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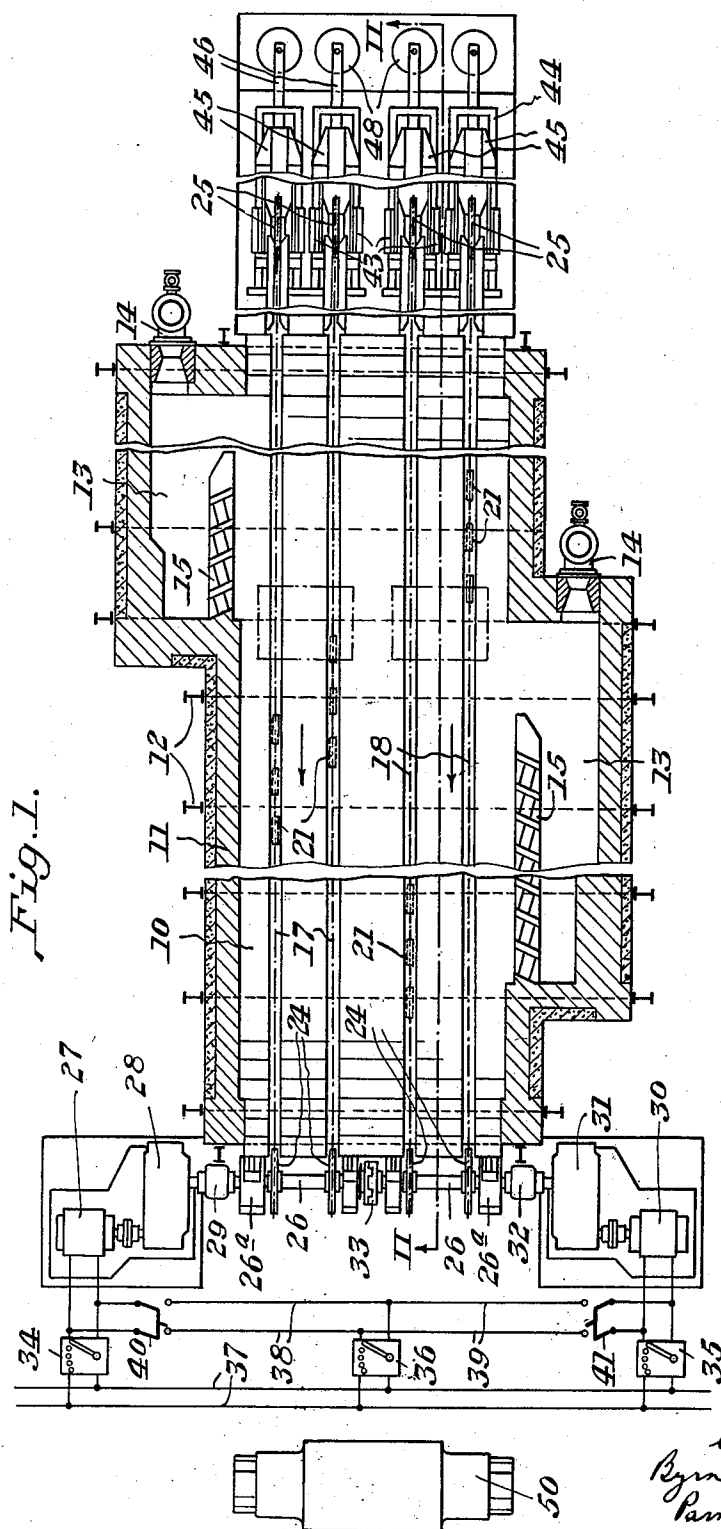
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2,035,252

METHOD OF MANUFACTURING SHEETS

Filed Oct. 31, 1931

5 Sheets-Sheet 1



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March 24, 1936.

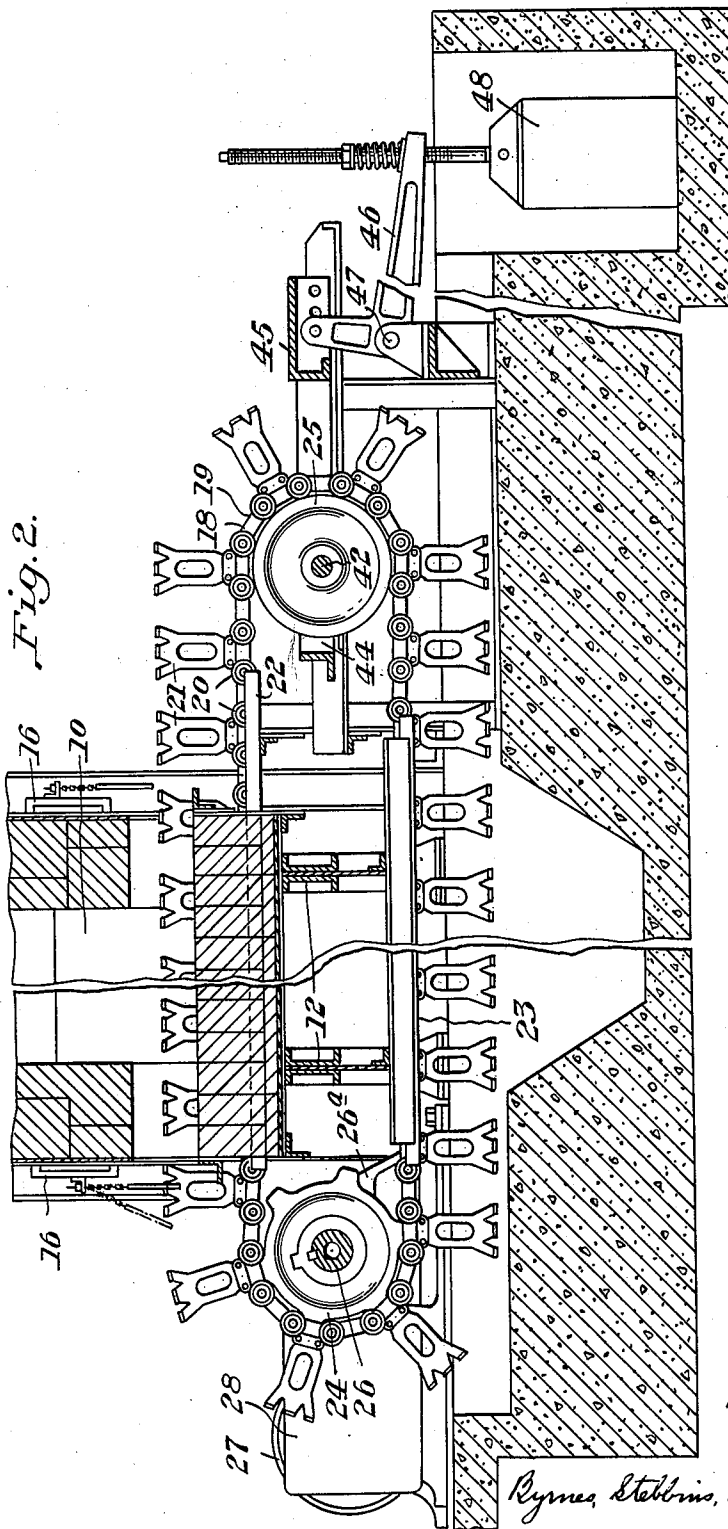
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METHOD OF MANUFACTURING SHEETS

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5 Sheets-Sheet 2



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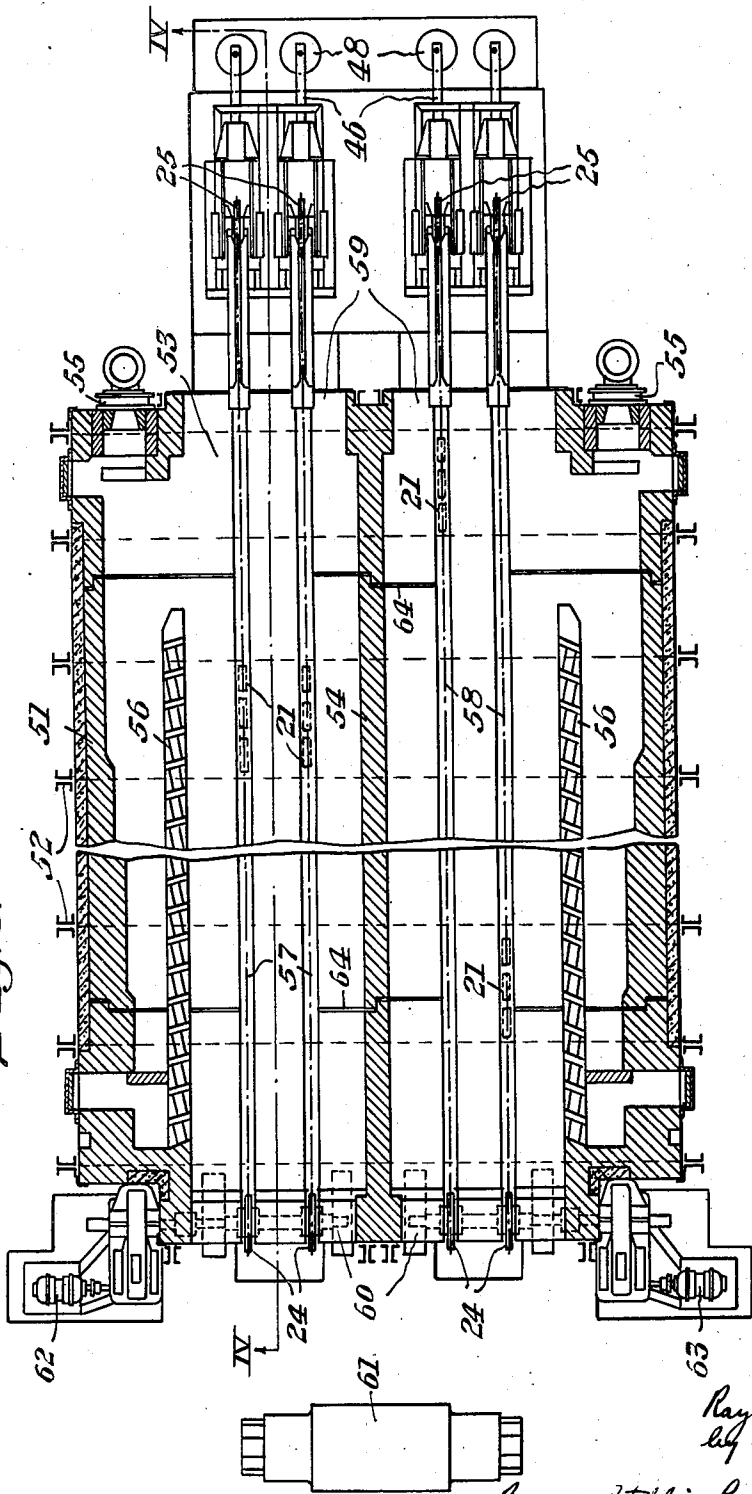
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METHOD OF MANUFACTURING SHEETS

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5 Sheets-Sheet 3

Fig. 3.



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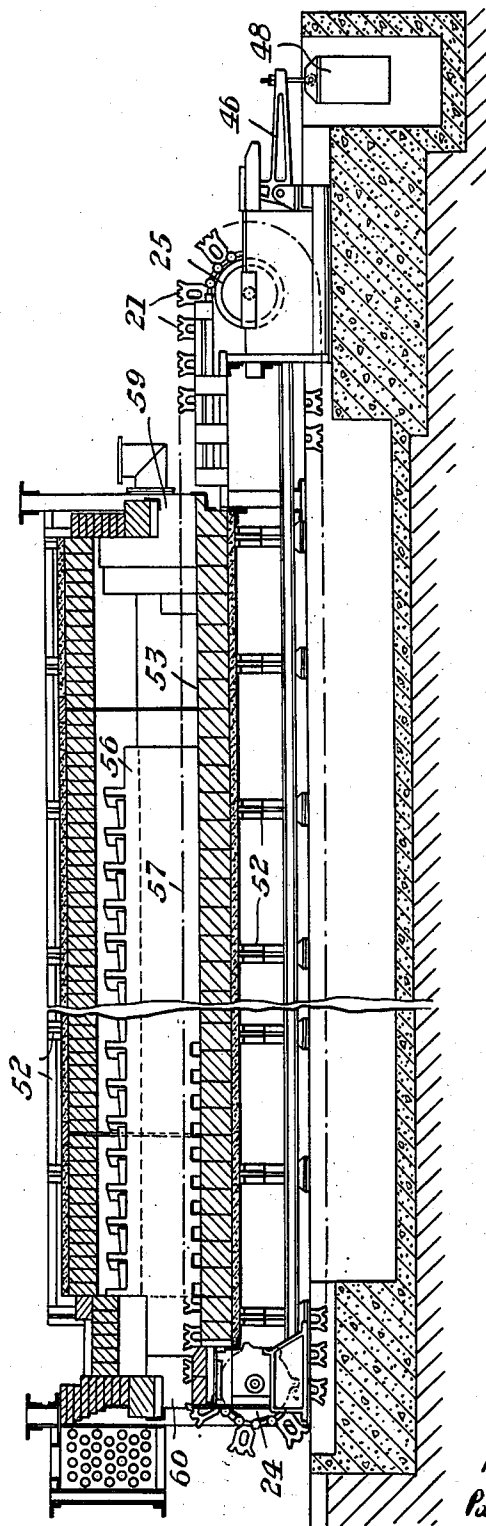
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METHOD OF MANUFACTURING SHEETS

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5 Sheets-Sheet 4

Fig. 4.



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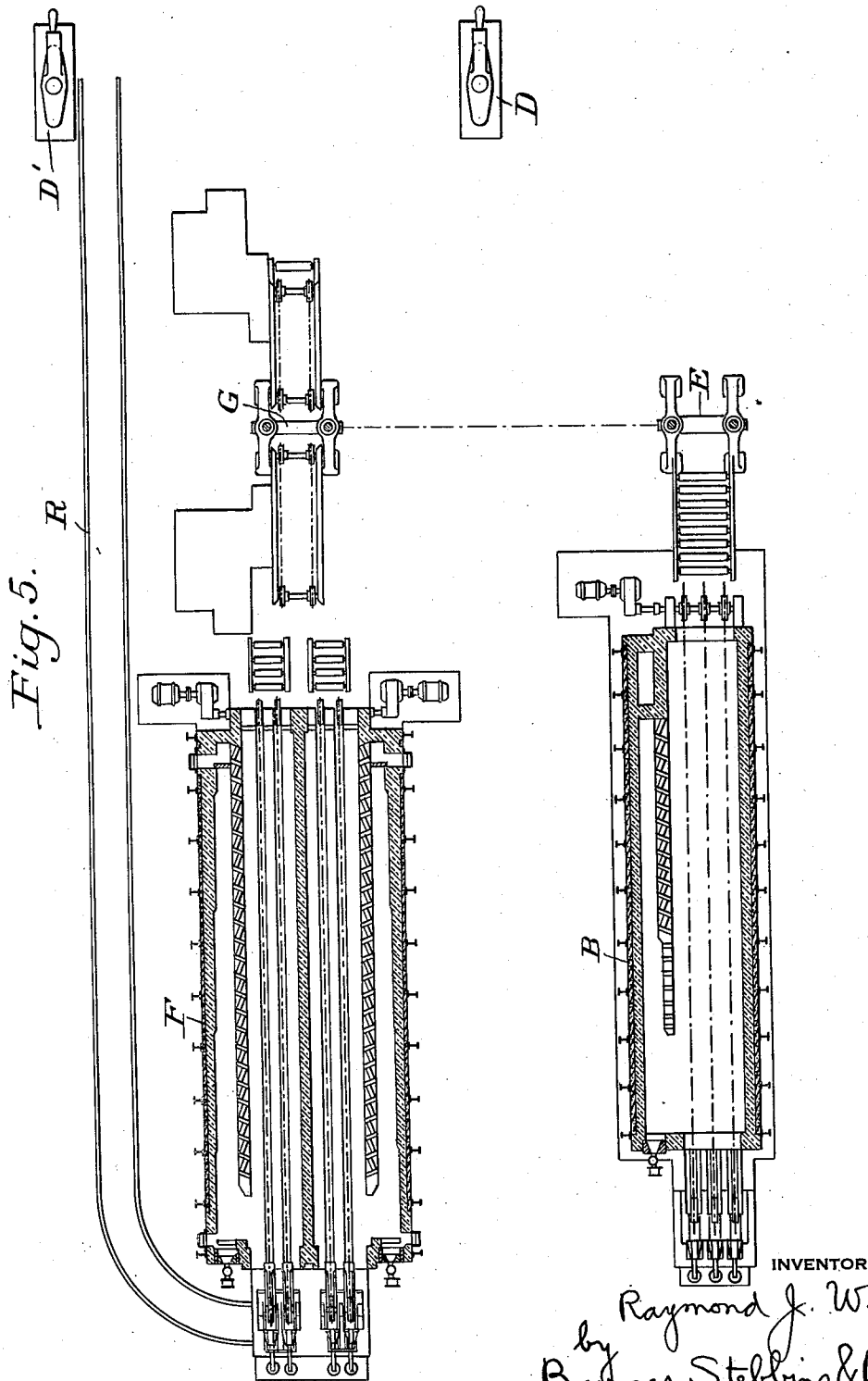
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METHOD OF MANUFACTURING SHEETS

Filed Oct. 31, 1931

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,035,252

METHOD OF MANUFACTURING SHEETS

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Application October 31, 1931, Serial No. 572,294

10 Claims. (Cl. 29—18)

My invention relates to a method of making sheets, for example, steel sheets, and also to apparatus adapted to carry out the method.

This application is a continuation in part of my copending application serial No. 482,213 filed September 16, 1930, for Improvement in continuous heating furnaces.

In accordance with a new manufacturing practice described and claimed in my U. S. Patent No. 1,871,102, granted August 9, 1932, for Method and apparatus for making sheets, steel sheets are made from sheet bars as follows: The bars are first passed through a bar heating furnace and then through the roughing rolls. The initial rolling operation when completed converts the bars into breakdowns. The partially elongated breakdowns are then passed through a second furnace in pairs for reheating and rerolling in the finishing rolls. The finishing roll operation converts the breakdowns into sheets and they are thereupon doubled and returned to the entrance of the second furnace for further reheating in packs followed by a final rolling operation. Since the same furnace is employed for heating matched pairs of breakdowns and doubled packs of sheets, it is apparent that there is considerable likelihood of congestion at the entrance to the furnace. A more serious objection, however, is that the pairs and packs each have their own optimum rolling temperature, and, since it is necessary that pairs and packs be passed through the furnace alternately in order to keep up the flow of production, it is impossible, under present practice, to heat both packs and pairs to the best rolling temperature.

Obviously, if packs and pairs alternately are heated in the same furnace by passing them therethrough at the same rate of speed, which is necessary since only a single conveyor has heretofore been provided in the furnace, the final temperature of both pairs and packs is a compromise between the best temperatures for both. Another factor contributing to this difficulty is that the breakdowns are comparatively cold when they enter the pack-heating furnace. The packs, however, are at a considerably higher temperature than the pairs and, therefore, are heated more rapidly to the final temperature, with the possibility of overheating unless extreme care is exercised.

A still further objection to the present method of operation is that it is very inflexible as to mill rolling schedules. In other words, the finishing mill must take the material as it comes from the

furnace, usually alternating packs and pairs, regardless of the production required.

I have overcome the aforementioned objections to the present methods and apparatus for making sheets by providing separate heating chambers in the pack heating furnace for the packs and pairs, with independently controllable burners for heating and conveyors for passing material therethrough. The chambers for heating the pairs and packs separately are formed by building a central division wall in a unitary furnace chamber of sufficient width for the purpose. The burners of the two chambers may be independently controlled to give the required final temperature to the material passing there- through, and the speed of operation of the conveyors may be similarly adjusted to prevent overheating and to insure the desired operating conditions. The independent conveyors also permit material to be discharged selectively from either the pack chamber or the pair chamber, depending upon the mill rolling schedule.

The packs and pairs may thus be heated proportionately, since the pairs, being cold require a greater amount of heat than the packs which retain a considerable proportion of their former heat. The twin chambers of the furnace for heating packs and pairs separately are arranged to supply material to the same stand of finishing rolls. The congestion at the entrance of the pack heating furnace which is now experienced is eliminated.

For a more complete understanding of the invention, reference is made to the accompanying drawings illustrating a present preferred embodiment of the invention, as well as a modification thereof.

In the drawings,

Figure 1 is a sectional view through one type of furnace by which the invention may be practiced, taken on a horizontal plane, partly broken away and showing portions of the apparatus diagrammatically;

Figure 2 is a longitudinal sectional view along the line II—II of Figure 1;

Figure 3 is a view similar to Figure 1, showing the preferred form of the invention;

Figure 4 is a sectional view along the line IV—IV of Figure 3; and

Fig. 5 is a diagrammatic plan view of a sheet metal adapted for the practice of my invention.

The method and apparatus for making sheets found in my Patent 1,871,102 above referred to will first be briefly explained in order that the place of the invention disclosed in the present

application may be clearly understood. As shown in Fig. 5 a bar heating furnace B operates to deliver bars heated to the proper temperature to roughing rolls E. The bars are passed between the roughing rolls E a sufficient number of times to partially elongate the bars and convert them into breakdowns. As is usual in the art, the breakdowns may either be matched and reduced in gauge by rolling as matched pairs, after preliminary heating to suitable rolling temperature, or the breakdowns may be doubled in the doubler D and rolled as doubles, after the necessary heating.

In accordance with the present invention, the pairs or doubles are brought to the proper temperature for rolling in a furnace F, the pairs or doubles being delivered from this furnace to the finishing rolls G. After the gauge of the sheets has been reduced by passing the packs between the finishing rolls G, the packs, if not sufficiently reduced in gauge, may be doubled in the doubler D' and returned by way of the conveyor R to the entrance end of the furnace F. My invention resides in improvements in this portion of the rolling operation, namely, the portion of the operation following the rolling in the roughing rolls E, and resides more particularly in the preparation of the packs for the finishing rolls G.

Referring in detail to Figures 1 to 4 inclusive of the drawings, a furnace chamber 10 is composed of a wall 11 of refractory brick, enclosed within a structural framework 12. Offset burner chambers 13 are provided in the side walls of the furnace. Burners 14 are fitted in the burner chambers and connected to any suitable fuel supply. Baffles 15 prevent the flames from the burners from playing directly on the material in the furnace.

The ends of the furnace 10 are open but are adapted to be closed by doors 16. Chain conveyors 17 and 18 are adapted to traverse the furnace from the charging end to the discharge end thereof, in the direction indicated by the arrows. Each conveyor consists of a pair of chains 19 having rollers 20 pivoted between the links thereof. Flights, or material engaging carriers 21, are secured to the chains at intervals and are adapted to pass through slots in the tile forming the floor of the furnace. In this way, the body of the conveyor is protected from the heat of the furnace. Rails 22 are provided below the furnace floor for supporting the rolls 20, and similar rails 23 are located below the furnace for the same purpose.

The chains 19 extend between a driving sprocket 24 and an idling sprocket 25. The driving sprockets 24 are secured to shafts 26 rotatably mounted in fixed bearings 26a. Driving means for the shaft 26 of the conveyor 17 include a motor 27 connected to a reducing gear 28. The reducing gear is coupled to the shaft 26 by a coupling 29. A similar motor 30 and reducing gear 31 are coupled to the shaft 26 of the conveyor 18 through a coupling 32.

A clutch 33 of any desired type may be provided for rigidly connecting the shafts 26 of the conveyors 17 and 18 when it is desired that the latter operate as a single unit.

The motor 27 is provided with a suitable speed controlling device indicated at 34. The details of the speed control device are, of course, dependent upon the type and characteristics of motor employed, and it is to be understood that any arrangement of these elements may be re-

sorted to. As an example, it might be assumed that the motors 27 and 30 are direct current shunt wound motors, and that the speed control device 34 consists of a rheostat connected in the circuit of the field winding of the motor. In such case, suitable starting connections will, of course, be provided for the motor armature circuit.

The speed control device 34 for the motor 27 is duplicated for the motor 30 at 35. A third speed control device 36 may be provided for controlling both motors simultaneously, but it is obvious that one of the devices 34 and 35 may be employed for this purpose. The devices 34 and 35 are connected directly between their respective motors and a supply circuit 37, to which the device 36 is also connected. The device 36 also has connections 38 and 39 to both motors 27 and 30. Switches 40 and 41 permit the speed controller 36 to be disengaged from both motors when it is desired to control them by means of the controllers 34 and 35. The latter will, of course, be set at open circuit position when the controller 36 is connected. Suitable interlocking between the various electrical devices and the clutch 33 may, if desired, be employed.

The idler sprockets 25 are each mounted on a shaft 42 journaled in bearing blocks 43. The bearing blocks 43 are slidable longitudinally on guides 44. A yoke 45 secured to the bearing blocks supporting each shaft 42 is connected to one arm of a bell crank 46 pivoted at 47. The other arm of the bell crank carries a counterweight 48. It will be obvious that this construction permits longitudinal movement of the sprockets 25 to maintain the conveyor chains 19 taut.

When it is desired to operate the conveyors synchronously, the clutch 33 may be connected, the speed control devices 34 and 35 set in the off position and the switches 40 and 41 closed. The operation of the motors 27 and 30 is then under control of the device 36, although the latter may be omitted and either of the devices 34 or 35 used for this purpose, the other being set in the off position. As long as the clutch 33 is engaged and the motors 27 and 30 operate under the control of a single speed control device, it is obvious that the conveyors will move synchronously through the furnace.

If it is desired to operate the conveyors independently, the clutch 33 may be disengaged and the motors 27 and 30 replaced under the control of their individual speed controllers 34 or 35. The speed of each motor may then be adjusted independently to operate the conveyors 17 and 18 at any desired speeds. This makes it possible to pass packs and pairs through the furnace on separate conveyors at different rates. The packs and pairs will thereby be subjected to the heating action of the furnace for different periods of time, which can be adjusted to insure that the final temperature of the material as it emerges from the furnace is at the proper point. On leaving the furnace, the material passes to the finishing roll stand indicated diagrammatically at 50. Since the conveyors are independently controlled, it is possible to obtain not only proportional heating of the different classes of material but also selective discharge thereof. It is not necessary, for example, for the material to be fed to the rolls in the order in which it comes from the furnace, but packs or pairs can be rolled successively for certain 71

periods, if desired. This removes the limitation characterizing the old system, under which it was necessary to roll the material exactly as it came from the furnace, usually packs and pairs alternately.

Although the furnace shown in Figures 1 and 2 serves very well to provide proportional heating and selective discharge of the material passed therethrough, I find that the desired results may be more effectively obtained by the use of a furnace of the type shown in Figures 3 and 4. This furnace is similar to that shown in Figures 1 and 2 and comprises a refractory housing 51 enclosed within a structural frame 52. The furnace is provided with a hearth 53 and a central partition wall 54. The wall 54 divides the interior of the furnace housing into twin furnaces or heating chambers. Each chamber has a burner 55 and a baffle 56 as in the furnace of Figures 1 and 2. Separate conveyors 57 and 58 are also provided in the twin chambers. The conveyors extend continuously through the furnace rising above the hearth as shown in Figure 4, and are of substantially the same construction as those shown in Figures 1 and 2. The conveyors serve, obviously to feed material into the entrance end 59, through the heating chambers and out the discharge end 60. From the discharge end 60, the material is passed to the finishing rolls 61 by any convenient handling mechanism. The details of the conveyor structure are the same as those previously described, so that a repetition of the description is not necessary. Independent motor drives 62 and 63 are provided for the conveyors 57 and 58. These drives are of the variable speed type, but none of the details thereof are shown as these are well known. Expansion joints 64 are incorporated in the side and middle walls of the furnace housing.

The operation of the furnace shown in Figures 3 and 4 is similar to that of the furnace in Figures 1 and 2. The packs and pairs are fed separately to the chambers of the furnace on the conveyors 57 and 58. The center wall 54 makes it possible to control the temperature in the two chambers of the furnace in any desired manner. The temperature conditions in one chamber, by reason of the wall 54, are independent of the conditions in the adjoining chamber. The independent control of the conveyors, furthermore, facilitates the proportional heating of packs and pairs separately and the selective discharge thereof from the furnace.

It will be apparent that the method and apparatus described herein possess numerous important advantages over present practice. The congestion at the entrance end of the pack heating furnace which has been experienced heretofore is avoided, because the capacity of the furnace disclosed herein is practically double that of the single width furnaces used heretofore. The difference between the temperature of the relatively cool breakdowns from the roughing mill and the temperature of the packs from the finishing mill and doubler can readily be taken care of by adjusting the burners of the chamber receiving the breakdowns to produce a higher temperature therein than in the chamber receiving packs. The speed of travel through the furnace chambers may also be adjusted so that the cool breakdowns have a longer heating period than the preheated packs. The exact temperature requirements of each class of material can thus be met with the requisite degree

of precision. The independent drive for the two conveyors in the furnace permits the mill operation to be altered to suit conditions without any rigidity imposed by the method of heating the different classes of material. In other words, if it is desired to roll packs only for a while, this can be done by stopping the pair conveyor, and the reverse is equally possible.

Although I have illustrated and described herein but two embodiments of the invention, it will be apparent that it may be practiced in other ways and by the use of other equipment than herein disclosed. Such changes in the apparatus and method described may, however, be made without departing from the spirit of the invention as defined in the appended claims.

1. In a continuous method of rolling sheet bars into sheets wherein the material is advanced continuously through a bar heating furnace, is then passed between roughing rolls to partially elongate the same to breakdowns and the breakdowns then reduced to the desired gauge by reheating and passing between finishing rolls, the improved steps consisting of continuously advancing breakdowns assembled in runover packs through a heating chamber to a point adjacent a rolling mill, subjecting the packs to a runover pass in the mill, doubling the packs, thereafter continuously advancing the doubled packs through a second heating chamber to a point adjacent the same mill, finish rolling the doubled packs in said mill, the rolling of doubled packs being interspersed with the rolling of runover packs, and maintaining the temperatures in the two chambers at the same or different temperatures as selected for imparting the proper amount of heat to the two series of packs.

2. The method of claim 1 wherein the runover packs and the finishing packs are fed through their respective heating chambers at different rates.

3. The method of claim 1 wherein the temperature of the runover packs on being discharged from their heating chamber differs from that of the finishing packs as discharged from their chamber.

4. In a continuous method of rolling sheet bars into sheets wherein the bars are passed through a continuous bar heating furnace, then subjected to a sufficient number of passes between roughing rolls to partially elongate the bars to breakdowns, the breakdowns then reheated and reduced to the desired gauge by passing between finishing rolls, the improved steps consisting of continuously advancing matched breakdowns forming runover packs through a heating chamber into proximity to a rolling mill, rolling the runover packs in the mill to form finishing packs, thereafter continuously advancing the finishing packs through a second heating chamber into proximity to the same mill, and rolling the reheated finishing packs in said mill, the rolling of runover and finishing packs being interspersed.

5. The method defined by claim 4 characterized by the step of controlling the speed of advancing the runover and finishing packs through their heating chambers respectively to regulate the temperature at which the packs are discharged from the chambers for rolling in the mill.

6. The method defined by claim 4 characterized by the step of maintaining different tem-

peratures in the chambers for heating runover and finishing packs respectively.

7. The method defined by claim 4 characterized by maintaining the temperatures in the two chambers at the same or different temperatures as selected by the operator for raising the temperature of the respective series of packs to the desired value for rolling.

8. In a continuous method of rolling sheet bars into sheets wherein the bars are passed through a continuous bar heating furnace, then subjected to a sufficient number of passes between roughing rolls to partially elongate the bars to breakdowns; the breakdowns then reheated and reduced to the desired gauge by passing between finishing rolls, the improved steps consisting of continuously advancing matched breakdowns forming runover packs through a heating chamber into proximity to a rolling mill, continuously advancing finishing packs formed by rolling said runover packs, through a second heating chamber into proximity to said mill, passing the runover and finishing packs through the mill in interspersed relation and then passing the runover packs which have been rolled

to form finishing packs through said second chamber.

9. A method of rolling sheets which consists in maintaining sheet material in different stages of completion at different temperatures, in passing material in different stages of completion through a mill stand, to perform a rolling operation thereon, and in periodically delivering material of a different temperature to such stand for the purpose of maintaining a substantial continuity in the delivery of finished material from said stand.

10. In the operation of rolling sheets, the step of heating partially finished material, in at least two furnaces, maintained at different temperatures, successively delivering sheet material in one stage of completion to one such furnace and delivering material in a different stage of completion to the other such furnace, periodically delivering material from each such furnace to a single hot mill, performing a rolling operation on material so delivered in said hot mill, whereby sheet material in different stages of completion is successively delivered to said mill.

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