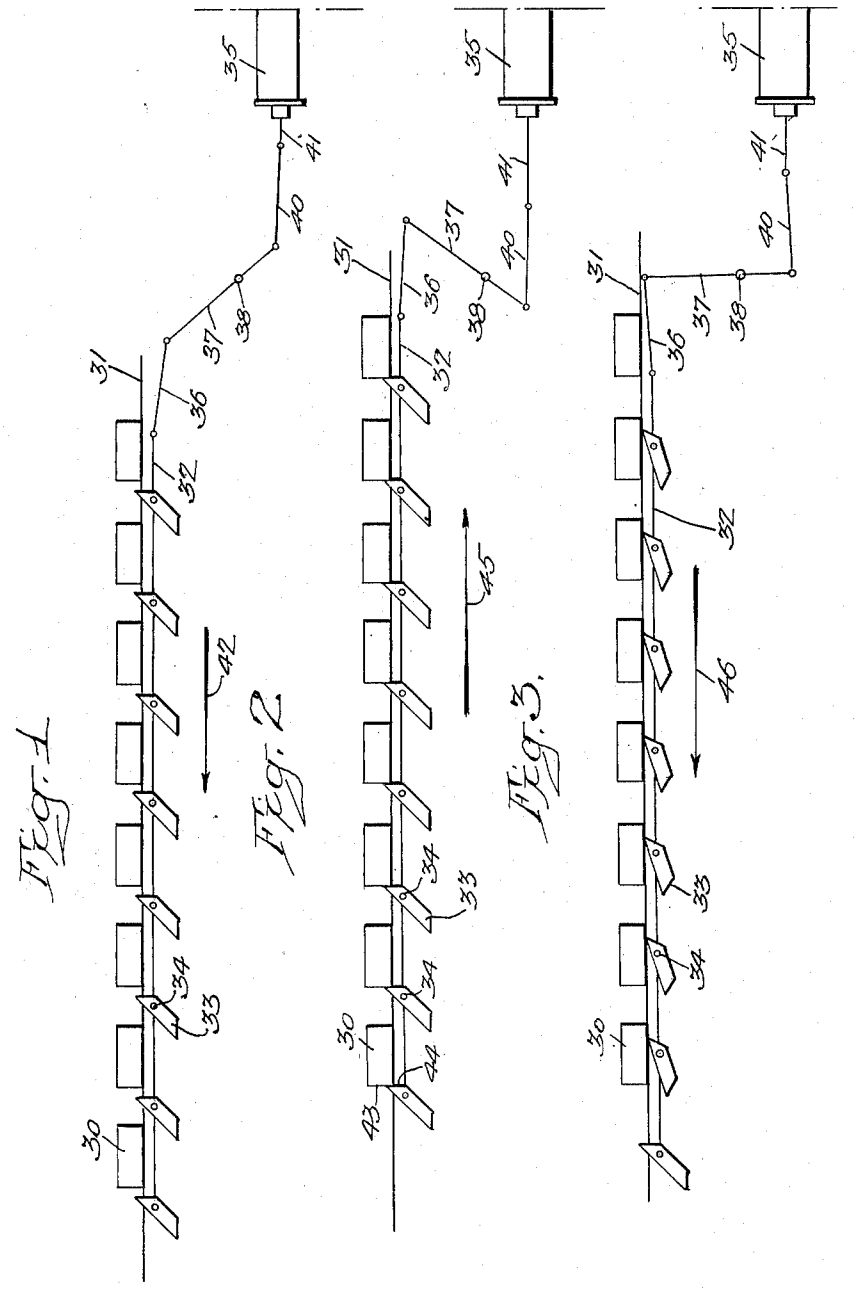
Jan. 29, 1952 L. B. ROSSEAU 2,583,968

PUSHER MECHANISM

Filed July 28, 1948 7 Sheets-Sheet 1



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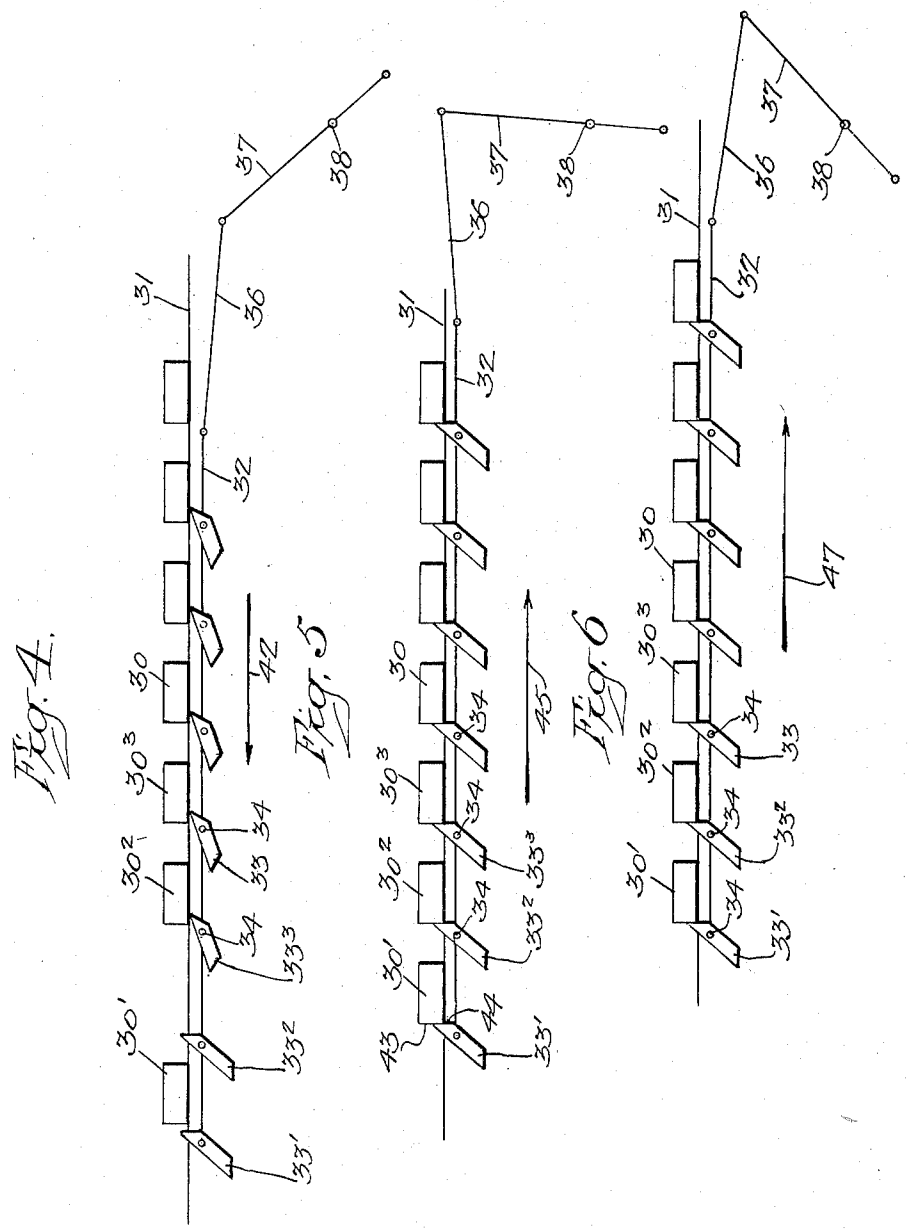
PUSHER MECHANISM

Filed July 28, 1948 7 Sheets-Sheet 2



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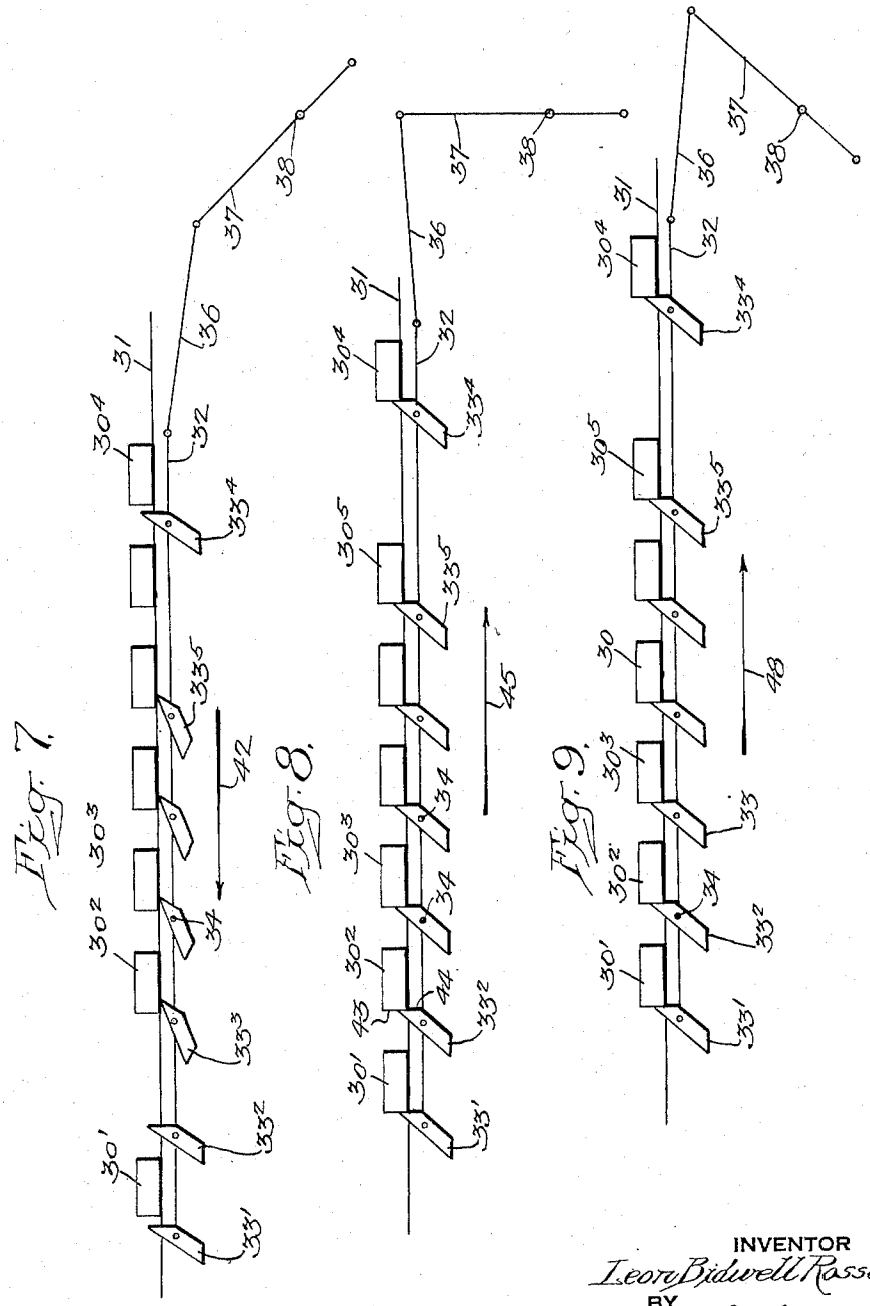
PUSHER MECHANISM

Filed July 28, 1948 7 Sheets-Sheet 3



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PUSHER MECHANISM

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Fig. 10.

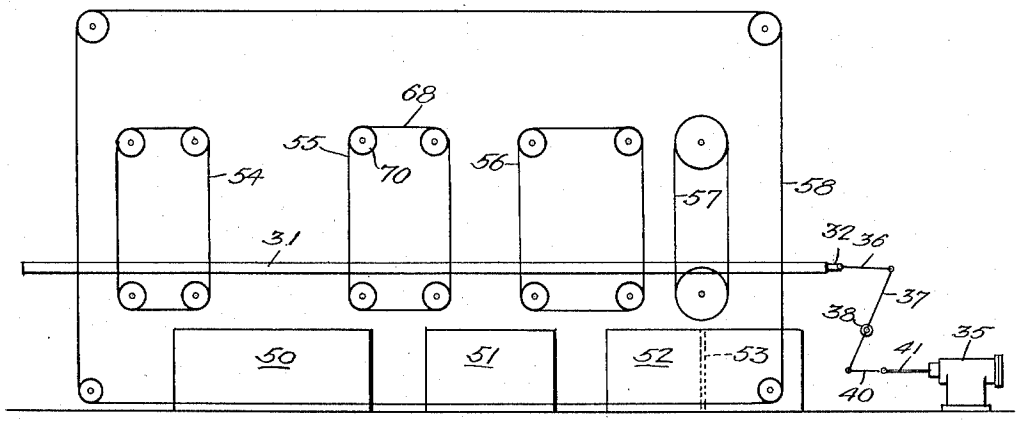


Fig. 11.

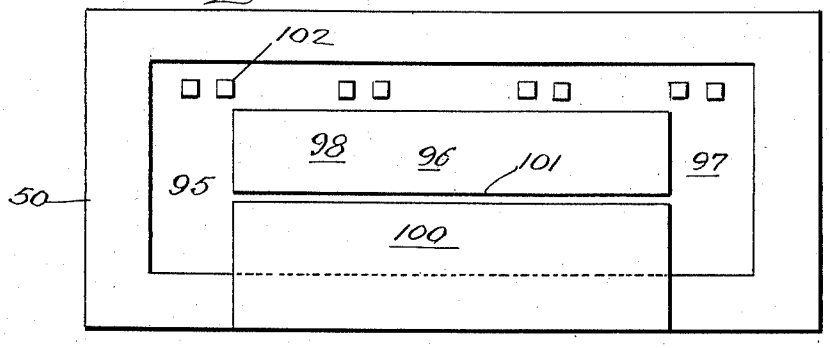


Fig. 18.

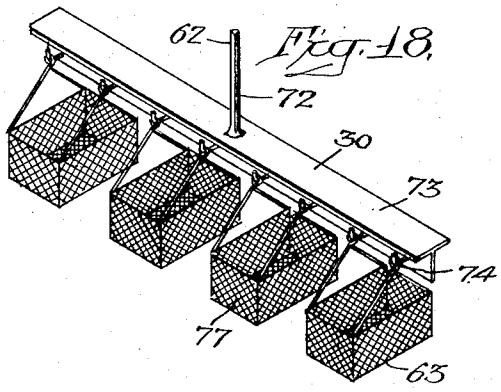
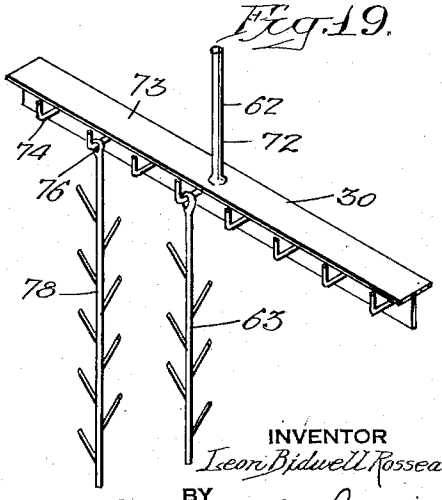


Fig. 19.



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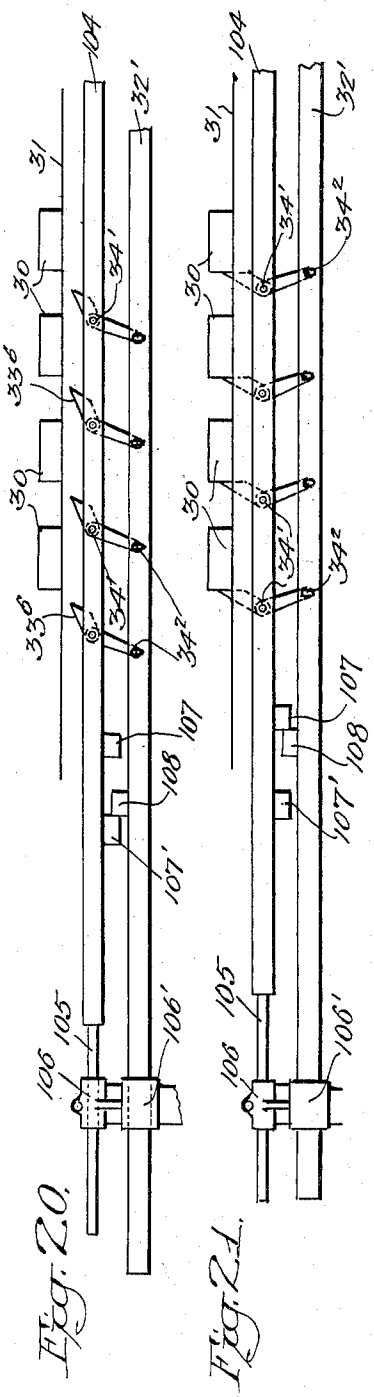

Fig. 20.

Fig. 21.

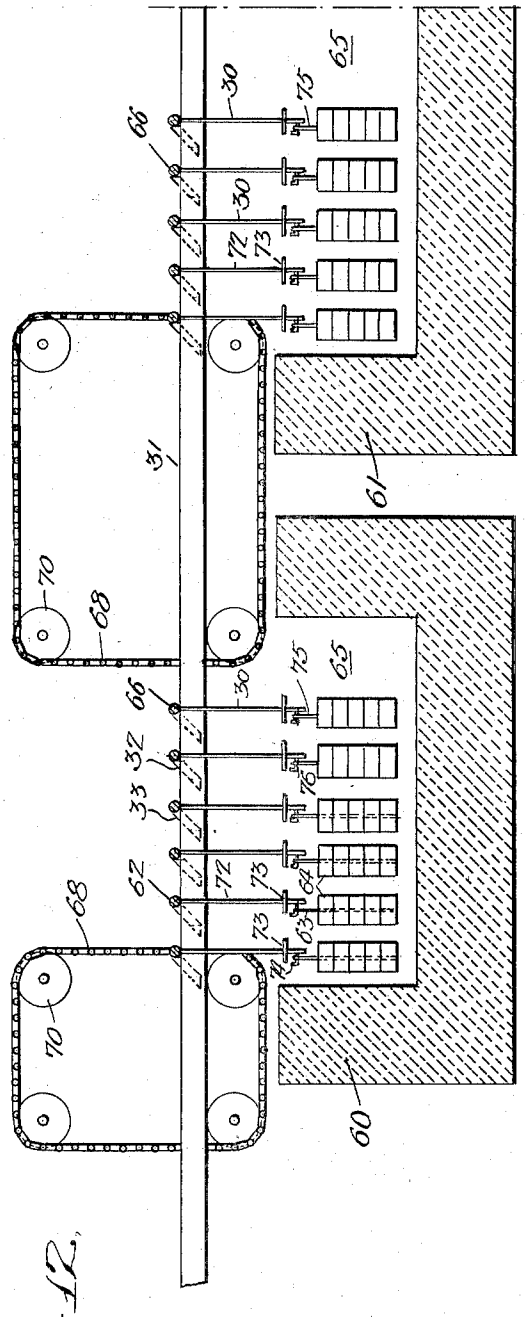

Fig. 12.

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Jan. 29, 1952 L. B. ROSSEAU 2,583,968

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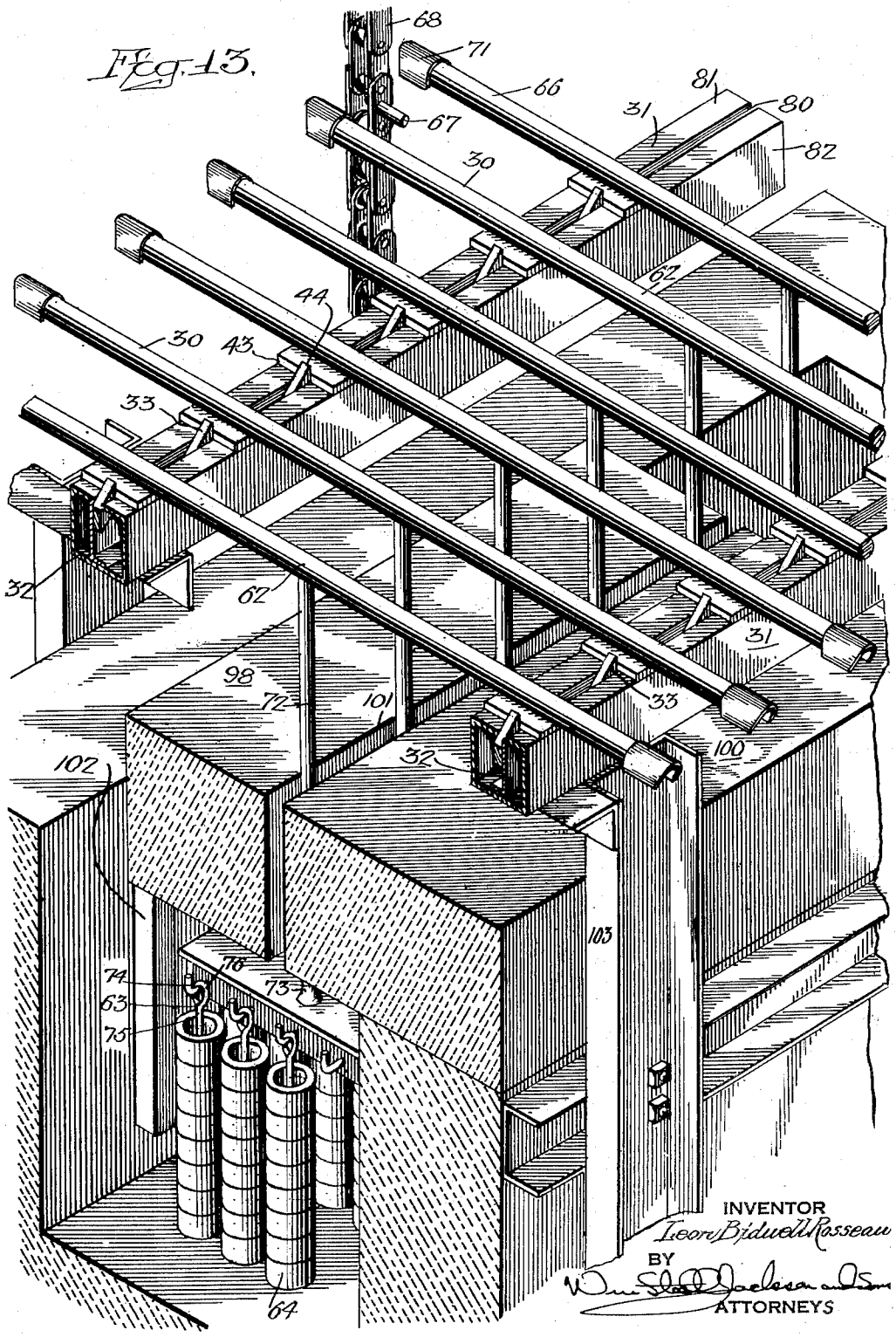
Fig. 13.



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Jan. 29, 1952 L. B. ROSSEAU 2,583,968

PUSHER MECHANISM

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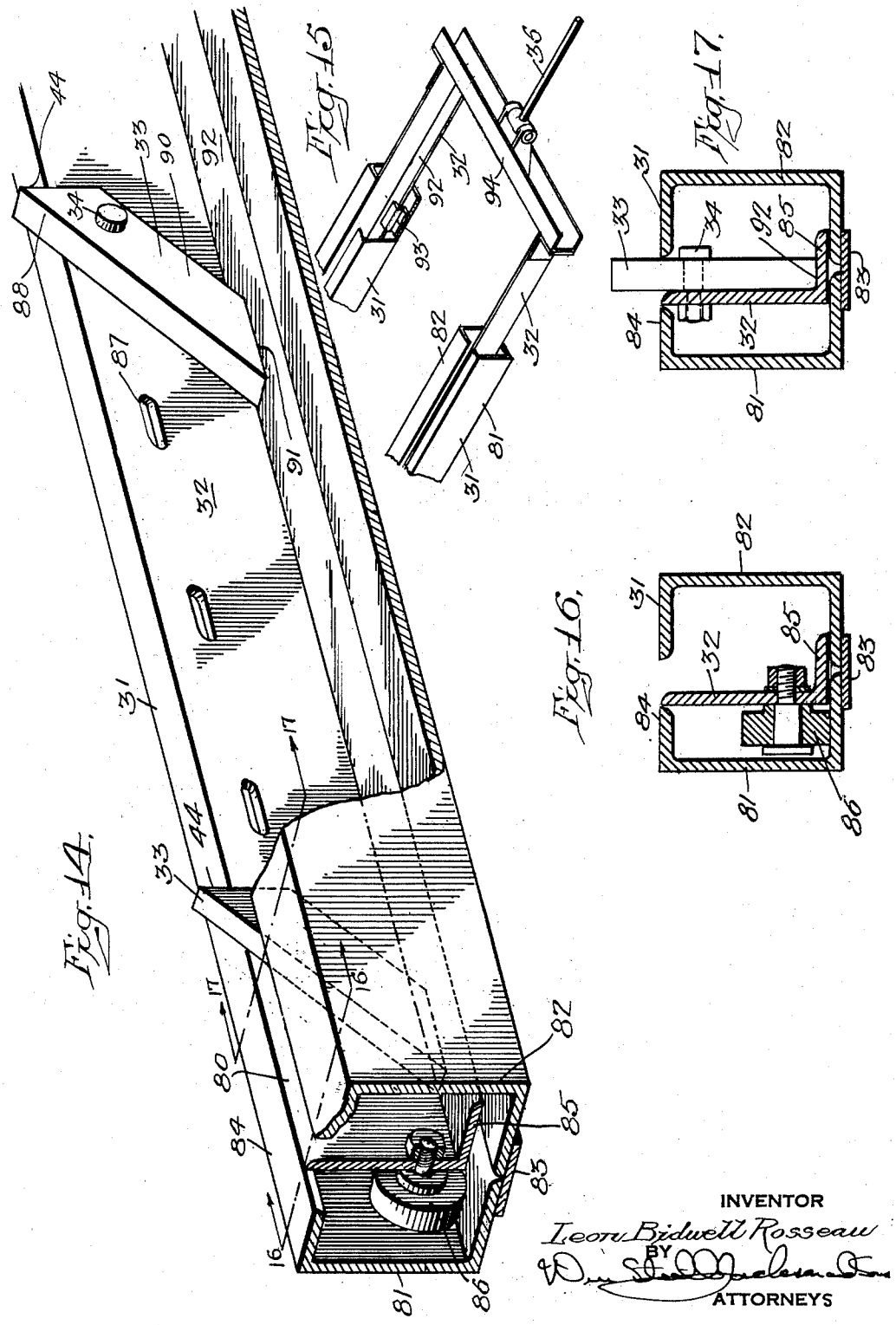

Patented Jan. 29, 1952

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UNITED STATES PATENT OFFICE

2,583,968

PUSHER MECHANISM

Leon Bidwell Rosseau, Narberth, Pa., assignor to Ajax Electric Company, Inc., Philadelphia, Pa., a corporation of Pennsylvania

Application July 28, 1948, Serial No. 41,041

16 Claims. (Cl. 263—6)

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The present invention relates to furnace mechanism and especially to salt bath furnaces.

A purpose of the invention is to permit more compact design of furnaces, especially pit type furnaces such as salt baths of the character which are used for heat treatment, and also of mechanism used for other liquid bath treatment.

A further purpose is to provide adequate space in the end of a pit type furnace such as a salt bath for insertion or removal of the work while at the same time providing greater space economy at intermediate points throughout the furnace.

A further purpose is to reduce the cost of an initial furnace installation and also to reduce the furnace heat loss and the salt consumption.

A further purpose is to permit more simple automatic feed mechanism for salt bath furnaces.

A further purpose is to permit more positive raising of pusher dogs.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the embodiments in which my invention may appear, choosing the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figures 1 to 3 inclusive are diagrammatic position views showing the application of the invention with uniform spacing of work units.

Figures 4 to 6 inclusive are diagrammatic position views showing closing of abnormal spacing at the beginning of the path of the work units.

Figures 7 to 9 inclusive are diagrammatic position views showing the closing of abnormal work space at the beginning and the opening of abnormal work space at the end of the work path.

Figure 10 is a diagrammatic side elevation of a series of furnaces to which the invention has been applied.

Figure 11 is a diagrammatic top plan view of one of the furnaces shown in Figure 10.

Figure 12 is a vertical longitudinal section showing two adjoining furnaces of the group illustrated in Figure 10.

Figure 13 is a sectional perspective showing the mechanism applied to a single furnace.

Figure 14 is a sectional perspective, partly broken away, showing a single rail and pusher bar.

Figure 15 is a fragmentary perspective partly broken away and showing the connection of two pusher bars at the end of a pair of rails.

Figure 16 is a section of a rail pusher bar structure on the line 16—16 of Figure 14.

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Figure 17 is a section on the line 17—17 of Figure 14.

Figures 18 and 19 are fragmentary perspectives showing alternate fixtures used to support the work on the work holders.

Figures 20 and 21 are diagrammatic elevations of an alternate pusher bar and dog construction.

In the drawings like numerals refer to like parts throughout.

In prior pit furnaces, it has been common practice, particularly with salt baths and the like, to lower individual work units into the work space of the furnace and in some cases to progress the work units along the work space manually or by mechanism. In general, in inserting a work unit into a pit furnace (that is, one loaded and unloaded at the top), whether it be a salt bath or other type of pit furnace, there is likely to be substantial pivoting or swing of the work unit about its upper point of support, and substantial clearance must be allowed near the inlet to the furnace in order to avoid striking of the work unit which is being charged against the furnace wall or electrodes or against other work units or associated mechanism. Likewise at the discharge end of the furnace, there may be a tendency to produce a lateral component during withdrawal of a work unit from the furnace, and although this is less likely to occur than at the inlet end, there is a need to provide adequate clearance at the outlet to avoid possible damage to the furnace or to other work. Once this clearance relationship has been established, it has in the prior art been carried throughout the furnace, so that the third, fourth, fifth and subsequent work units are spaced from one another by the same distance which separates the first from the second and which separates the last from the next-to-the-last.

Studies of furnace operation which have been made by the present inventor indicate that this condition is very wasteful both from the standpoint of efficient use of furnace space, which is a factor in first cost of the furnace, and also from the standpoint of cost of operation, including furnace heat losses, consumption of salt for a salt bath furnace, and the like. Salt consumption is reduced in many cases by decreasing the volume of salt and thus decreasing the decomposition, and by decreasing the surface and therefore reducing the amount of volatilization.

In accordance with the present invention, the advantages of wide spacing for the first and last work unit can be obtained while intermediate work units can be close spaced by a very simple

mechanism which will progress all units forward throughout the furnace or series of furnaces.

Studies of the design indicate that by thus spacing out the ends of a sequence of work units and close spacing or crowding the intermediate work units, the length of a salt bath or similar pit furnace with mechanized translating devices can be reduced by 25 to 30% with a proportional increase in efficiency. The advantages of the invention will also be applicable to other liquid treating baths which are not furnaces.

The mechanism of the character referred to herein is variously described as puller mechanism and as pusher mechanism, the meaning in any case being that a reciprocating motion of a translating device is applied to work units.

It will be understood that the work units as referred to herein normally consist partially of work holders and fixtures relating thereto, and partially of the work itself held in or on the work holders or fixtures, but it will be understood that the work units may in some cases consist entirely of the work, where the nature of the work is such that fixtures need not be employed. It will also be understood that the pusher mechanism will ordinarily operate upon a controlling upper portion of the work units, the greater bulk of which will normally be depending below such upper portion.

Considering first the diagrammatic illustration of Figures 1 to 3 inclusive, a plurality of work units 30 are arranged in a line or sequence, in this case uniformly spaced from end to end. To simplify the illustration, the depending portions of the work units are omitted in the position diagrams. The units are supported in any convenient way for example by resting them on rails 31 extending longitudinally of the sequence of work units. It will be understood that the method of support may vary with individual installations, and where suitable supporting structure exists, such structure may serve the purpose of the rails. For example in some cases the top of the side walls of the furnace may serve this purpose.

The work units 30 are moved forward from left to right in Figures 1 to 3 under the action of reciprocating pusher bars 32 (only one is here shown). The pusher bars preferably extend over guides not shown in these views to a remote position where operating connection to suitable driving mechanism can be made. The pusher bars carry a longitudinal sequence of dogs 33 operatively secured thereto at a spacing which corresponds with the spacing which it is desired to have the work units attain at the end of the stroke. In order that the dogs may not undesirably displace the work units in their retractive stroke, they preferably pass inoperatively along the work units without moving the work units in retraction, due for example to the pivot connection of the dogs on the pusher bars at 34, and the biasing of the pusher bars toward the position which they assume in the forward stroke, as by placing the preponderant weight of the dogs below the pivots as shown in Figures 1 to 3. It will be understood of course that the gravity biasing is illustrated merely as being preferable to spring bias, and that the positions achieved by the dogs in Figures 1 and 2 for example are held by stops omitted in these figures but shown in later figures.

Thus to achieve the position of full retraction of the pusher bar stroke shown in Figure 1, the dogs have moved inoperatively along the work

units as shown in Figure 3 due to the cam displacement of the dogs to the rocked position of Figure 3.

The reciprocation of the pusher bars is accomplished in any suitable manner, for example by a fluid cylinder 35 having a piston therein (not shown) and connected to the pusher bar by suitable levers, for example a link 36 making pivotal connection at one end to the pusher bar and at the other end of a rocker 37 having a fixed pivot 38 intermediate its ends, and pivotally connected at the other end to a link 40 which is pivotally connected to the piston rod 41.

Starting with the position of Figure 1, the pusher bars and dogs are shown fully retracted, each dog being behind one of the work units, and the pusher bars and dogs just having undergone a retraction stroke as indicated by the arrow 42. Figure 2 shows the completion of the forward stroke, during which a rearward surface 43 of each work unit has been pushed forward by a forward surface 44 on each dog. As the work units move forward they conveniently slide on the rails 31. This forward motion is indicated by the arrow 45.

Figure 3 indicates the beginning of the retraction stroke as shown by arrow 46, and during this portion of the retraction stroke various dogs are swung clockwise into a retraction position as shown in Figure 3. During this travel the dogs in retraction position slide along (under) the work units without displacing the work units.

In the simplified form of Figures 1 to 3, the distance through which the work units move is the same in each case. Figures 4 to 6, however, deal with a condition in which a rearward work unit $30'$ is initially relatively widely spaced from the next work unit 30^2, while the succeeding work units 30^3, etc. are closely spaced from one another. As shown at the limit of the retraction stroke in Figure 4, certain of the dogs $33'$ and 33^2 (the rear dog and the next-to-the-rear dog) are in pushing position while all forward dogs 33^3 etc. are in retraction position due to the fact that the pusher bar has not moved back far enough to permit them to engage behind the work pieces which they are adjoining.

Therefore, during the initial part of the forward stroke as shown in Figure 4, the effect is to close the space between work units $30'$ and 30^2 to the same spacing which exists between work unit 30^2 and work unit 30^3, and between each pair of work units in advance thereof. As far as work units 30^2, 30^3, etc. are concerned, the portion of the pusher bar stroke between Figures 4 and 5 is inoperative, but as far as work unit $30'$ is concerned, this portion of the stroke closes the spacing of work unit $30'$ to the normal spacing from work unit 30^2. Figure 6 indicates by the arrow 47 the effect of further forward motion of the pusher bar to the limit of its forward stroke, which simply advances all of the work units at the normal close spacing to the limit of their forward positions.

Thus it will be evident that the procedure of Figures 4 to 6 has accomplished the closing of the abnormal spacing of the initial pair of work units and also the advance of all work units by a distance which corresponds with the spacing between the centers of two close spaced units.

In some cases it may be desirable to accomplish not only the closing of the space between initial units, but the abnormal spacing of final units, and this is shown in Figures 7 to 9. Thus over at the left of Figures 7 to 9 there is an ar-

rangement substantially the same as the arrangement at the left of Figures 4 to 6, but the arrangement at the right of Figures 7 to 9 differs from that of Figures 4 to 6 in order to permit spacing out of the last work unit. Thus as shown in Figure 7 in the full retraction position, the work unit 30^4 has engaged behind it a dog 33^4, and a wide space exists between this dog and the next following dog 33^5, which is one of a sequence of following dogs having close spacing. Thus during the early part of the forward stroke, between Figures 7 and 8, the forwardmost work unit 30^4 is carried forward through abnormal spacing by the dog 33^4 at the same time that the abnormal spacing of the last work unit 30' is closed by the dog 33' Various other dogs in the meantime are moving inoperatively along (under) work units 30^2, 30^3, etc. to the position of Figure 8.

On the completion of the forward stroke, between the position of Figure 8 and that of Figure 9, all of the work units are carried further forward as indicated by the arrow 48 by a distance corresponding to the close spacing between work pieces. Thus the forwardmost work unit 30^4 preserves its abnormal spacing from the next work unit 30^5 throughout this stroke.

It will thus be evident that the operation in Figures 7 to 9 amounts to closing the abnormal spacing of the rear work unit, producing abnormal spacing of the forwardmost work unit and progressing all work units forward in addition by an amount corresponding to the center-to-center spacing of the close spaced work units.

The additional spacing at the beginning and the end therefore makes possible additional clearance for insertion and withdrawal of work units into a furnace, while the compact spacing of the intermediate work units assures efficient use of the furnace space.

Figure 10 illustrates the application of the principle of the present invention to a plurality of furnaces, conveniently electrically heated salt baths. It will be evident that a furnace sequence of this character may be employed in a variety of metallurgical operations, the number of salt baths or other furnaces being employed bearing a close relation to the particular process.

One illustration of a process to which the invention may be applied is carburizing followed by quenching, both of which may be accomplished in salt bath furnaces.

Another process involves the sequence of carburizing, air dwell, reheating in a neutral salt bath, martempering, air cooling, and drawing. All of these operations except the air dwell and the air cool will preferably be carried out in salt bath furnaces. The invention may also be applied to annealing and to cyclic annealing. The invention has application also in drawing and in brazing.

The invention may also be used in austempering, consisting of a preheat, a high heat, a quench and a draw. All of these operations will preferably be performed in salt bath furnaces.

The work for many of these operations will be steel, but it will be evident that for other operations such as annealing and brazing the work may consist of non-ferrous metals such as brass, bronze or the like. The invention may also be applied to precipitation hardening of aluminum alloys.

In Figure 10 three pit type furnaces 50, 51 and 52 are arranged in line, each preferably being an electrically heated salt bath. Pusher bars 32 extend the length of the furnaces and each pusher bar has dogs arranged for example according to the plan of Figures 1 to 3, 4 to 6 or 7 to 9 at each of the furnaces, depending upon the character of spacing desired. It will be understood that in some cases it will be preferable to use separate pusher bars for individual furnaces. Furnace 52 is conveniently divided into two parts by a vertical partition 53. An elevator 54 is provided, suitably of chain type, for lowering work units into a position at the inlet of furnace 50, and a similar elevator 55 withdraws the work units vertically from the furnace 50 and introduces them into the inlet of the furnace 51. From the furnace 51 the work units are transferred vertically by an elevator 56 to the furnace 52. In the furnace 52 work units are transferred vertically from one side to the other side of the partition by an elevator 57. At the end of the path in the furnace 52 the work units are picked up by a return elevator 58, removed from the furnace where they can be unloaded, and the work holders and fixtures are returned to the beginning of the cycle for loading with additional work.

It will be evident that the principles of my copending application Serial No. 40,862, filed July 27, 1948, for Furnace Lift and Translation Mechanism, can be applied to the elevators if desired.

The arrangement in any particular group of furnaces is best indicated by Figure 12, which shows two adjoining furnaces 60 and 61, each preferably a salt bath pit furnace (the salt is not shown). As here shown each work unit 30 comprises a work holder 62, fixtures 63 secured thereto and work 64 on the fixtures. The work holders depend from their point of support to a point usually inside the furnace, at which the fixtures are conveniently mounted, and the work is held on the fixtures within the furnace chamber 65. It will be understood of course that the work will vary in shape from one job to another, the particular items here shown being for example bearing races.

The work holders as best seen in Figure 13 include header bars 66 which extend across the tops of the rails 31 and desirably extend longitudinally of the bars beyond the rails for engagement at the ends by pins 67 on the elevator chains 68. The elevator chains are carried over supporting and driving sprockets 70 (Figure 12). To provide for each engagement between the elevator pin 67 and the header bars, each end of the header bars carries a socket projection 71 which receives and is held on the pins and which permits the work holders to swing in an upright position regardless of the point at which they are supported by the chains throughout the chain cycle. It will be understood of course that the elevators include chains (not shown) at each end of the header bars. Suitably depending from the header bars, preferably at the center, are suspension rods 72, which preferably carry at their lower ends fixture bars 73, desirably extending transversely and having fixture hooks 74.

Depending upon the character of work, the fixture hooks 74 will engage fixtures of various characters which are capable of travelling through the furnace chamber 65 and extending below the surface of the salt bath in a salt bath furnace. Thus in Figures 12 and 13 the fixtures 63 comprise rods 75 having eyes 76 at the top and suitable supporting enlargements not shown at the bottom. In Figure 18 the fixtures comprise baskets 77 (Figure 18) having suitable hook sup-

port, while in Figure 19 they comprise trees 78 provided with branches for supporting the work. It will be evident that other forms of work supports and fixtures may be used, or that the shape of the work itself may permit elimination of some of these elements.

The rails 31 in the form of Figures 13 to 17 are suitably in the form of a box section having a pusher slot 80 at the top. The channels forming the box section are conveniently joined at the bottom at 83 as by a welded strip, and one of the channels has one upper flange 84 relatively short.

In the interior of the box section and extending longitudinally thereof is a pusher bar 32 in the form of an angle 85, having supporting and guiding rollers 86 pivotally mounted thereon near the bottom to engage the inside of one channel flange. At intervals between the rollers are located the dogs 33, whose pivotal bolts 34 are longitudinally adjustable in slots 87 of the pusher bars in order to vary the spacing of the dogs. It will be understood that the slots may be lengthened or shortened, as desired. The pivots comprise adjustment bolts.

As shown, the dogs are of parallelogram form, the upper or working ends 88 extending slightly above the top of the track, and having faces 89, forwardly directed, which assume a vertical position when the heavier lower ends 90 are downward and the bottom surfaces 91 are brought to a stop position against the bottom flange 92 of the pusher bar.

The pusher bars are conveniently guided by clips 93 extending from the lower flanges of the rails into contact with the bottom flange 92 of the pusher bars. The respective pusher bars are interconnected at the operating end by a cross beam 94 which makes pivotal connection to the link 36 at one end.

It will be understood that while the pusher bars are shown as extending longitudinally over several furnaces, the pusher bars may be individual to each furnace or to any group of furnaces so as to provide different strokes in differen furnaces.

The problem of covering the furnaces is complicated by the fact that the work units must move bodily in and out at the opposite ends of each furnace. For example, considering the top plan of Figure 11, the inlet opening 95 of the salt bath furnace 50 there shown is immediately below the elevator 54, and provision is made for spacing out the first work unit from the next succeeding work unit at this point. The work units opposite the intermediate portion 96 of the furnace are suitably close spaced, while the work unit oppostie the outlet portion 97 is more widely spaced to allow additional lateral clearance for withdrawal by the elevator 55. The inlet and outlet spaces are preferably not covered (or covered separately), but the intermediate space is suitably covered by a roof 98 extending from the rear and a roof 100 extending from the front, leaving an intermediate slot 101 for passing the suspension rods 72 of the work holders, as best seen in Figure 13. The electrodes of the electrric salt bath furnace are shown at 102, arranged in pairs according to the Hultgren arrangement usually employed. The roof section 98 has not been extended over the electrodes to permit inspection thereof, and a separate roof section might be used at this point. As best seen in Figure 13 the rails are conveniently supported by beam structures 103 extending above the roof sections 98 and 100, and the roof sections may be supported therefrom.

In operation it will be evident that any individual furnace may be designed according to the procedure of Figures 1 to 3, Figures 4 to 6 or Figures 7 to 9, using abnormal spacing at the inlet, at the outlet, at both points or at either point, depending on the requirements of the particular furnace. Thus there may be in one furnace line examples of each type. The work unit will be lowered by the elevator 54 of Figure 10 into the first furnace, and carried across that furnace in steps depending upon the particular dog spacing. At the end of the travel through the first furnace, it will be picked up by an elevator, withdrawn vertically from the first furnace and then deposited in the second furnace. Here the process will be repeated, progressing the work unit according to the progress determined by the dog spacing and the pusher bar stroke. This will continue until the end of the feeder. At this point the work will preferably be discharged and the work holders and fixtures will be returned to the start of the cycle.

In the forms previously shown the biasing or urging of the dogs to their pushing position (the position in which they are raised above the rails to contact the work units) is accomplished by gravity. For some types of service, because of the elevated temperature involved, springs are not very satisfactory when located directly above the furnace. In some instances it may be desired to have a more positive means for raising the dogs, and a device of this kind is shown in Figures 20 and 21. Figure 20 illustrates the position of the parts at the start of the forward or driving stroke, and the relation of the parts throughout the retraction stroke will be similar. Figure 21 shows the parts after the beginning of the forward stroke and throughout the forward stroke subsequently thereto.

The work units 30 are supported on rails 31 and pusher bars 32', extending longitudinally of and preferably below the rails. The pusher bars are connected to reciprocating mechanism as shown in the other figures. Extending longitudinally of the pusher bars and preferably above the same but below the rails are dog bars 104, which are capable of moving longitudinally with the pusher bars, but are provided with rod extensions 105 which pass through friction boxes 106 and are suitably dragged or retarded by the friction boxes during motion in either direction. The friction boxes are mounted on supports not shown, and the pusher bars and dog bars are guided on guides 106'.

Dogs 33^6 are distributed along the pusher bars and dog bars in the manner shown in the other views, being pivotally connected to the pusher bars at 34^2 by pin and slot joints, and pivotally connected to the dog bars at 34'. Stops 107 are mounted on the dog bars and cooperating stops 108 are on the pusher bars. On the retracting stroke the stop 108 on the pusher bar 32' engages the stop 107' on the dog bar 104 and thereby determines the position of the dog 34^6 in relation to the work unit 30.

On retraction of the pusher bars, the friction boxes retard the dog bars and the dogs pivot to the retracting or lower position as shown in Figure 20, so that the dogs pass under the work units without displacing the same.

At the start of the forward or pushing stroke as shown in Figure 20, the dogs are still in the lower position. The pusher bars now move for-

ward and the friction boxes drag the dog bars so that the dogs pivot into raised position as shown in Figure 21, and engage behind the work units to push them forward on the rails. The forward motion of the pusher bar with respect to the dog bar is limited by the engagement of the stops 108 on the pusher bars with the stops 107 on the dog bars. During further forward movement the dog bars are pulled forward against the frictional drag of the friction boxes in order to carry forward the dogs. Thus it will be seen that the dog bars encounter frictional drag in both directions and have slight relative movement with the corresponding pusher bar, but otherwise move back and forth with the appropriate pusher bar.

It will be evident that the mechanism is very flexible, and can readily be readjusted to provide for progression of the work in steps of different lengths by simply varying the dog spacing and the pusher bar stroke.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubltless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the process and structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

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

1. In transfer mechanism for work units of a furnace and the like, rails supporting a plurality of work units, a pusher bar adapted to reciprocate and extending lengthwise of the rails, a dog bar extending lengthwise along the pusher bar and adapted to move therewith, and dogs at intervals pivotally interconnected with the dog bar and the pusher bar and adapted in raised position to contact the work units.

2. In transfer mechanism for work units of a furnace and the like, rails supporting a plurality of work units, a pusher bar adapted to reciprocate and extending lengthwise of the rails, a dog bar extending lengthwise along the pusher bar and adapted to move therewith, friction means for applying a drag to the dog bar and dogs at intervals pivotally interconnected with the dog bar and the pusher bar and adapted in raised position to contact the work units.

3. In transfer mechanism for work units of a furnace and the like, rails supporting a plurality of work units, a pusher bar adapted to reciprocate and extending lengthwise of the rails, a dog bar extending lengthwise along the pusher bar and adapted to move therewith, friction means for applying a drag to the dog bar, stops between the pusher bar and the dog bar for limiting the relative movement, and dogs at intervals pivotally interconnected with the dog bar and the pusher bar and adapted in raised position to contact the work units.

4. In transfer mechanism for work units of a furnace and the like, rails supporting a plurality of work units, a pusher bar adapted to reciprocate and extending lengthwise of the rails below the top, a dog bar extending lengthwise of the pusher bar above the same and below the top of the rails, the dog bar being adapted to move longitudinally, friction means for applying a drag on the dog bar, stops limiting relative motion between the pusher bar and the dog bar, and dogs at intervals pivoted to the pusher bar and to the dog bar and adapted in raised position to extend above the rails and contact the work units.

5. The process of translating work units having support portions by a pusher having dogs which move from an engaging position behind the support portions to a retracting position slidable along the support portions, which comprises slidably supporting the work units by a support in a generally horizontal row in which one of the work units is spaced from the next by a relatively greater distance and the other work units are each spaced from the next by a relatively lesser distance, retracting the pusher along the work units from its position of farthest forward advance and thereby retracting all of the dogs the same distance, one of the dogs moving to a pushing position immediately behind the support portion of the work unit which is spaced from the next by the relatively greater distance and the other dogs moving to a pushing position far behind the respective adjoining work units, and then pushing a pusher forward over the relatively greater distance and thereby bringing the work unit spaced from the next by the greater distance forward the greater distance and bringing the other work units forward the relatively smaller distance.

6. The process of translating work units having support portions by a pusher having dogs which move from a pushing position behind the support portions of the work units to a retracting position sliding beneath the support portions of the work units, which comprises slidably supporting the work units by the support portions in a generally horizontal row in which the last work unit is spaced from the next preceding by a greater distance and the preceding work units are spaced from one another by a lesser distance, retracting the pusher beneath the work units from its position of farthest advance and thereby retracting all of the dogs the same distance, the last of the dogs moving to a position in a pushing relation behind the supporting portion of the last work unit and the other dogs moving to a pushing position behind the supporting portions of the respective next preceding work units and beneath the supporting portion of the next-but-one preceding work units in sliding relation, and then pushing the pusher forward over the greater distance and thereby bringing the last work unit forward by the greater distance and bringing the other work units forward by the smaller distance.

7. The process of translating work units having support portions by a pusher having dogs which move from a pushing position behind the support portions of the work units to a retracting position sliding along the support portions, which comprises slidably supporting the work units by the support portions in a generally horizontal row in which the work units of a group are each separated from the next by a relatively leesser distance, spacing a group of the dogs by distances corresponding to the lesser distance and spacing one of the dogs from the next by a greater distance, retracting the pusher and the dogs along the work units from its position of farthest advance over a relatively greater distance and thereby retracting all of the dogs over the relatively greater distance, one of the dogs moving into pushing position immediately behind the support portion of one of the work units and the other dogs moving to positions far behind the support portions of respective preceding work units in the sequence and then pushing the pusher forward over the greater distance and

thereby advancing the one work unit over the greater distance and advancing the other work units over the smaller distance.

8. The process of translating work units having support portions by a pusher having dogs which move from a raised pushing position above the level of the support portions of the work units to a depreessed retracting position beneath the level of the support portions of the work units, which comprises slidably supporting the work units by the support portions in a generally horizontal row in which the work units are each spaced from the next by a relatively lesser distance, spacing a group of the dogs by distances corresponding to the lesser distance and spacing the forwardmost of the dogs by a relatively greater distance from the next dog, retracting the pusher and the dogs beneath the work units from its position of farthest advance over the relatively greater distance and thereby retracting all of the dogs over the relatively greater distance, the forwardmost dog moving to a position immediately behind and above the level of the support portion of the forwardmost work unit and the other dogs moving to positions far behind the support portions of preceding work units in the sequence and furthermore in retracting position beneath the next preceding work units and then pushing the pusher forward over the greater distance and thereby advancing the forward work unit over the greater distance and advancing the other work units over the smaller distance.

9. The process of translating work units having support portions by a pusher having dogs which move from a pushing position behind the support portions to a retracting position sliding along the support portions, which comprises slidably supporting the work units by the support portions in a generally horizontal row in which the first work unit is spaced from the next by a relatively greater distance and the other work units are spaced from one another by a relatively lesser distance, spacing a group of the dogs by distances corresponding to the lesser distance and spacing the forwardmost dog by a distance corresponding to the greater distance, retracting the pusher along the work units from its position of farthest advance and thereby retracting all of the dogs over the greater distance, the rearwardmost dog moving into pushing position immediately behind the support portion of the rearwardmost work unit, the forwardmost dog moving into pushing position immediately behind the support portion of the forwardmost work unit and a group of other dogs moving to a position far behind the support portions of the intermediate work units in the sequence and then pushing the pusher forward over the greater distance and thereby advancing the rearwardmost and the forwardmost work units over the greater distance and the other work units over the smaller distance.

10. In a conveyor for a furnace having a work space, generally horizontal rails above the work space, work units slidably positioned in line along the rails, some of the work units being relatively closely spaced from one another and one of the work units being spaced from the next by a relatively greater distance, a pusher bar extending along the work units, dogs on the pusher bar having pusher positions engaging behind the work units and retracting positions sliding along the work units and mechanism reciprocating the pusher bar over a stroke from the forwardmost position backward over the greater distance to a position with one of the dogs close behind the one work unit and the other dogs far behind the respective other work units and for reciprocating the pusher bar forward over the greater distance and thereby advancing the one work unit over the greater distance and the other work units over the lesser distance.

11. In a conveyor for a furnace having a work space, generally horizontal rails above the work space, work units slidably positioned in line along the rails, a group of the work units being relatively closely spaced from one another and the last of the work units being spaced from the next by a greater distance, a pusher bar extending beneath the work units, dogs on the pusher bar having pushing positions extending upward behind the work units and retracting positions sliding along beneath the work units and mechanism reciprocating the pusher bar over a stroke from its forwardmost position backward over the greater distance to a position at which the last dog is close behind the last work unit and the other dogs are far behind their next preceding work unit and depressed beneath the second preceding work unit and for reciprocating the pusher bar forward over the greater distance and thereby advancing the last work unit over the greater distance and the other work units over the lesser distance.

12. In a conveyor for a furnace having a work space, generally horizontal rails above the work space, work units slidably pushed along the rails, the work units of a group being spaced from one another by a relatively lesser distance, a pusher bar extending along the work units, dogs on the pusher bar having pushing positions engaging behind the work units and retracting positions sliding along the work units, a group of the dogs being spaced from one another by the lesser distance and one of the dogs being spaced from the next by a relatively greater distance, and mechanism reciprocating the pusher bar over a stroke from the forwardmost position backward over the greater distance to a position at which the dog spaced by the greater distance is close behind one of the work units and in pushing position and the other dogs which are spaced by the lesser distance are far behind the respective next work units to be pushed and for reciprocating the pusher bar forward over the greater distance and thereby advancing the one work unit over the greater distance and the other work units over the lesser distance.

13. In a conveyor for a furnace having a work space, generally horizontal rails above the work space, work units slidably positioned along the rails, some of the work units being spaced from one another by a leaser distance, a pusher bar extending beneath the work units, dogs on the pusher bar having raised pushing positions behind the work units and retracting positions sliding beneath the work units, the forwardmost dog being spaced from the next by a relatively greater distance and the succeeding dogs being spaced from the next by the relatively lesser distance, and mechanism reciprocating the pusher bar over a stroke from the forwardmost position backward over the greater distance to a point at which the forwardmost dog is in pushing position close behind the forwardmost work unit and the succeeding dogs are far behind the next succeeding respective work units and in sliding relation beneath the next-but-one succeeding work units and for reciprocating the pusher bar forward over the greater distance and thereby advancing the

forward work unit over the greater distance and the other work units over the lesser distance.

14. In a conveyor for a furnace having work space, generally horizontal rails above the work space, work units slidably positioned along the rails, some of the work units being spaced from one another by a lesser distance and the last of the work units being spaced from the next work unit by a greater distance, a pusher bar extending along the work units, dogs on the pusher bar having pushing positions engaging behind the work units and retracting positions sliding along the work units, the forwardmost dog being spaced from the next by the greater distance and the succeeding dogs being spaced from the next by the lesser distance, and mechanism reciprocating the pusher bar over a stroke from the forwardmost position backward over the greater distance to a point at which the rearwardmost dog is close behind the last work unit, the forwardmost dog is close behind the forwardmost work unit and the intermediate dogs are respectively far behind the respective intermediate work units and for reciprocating the pusher bar forward over the greater distance and thereby advancing the first and last work units over the greater distance and intermediate work units over the lesser distance.

15. In a conveyor for a plurality of furnaces in line each having a work space, rails extending generally horizontally above the work spaces of the respective furnaces, work units slidably positioned on the rails and extending into the respective work spaces of the furnaces, the first work unit in each work space being spaced from the next by a relatively greater distance and the succeeding work units in each work space being spaced from the next by relatively lesser distances, a pusher bar extending along all of the work units in the work spaces, dogs on the pusher bar having pushing positions engaging behind the various work units and retracting positions sliding along the work units, the forwardmost dog at each work space being spaced from the next by the greater distance and the succeeding dogs at each work space being spaced from the next by the lesser distance, mechanism reciprocating the pusher bar across all of the work spaces over a stroke from the forwardmost position backward over the greater distance to a point at which the rearwardmost dog at each work space is immediately behind the rearwardmost work unit and the forwardmost dog at each work space is immediately behind the forwardmost work unit and the intermediate dogs are respectively far behind the respective intermediate work units and for reciprocating the pusher bar forward over the greater distance and thereby advancing the forwardmost and rearwardmost work units over the greater distance and the intermediate work units over the lesser distance at each work space, and elevator means for transferring the work units from one work space to the next.

16. In a conveyor for a pot type furnace having a work space, having a slotted roof extending across the furnace and having an open inlet portion at the beginning and an open outlet portion at the end, rails extending generally horizontal above the roof, means for lowering a work unit onto the rails through the inlet space in line with the slot in the roof, the last work unit being spaced from the next by a greater distance and the preceding work units being spaced from the next by a lesser distance, a pusher bar extending along the work units, dogs on the pusher bar having pushing positions engaging behind the work units and retracting positions sliding along the work units, the forwardmost dog being spaced from the next by the greater distance and the succeeding dogs being spaced from the next by the lesser distance, mechanism reciprocating the pusher bar over a stroke from the forwardmost position backward over the greater distance to a point at which the forwardmost dog reaches pushing position immediately behind the forwardmost work unit, the rearwardmost dog reaches pushing position immediately behind the rearwardmost work unit and the intermediate dogs reach positions far behind the respective intermediate work units and for reciprocating the pusher bar forward over the greater distance and thereby advancing the forwardmost and the last work units over the greater distance and the intermediate work units over the lesser distance and elevator means for raising the last work unit from the outlet opening beyond the roof.

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