend on the right contacts of contactor 915 which is left. Also switches 1018*a*, 1018*b*, 964 are opened.

The left movement of contactor 1019, in each case, causes valve 1027 to open to advance the supply unit and deposit a billet. The cycles then proceed normally through the advance of the delivery pusher and the reverse of the same and reverse of the supply unit, the billet being delivered to whichever path is in question.

Upon the advances of the delivery pusher, the switches closed to cause left movement of contactor 918 are 1042*a*, 1042*b*, 1140, corresponding to 1042, the circuits being those normally applicable for the path in question.

Upon these left movements of contactor 918, the controller is not stepped ahead, as normally, because contactor 915 has remained to the left. As in the special cycle for the 4th path, contactor 935 moves left, switches 934*a*, 934*b*, 934*c* being still closed because the holders are still advanced. Contactor 918 goes right to cause valves 1060, 1072, 1091 to open and the infeed pusher in question advances to insert the specially delivered billet. Also contactor 724*a* moves left. Thereafter the special cycle repeats or the normal cycle proceeds as described in connection with the 4th path.

In order to operate the furnace control circuit by hand, hand switch 601 is moved to the left, disconnecting the source of supply from conductors 903 and 977 leading to the automatic control and connecting it over a plurality of conductors to the hand switches.

In order to open valve 945 to insert a billet into the last path of the furnace, switch 1115 is closed, completing a circuit from one side of the line on hand switch 601, conductors 1116, contacts of hand switch 1115, conductor 952, operating coil of valve 945, to conductor 951, through switch 950, conductors 949, 1117, to the other side of the line at hand switch 601. At the same time switch 1118 is closed to open valve 927 which controls the movement of billet holder into the furnace to receive the hot billet. The closure of switch 1118 completes a circuit from conductor 1116, contacts of switch 1118, conductor 931, operating coil of valve 927, conductor 930, to the other side of the current source at the contacts of switch 601.

The billet holder is withdrawn by closing switch 1119, completing a circuit for the operating coil of valve 971 extending from

current source at switch 601, conductor 1120, contacts of switch 1119, conductor 974, operating coil of valve 971, conductors 975, 976, 1121, 1122, to switch 601.

It is noted that the operating coils of valves 1062, 1083 and 1099 are included in parallel with the circuit for the operating coil of valve 971 so that, when switch 1119 is closed, these valves will be opened.

To swing the turntable into position to receive the hot billet, valve 978 is opened by closing switch 1123, completing a circuit from conductor 1120, contacts of switch 1123, conductor 1124, operating coil of valve 978, conductors 983, 984, 1121 and 1122. Thereupon valve 987, controlling the discharge unit is opened under control of hand switch 1125 which, upon being closed, completes a circuit from conductor 1120, contacts of switch 1125, conductor 988, operating coil of valve 987, to conductor 976, thence back to switch 601 as before described. The billet having been deposited upon the turntable, the latter is turned back, under constant pressure, by opening switch 1125.

Valve 1027 for the supply unit is opened upon the closure of switch 1127 which completes a circuit from conductor 1120, to the contacts of switch 1127, conductor 1032, operating coil of valve 1027, back to switch 601, over conductors 984 and 976.

The billet stop for the proper line of the furnace may also be set by hand. For this purpose any one of the valves 997, 1079 or 1100 is opened. For opening valve 997 hand switch 1128 is closed completing a circuit from conductor 1116, contacts of switch 1128, conductor 1004, operating coil of valve 997, conductors 1005, 1129, to switch 601. Valve 1079 is energized upon the closure of switch 1130 in a circuit extending from conductor 1116, through the contacts of switch 1130, conductor 1080, operating coil of valve 1079 to conductor 1005, and valve 1100 is opened upon the closure of switch 1131, its circuit extending from conductor 1116, contacts of switch 1131, conductor 1101, operating coil of valve 1100 to conductor 1005. Valve 1035 for the delivery pusher is opened by closing hand switch 1132, whereupon a circuit is established from conductor 1116 to one pole of switch 1132, conductor 1041, operating coil of valve 1035, conductor 1040, through the second pole of switch 1132 to conductor 1120.

For opening valve 1060 switch 1133 is closed, establishing a circuit from conductor 1116, contacts of switch 1133, conductor 1063, operating coil of valve 1060, to conductor 951, while the operating coil of valve 1072 is energized upon the closure of switch 1134 in a circuit extending from conductor 1116, contacts of switch 1134, conductor 1078, operating coil of valve 1072 to conductor 951.

Valve 1091 is opened upon the closure of switch 1138, this switch completing a circuit from conductor 1116, contacts of switch 1138, conductor 1092, operating coil of valve 1091 to conductor 951.

The valves for the billet holders for the second, third and fourth furnace lines may also be operated by hand, switch 1135 controlling valve 1061. The circuit for the coil of this valve extends from conductor 1116, contacts of switch 1135, conductor 1000, operating coil of valve 1061 to conductor 930. The coil of valve 1082 is energized upon the closure of switch 1136 in a circuit extending from conductor 1116, contacts of switch 1136, conductor 1075, operating coil of valve 1082 to conductor 930, while the coil of valve 1098 is energized upon the closure of switch 1137, the circuit extending from conductor 1116, contacts of switch 1137, conductor 1095, operating coil of valve 1098 to conductor 930.

There is provided indicating means for showing various circuit conditions. In the present embodiment a series of pilot lamps are located at the switchboard.

Lamp 902 connects from conductor 605, over conductor 903 with the lower left contacts of contactor 750, to conductor 749, in the furnace control circuit to notify the operator that this contactor has closed its left contacts connecting alternating current to the furnace control circuit, while lamp 904 shows the closure of direct current controlling contactor 907 also in the furnace control circuit. The circuit for lamp 904 extends from the right contacts of switch 601, conductor 977, upper left contacts of contactor 907, conductors 976, 1121, 906, through lamp 904, conductors 905, 993, lower contacts of contactor 907, conductor 903 to the contacts of hand switch 601.

It will be noted that the holdback 50, by cooperating with a heated billet just past the top of the incline (Figure 9), limits the number of billets movable by the infeed pusher from the heating path into the discharge path. In the present example, the number is limited to one at a time. It will also be noted that the delivery pusher, cooperating with the selective stops (except for the farthest billet path where no selective stop is required), constitutes a positioning means; the turntable, constituting the receiver for the billets heated in the furnace and discharged therefrom, is shown in the present example as operating to receive one heated billet at a time. It will also be understood that the term " ejector ", as used in the claims, refers to the billet removing device, herein shown as pusher 63, without implying any particular speed of removal as being necessary.

What is claimed is:

1. In combination with a furnace hous-

ing having a plurality of billet paths, a guideway extending past the entrance end of said paths, a delivery pusher for pushing a billet along said guideway, means for supplying a billet to said guideway, selective stop means for stopping a billet in front of a predetermined path, and means for pushing the stopped billet into the furnace.

2. In combination with a furnace housing having an entrance door, a guideway extending past said door, a billet magazine comprising an endless conveyor having a plurality of billet-receiving compartments and arranged with its forward end adjacent said guideway, means for moving the conveyor with a step-by-step movement whereby at each step a billet is supplied to said guideway by the down turn of the conveyor, means for moving the supplied billet to a position in front of the furnace door, and means for inserting the billet in the furnace.

3. In combination with a furnace having an entrance door, a guideway extending past said door, a billet magazine comprising an endless conveyor having a plurality of billet-receiving compartments arranged in a plurality of rows, the compartments of each row being staggered with respect to the compartments of the other row or rows, means for advancing said conveyor with a step-by-step movement whereby billets are supplied to the guideway from the several rows in succession, means for moving a supplied billet along said guideway to a position in front of the furnace door, and means for inserting the billet in the furnace.

4. In combination with a furnace housing having a plurality of billet paths, a guideway extending past each end of the paths, means for delivering a billet along the guideway at the entrance end of the furnace, and positioning it in front of a given path, means for inserting the billet in the furnace, the leading hot billet in that path being thereby discharged into the guideway at the discharge end of the furnace, and means common to the several paths for pushing the successively discharged billets out of the furnace.

5. In combination with a furnace having a path along which a row of billets may be pushed, the floor of said path having a raised portion adjacent the discharge end, means for inserting a billet in the furnace and thereby advancing the billet row, a hold-back element for engaging the leading billet to hold it just beyond the crest of said raised portion, and means for withdrawing said hold-back after the billet row has come to rest, thereby to permit the leading billet to move down the far side of said raised portion.

6. In combination with a furnace housing having a path along which billets may be pushed, a discharge guideway extending past the discharge end of the path within the housing, a conduit connecting said guideway with the outside of the housing, means for causing the leading billet in said path to be deposited in said guideway, means for pushing said billet out of the furnace through said conduit, a turntable for receiving said billet and reversing its direction of facing, and a wall on said turntable for normally closing the end of said conduit.

7. In combination with a furnace housing having a plurality of billet paths, a billet magazine, and automatic means for feeding billets from said magazines to said furnace paths in predetermined order.

8. In combination with a furnace housing having a path along which billets may be pushed, the floor of said path having a raised portion adjacent the discharge end, means for inserting a billet in the furnace and thereby advancing the billet row, a hold-back element for engaging the leading billet to hold it just beyond the crest of said raised portion, and means dependent on the advance of the row of billets for automatically withdrawing said hold-back, thereby to permit the leading billet to move down the far side of said raised portion.

9. In combination with a furnace housing having a plurality of billet paths, a guideway extending past the entrance ends of said paths, a delivery pusher for moving a billet along said guideway, selective stop means for stopping a billet in front of a given path, an infeed pusher for each of said paths, and automatic means for operating said stops and infeed pushers in predetermined order and for operating said delivery pusher.

10. In combination with a furnace housing having a plurality of billet paths, a delivery groove extending past the entrance ends of said paths, a discharge groove extending past the discharge ends of said paths, a delivery pusher for moving a billet along said delivery groove, selective stop means for stopping a billet in front of a given path, an infeed pusher for each path, a discharge pusher for moving a billet along said discharge groove to eject it from the furnace, the leading hot billet in a given path being delivered to said groove by the introduction of a cold billet when a predetermined number of billets have been fed to each path, means for supplying billets to the delivery groove, and automatic means for operating said supply means, pushers and stops in proper sequences to supply successive billets to the delivery groove, push said billets along the groove, position the same, and insert them in the furnace paths in pre-

determined order, and eject the discharged billets.

11. In combination with a furnace housing having a billet path along which billets may be pushed, a guideway extending past the discharge end of said path, a pusher for inserting a cold billet in the furnace, the leading hot billet being delivered thereby to said guideway, a billet hold back movable longitudinally of the billet path and serving, when in advanced position, to prevent movement of the leading hot billet, a displaceable detector for engagement by the leading hot billet upon initiation of its movement under the force of said pusher, and automatic means controlled by such displacement of the detector for causing withdrawal of the hold-back.

12. In combination with a furnace housing having a path along which billets may be pushed, a movable billet holder at the discharge end of the furnace, means for advancing said holder, and automatic means controlled by the advance of said holder for inserting a billet into the furnace, the line of billets in said path being thereby pushed ahead.

13. In combination with a furnace housing having a path along which billets may be pushed, a discharge groove below the discharge end of the path, a billet holder at the discharge end of the furnace, means for advancing the holder, means for inserting a billet in the furnace, thereby to push the line of billets toward said holder, and automatic means controlled by the advance of the leading billet for causing withdrawal of the inserting means and said holder, said automatic means including means whereby the inserting means is withdrawn in advance of withdrawal of the holder, the withdrawal of the holder causing movement of the leading hot billet into said groove.

14. In combination with a furnace housing having a discharge groove into which a hot billet may be deposited, a billet holder for controlling the movement of a billet into said groove, and automatic means controlled by the movement of said holder for discharging the deposited billet from the furnace.

15. In combination with a furnace housing having a discharge groove, means for causing a billet to be deposited in said groove, a turntable adjacent the discharge end of the furnace, and automatic means controlled by the operation of said first-named means for moving said turntable to a position to receive a billet.

16. In combination with a furnace housing having a discharge groove, means for causing a billet to be deposited in said groove, a turntable adjacent the discharge end of the furnace, means for discharging a billet onto said turntable, and automatic means controlled by said discharging means for turning said turntable.

17. In combination with a furnace housing having a plurality of paths along which billets may be pushed, a plurality of selective stops for positioning billets in front of the several paths, means for discharging a billet from the furnace, and automatic means controlled by said discharge means for operating one of said stops.

18. In combination with a furnace housing having a plurality of paths along which billets may be pushed, a plurality of selective stops for positioning billets in front of the several paths, means for discharging a billet from the furnace, and automatic means controlled by said discharge means for operating said stops successively in predetermined order upon successive operations of the discharge means.

19. In combination with a furnace housing having a plurality of paths for billets, automatic means for feeding billets to said paths in predetermined order, and means controlled by the demands of said paths for causing said feeding means to skip any given path.

20. In combination with a furnace housing, a billet magazine, a groove extending from the magazine to the furnace, means for depositing a billet from the magazine into said groove, and automatic means controlled by said first-named means for pushing the deposited billet along said groove.

21. In combination with a furnace housing having a plurality of paths for billets, automatic means for feeding billets to said paths in predetermined order, and means controlled by the demands of said paths for causing said feeding means to repeat the feed to any given path.

22. In combination with a furnace having a path along which a row of billets may be pushed, said path having an upward incline at the discharge end, means for pushing a cold billet into the furnace thereby to push the row of billets in the path ahead, and means for holding the leading billet at the crest of said incline until the force of said pushing means has been relieved whereby only one billet is ejected from the path by the insertion of the cold billet.

23. In combination, a furnace having a billet heating path, means for supplying heat thereto, a billet actuated detector cooperable with a heated billet in predetermined position in said path, a billet receiver moved into billet receiving position by actuation of said detector, and a billet ejector for removing a heated billet from said furnace to said receiver and called into action by operation of said billet actuated detector.

24. In combination, a furnace having a billet heating path, a billet actuated detector, a billet receiver for receiving a billet dis-

charged from said furnace, and movable into billet receiving position by operation of said detector, and a billet ejector for removing a billet from said furnace and called into action by movement of said billet receiver into billet receiving position.

25. In combination, a furnace having a billet heating path and a billet discharge path, a billet engaging device for coacting with a billet in its movement from the first-named path to the second named path, a billet actuated detector associated with said billet engaging device and calling it into action by presence of a billet in predetermined relation to said detector, and a billet ejector thereby called into action for ejecting said billet from said furnace.

26. In combination with a furnace having a billet heating path and a billet discharge path, a billet engaging device for coacting with said billet in its movement from said first-named path to said second-named path, a billet actuated detector associated with said billet engaging device and calling it into action by presence of a billet in predetermined relation to said detector, a billet receiver movable to billet receiving position by operation of said billet engaging device, and a billet ejector called into action by movement of said receiver to billet receiving position for moving the billet in said discharge path to said billet receiver.

27. In combination with a furnace having a billet heating path and a billet discharge opening, a billet actuated detector, a billet receiver for receiving a billet discharged from said furnace and movable into billet receiving position by operation of said detector, a billet ejector for removing a billet from said furnace and called into action by movement of said billet receiver into billet receiving position, and a closure member for said discharge opening moved into closing position by billet removing operation of said ejector.

28. In combination, a furnace having a billet heating path and a billet discharge opening, a billet actuated detector, a billet receiver for receiving a billet discharged from said furnace and moved into billet receiving position by operation of said detector, a billet ejector for removing a billet from said furnace and called into action by movement of said billet receiver into billet receiving position, and a closure member for said discharge opening carried by said billet receiver said billet receiver being moved out of billet receiving position and said closure member being movable into closing relation to said discharge opening by billet ejecting movement of said billet ejector.

29. In combination, a furnace having a plurality of separate billet heating paths, a billet actuated detector associated with each of said paths, and a billet ejector for removing from said furnace billets heated in any of said paths and called into action by operation of any of said billet detectors.

30. In combination with a furnace having a plurality of separate billet heating paths and a discharge path, a billet actuated detector associated with each of said billet heating paths, a billet receiver for receiving a billet discharged from said furnace by way of said discharge path and moved into billet receiving position by operation of the detector for any billet heating path, and a billet ejector for removing a billet from said furnace by way of said discharge path to said receiver and called into action by movement of said billet receiver into billet receiving position.

31. In combination with a furnace having a plurality of separate billet heating paths and a discharge path, a billet actuated detector associated with each of said billet heating paths, said furnace having a discharge opening for said discharge path, a billet receiver for receiving a billet discharged from said furnace through said opening by way of said discharge path and moved into billet receiving position by operation of the detector for any billet heating path, a billet ejector for removing a billet from said furnace by way of said discharge path and discharge opening to said receiver and called into action by movement of said billet receiver into billet receiving position, and a closure member for said discharge opening moved into closing relation therewith by billet ejecting movement of said billet ejector.

32. In combination with a furnace having a billet heating path and a billet discharge path, means for supplying heat to said heating path, a billet engaging holdback for limiting the number of billets movable at a time from said first-named path to said second-named path, and a billet actuated detector associated with said holdback and calling it into limiting action by presence of a billet in said first-named path in predetermined relation to said detector.

33. In combination with a furnace having a billet heating path and a billet discharge path, means for supplying heat to said heating path, a billet engaging holdback for limiting the number of billets movable at a time from said first-named path to said second-named path, a billet actuated detector associated with said holdback and calling it into limiting action by presence of a billet in said first-named path in predetermined relation to said detector, and a billet ejector called into billet removing motion with respect to said furnace by completion of the limiting action of said holdback.

34. In combination with a furnace having a billet heating path and a billet discharge path, means for supplying heat to said heat-

ing path, a billet engaging holdback for limiting the number of billets movable at a time from said first-named path to said second-named path, a billet actuated detector associated with said holdback and calling it into limiting action by presence of a billet in said first-named path in predetermined relation to said detector, a billet receiver for receiving billets discharged from said furnace and moved into billet receiving position by limiting action of said holdback, and a billet ejector associated with said discharge path and called into billet discharging motion by movement of said billet receiver to billet receiving position.

35. In combination, a furnace having a discharge opening, a billet heating path, means for supplying heat thereto, billet moving mechanism for giving a series of billets in said path a step by step forward movement, a billet actuated detector, a billet receiver moved into billet receiving position by actuation of said detector, a billet ejector for removing a billet from said furnace to said receiver and called into action by operation of said billet actuated detector, and a closure for said discharge opening associated with said receiver and moved thereby into and out of closing position.

36. In combination, a furnace having a billet heating path, means for supplying heat thereto, said furnace having a discharge opening, a billet actuated detector, a billet receiver moved into billet receiving position by actuation of said detector, a billet ejector for removing a billet from said furnace to said receiver and called into action by operation of said billet actuated detector, and a closure for said discharge opening moved into closing relation therewith by completion of billet removing action of said billet ejector, and moved out of closing relation therewith by movement of said receiver into billet receiving position.

37. In combination, a furnace having a plurality of billet heating paths, means for supplying heat thereto, mechanism for moving billets in one path after another in predetermined order, a billet actuated detector associated with each of said paths, and a billet ejector for removing from said furnace billets heated in any of said paths and called into action by operation of any of said billet detectors.

38. In combination, a furnace having a billet heating path, means for supplying heat thereto, a billet ejector for removing from said furnace a billet heated in said path, a billet delivery device and moved out of closing relation therewith by movement of said receiver into billet receiving position into billet delivering movement with respect to said path by billet removing operation of said billet ejector, and mechanism called into action by billet delivering movement of said device for moving said device out of billet delivering position.

39. In combination, a furnace having a billet heating path and a billet discharge path, means for supplying heat to said billet heating path, a billet engaging device for coacting with a billet in its movement from the first-named path to the second-named path, a billet actuated detector associated with said billet engaging device and calling it into action by presence of a billet in predetermined relation to said detector, a billet ejector cooperating with said discharge path for removing from said furnace a billet heated in said heating path and called into billet removing operation by action of said detector, a billet delivery device called into billet delivering movement with respect to said heating path by billet removing operation of said ejector, and mechanism called into action by billet delivering movement of said delivering device for moving said device out of billet delivering position.

40. In combination, a furnace having a billet heating path and a billet discharge path, means for supplying heat to said heating path, a billet engaging device for coacting with a billet in its movement from said first-named path to said second-named path, a billet actuated detector associated with said billet engaging device and calling it into action by presence of a billet in predetermined relation to said detector, a billet receiver moved into billet receiving position with respect to said discharge path by presence of such billet in said predetermined relation to said dectector, a billet ejector associated with said discharge path for removing a billet therefrom to said receiver and calling into billet ejecting action by billet receiving movement of said billet receiver, a billet delivery device called into billet delivering movement with respect to said heating path by action of said billet ejector, and mechanism called into action by billet delivering movement of said delivery device for moving said device out of billet delivering position.

41. In combination, a furnace having a billet heating path, a discharge opening and a discharge path from said heating path to said discharge opening, means for supplying heat to said heating path, a billet engaging device for coacting with a billet in its movement from said first-named path to said second-named path, a billet actuated detector associated with said billet engaging device and calling it into action by presence of a billet in predetermined relation to said detector, a billet receiver moved into billet receiving position with respect to said discharge path by presence of such billet in said predetermined relation to said detector, a billet ejector associated with said discharge path for removing a billet therefrom

to said receiver and called into billet ejecting action by billet receiving movement of said billet receiver, a billet delivery device called into billet delivery movement with respect to said heating path by action of said billet ejector, mechanism called into action by billet delivering movement of said delivery device for moving said device out of billet delivering position, and a closure for said discharge opening called into closing action with respect thereto by removal from the furnace by said ejector of a billet through said discharge opening.

42. In combination, a furnace having a billet heating path and a billet discharge path, means for supplying heat to said billet heating path, a billet engaging holdback for limiting the number of billets movable at a time from said first-named path to said second-named path, a billet actuated detector associated with said holdback and calling it into action by presence of a billet in predetermined relation to said detector, a billet ejector cooperating with said discharge path for removing from said furnace a billet heated in said heating path and called into billet removing operation by action of said detector, mechanism called into action by billet removing operation of said ejector for shifting said ejector to preparatory position for removing a billet, a billet delivery device called into billet delivering movement with respect to said heating path by billet removing operation of said ejector, and mechanism called into action by billet delivering movement of said delivering device for moving said device into preparatory position for its billet delivery movement.

43. In combination, a furnace having a billet heating path and a billet discharge path, means for supplying heat to said billet heating path, a billet engaging holdback for limiting the number of billets movable at a time from said first-named path to said second-named path, a billet actuated detector associated with said holdback and calling it into action by presence of a billet in predetermined relation to said detector, a billet ejector cooperating with said discharge path for removing from said furnace a billet heated in said heating path and called into billet removing operation by action of said detector, mechanism called into action by billet removing operation of said ejector for shifting said ejector to preparatory position for removing a billet, a billet delivery device called into billet delivering movement with respect to said heating path by billet removing operation of said ejector, mechanism called into action by billet delivering movement of said delivering device for moving said device into preparatory position for its billet delivering movement, and a billet receiver for receiving billets removed from said furnace by said ejector and moved into billet receiving position by limiting action of said holdback.

44. In combination, a furnace having a billet heating path, a discharge opening and a discharge path to said discharge opening from said heating path, a billet engaging holdback for limiting the number of billets movable at a time from said first-named path to said second-named path, a billet actuated detector associated with said holdback and calling it into action by presence of a billet in predetermined relation to said detector, a billet ejector cooperating with said discharge path for removing from said furnace a billet heated in said heating path and called into billet removing operation by action of said detector, mechanism called into action by billet removing operation of said ejector for shifting said ejector to preparatory position for removing a billet, a billet delivery device called into billet delivering movement with respect to said heating path by billet removing operation of said ejector, mechanism called into action by billet delivering movement of said delivering device for moving said device into preparatory position for its billet delivering movement, a billet receiver for receiving billets removed from said furnace by said ejector and moved into billet receiving position by limiting action of said holdback, said receiver being moved out of receiving position by billet removing operation of said ejector, and a closure for said discharge opening brought into closing relation therewith by billet removing operation of said ejector.

45. In combination, a furnace having a plurality of billet heating paths, means for supplying heat thereto, a common discharge path, a billet ejector for removing from said furnace, by way of said discharge path, billets heated in said billet heating paths, a billet delivery device for each of said billet heating paths, said devices being called into action successively by successive operations of said billet ejector, and a billet actuated detector associated with each of said heating paths, said billet ejector being called into billet removing operation by billet actuation of any of said detectors.

46. In combination, a furnace having a plurality of billet heating paths, means for supplying heat thereto, a common discharge path, a billet ejector for removing from said furnace, by way of said discharge path, billets heated in said billet heating paths, a billet delivery device for each of said billet heating paths, said devices being called into action successively by successive operations of said billet ejector, a billet receiver for receiving billets discharged from said furnace by way of said discharge path, a billet actuated detector associated with each of said heating paths, said billet receiver

being moved to billet receiving positions by billet actuation of any of said billet detectors, and said billet ejector being called into billet removing operation by movement of said billet receiver into billet receiving position.

47. A furnace having a billet heating path and a billet discharge opening, means for supplying heat to said billet heating path, a billet delivery device for delivering billets to said billet heating path and movable into billet delivered position and billet delivery preparatory position, and a billet ejector for removing, by way of said discharge opening, billets heated by said furnace in said heating path, and movable into billet ejected position and billet ejecting preparatory position, said billet ejector being called into billet ejecting movement to billet ejected position by billet delivering movement of said billet delivery device to billet delivered position and said billet ejector being, by its said movement, called into movement to billet ejecting preparatory position, said billet delivery device being called into billet delivering movement to billet delivered position by billet ejecting movement of said billet ejector and said billet delivery device being, by its said movement, called into movement to billet delivery preparatory position.

48. In combination, a furnace having a billet heating path, means for supplying heat to said path, a billet magazine operable to supply billets to be heated in said furnace, a billet positioner called into action by operation of said billet magazine for placing in predetermined relation to said heating path a billet supplied by said magazine, and a billet delivery device called into action by operation of said billet positioner for delivering to said heating path a billet placed by said positioner.

49. In combination, a furnace having a plurality of billet heating paths, means for supplying heat to said paths, a billet magazine operable to supply billets to be heated in said furnace, a billet positioner called into action by operation of said billet magazine for placing, in a given order, in predetermined relation to said paths billets supplied by said magazine, and a billet delivery device for each path called into action in said given order by operation of said billet positioner for delivering to said heating paths the billets placed by said positioner.

50. In combination, a furnace having a billet heating path, means for supplying heat to said path, a multiple billet magazine for holding a plurality of groups of billets to be heated in said furnace, means for operating said magazine for supplying billets from said groups in predetermined order, a billet positioner called into action by operation of said magazine for placing in predetermined relation to said path billets supplied by said magazine, and a billet delivery device for delivering to said heating path billets placed by said positioner and called into action by billet placing operation of said positioner.

51. In combination, a furnace having a plurality of billet heating paths, means for supplying heat to said paths, a multiple billet magazine for holding a plurality of groups of billets to be heated in said furnace, means for operating said magazine for supplying billets from said groups in predetermined order, a billet positioner called into action by operation of said billet magazine for placing, in a given order, in predetermined relation to said paths billets supplied by said magazine, and a billet delivery device for each path called into action in said given order by operation of said billet positioner for delivering to said heating paths the billets placed by said positioner.

52. In combination, a furnace having a plurality of billet heating paths, means for supplying heat to said paths, a billet magazine operable to supply billets to be heated in said furnace, a billet positioner called into action by operation of said billet magazine for placing, in a given order, in predetermined relation to said paths billets supplied by said magazine, a billet delivery device for each path called into action in said given order by operation of said billet positioner for delivering to said heating paths the billets placed by said positioner, and a billet ejector called into action by operation of the billet delivery device for any path for removing from said furnace a billet heated in such heating path.

53. In combination, a furnace having a plurality of billet heating paths, means for supplying heat to said paths, a multiple billet magazine for holding a plurality of groups of billets to be heated in said furnace, means for operating said magazine for supplying billets from said groups in predetermined order, a billet positioner called into action by operation of said billet magazine for placing, in a given order, in predetermined relation to said paths billets supplied by said magazine, a billet delivery device for each path called into action in said given order by operation of said billet positioner for delivering to said heating paths the billets placed by said positioner, and a billet ejector called into action by operation of the billet delivery device for any path for removing from said furnace a billet heated in such heating path.

54. In combination, a furnace having a plurality of billet heating paths, means for supplying heat to said paths, a billet magazine operable to supply billets to be heated in said furnace, a billet positioner called into

action by operation of said billet magazine for placing, in a given order, in predetermined relation to said paths billets supplied by said magazine, a billet delivery device for each path called into action in said given order by operation of said billet positioner for delivering to said heating paths the billets placed by said positioner, a billet ejector called into action by operation of the billet delivery device for any path for removing from said furnace a billet heated in such heating path, and a billet receiver called into action by said operation of said delivery device for receiving the billet removed from said furnace by said billet ejector.

55. In combination, a furnace having a plurality of billet heating paths, means for supplying heat to said paths, a multiple billet magazine for holding a plurality of groups of billets to be heated in said furnace, means for operating said magazine for supplying billets from said groups in predetermined order, a billet positioner called into action by operation of said billet magazine for placing, in a given order, in predetermined relation to said paths billets supplied by said magazine, a billet delivery device for each path called into action in said given order by operation of said billet positioner for delivering to said heating paths the billets placed by said positioner, a billet ejector called into action by operation of the billet delivery device for any path for removing from said furnace a billet heated in such heating path, and a billet receiver called into action by said operation of said billet delivery device for receiving the billet removed from said furnace by said billet ejector.

DAVID L. SUMMEY.

CERTIFICATE OF CORRECTION.

Patent No. 1,920,133. **July 25, 1933.**

DAVID L. SUMMEY.

It is hereby certified that error appears in the printed specifications of the above numbered patent requiring correction as follows: Page 17, lines 59, 60 and 61, claim 38, strike out the words "and moved out of closing relation therewith by movement of said receiver into billet receiving position" and insert instead , mechanism cooperating with said billet ejector and with said delivery device and calling said delivery device; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of November, A. D. 1933.

F. M. Hopkins

(Seal) **Acting Commissioner of Patents.**