May 3, 1932. J. SYLVESTER 1,856,668

ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 1

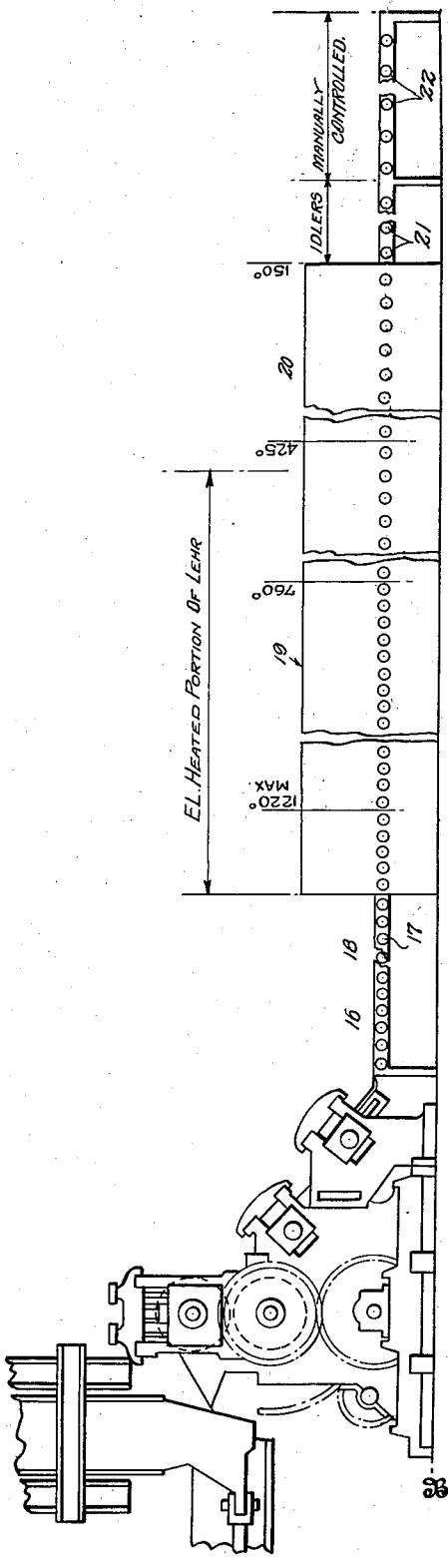

Fig. 1.

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ANNEALING LEER

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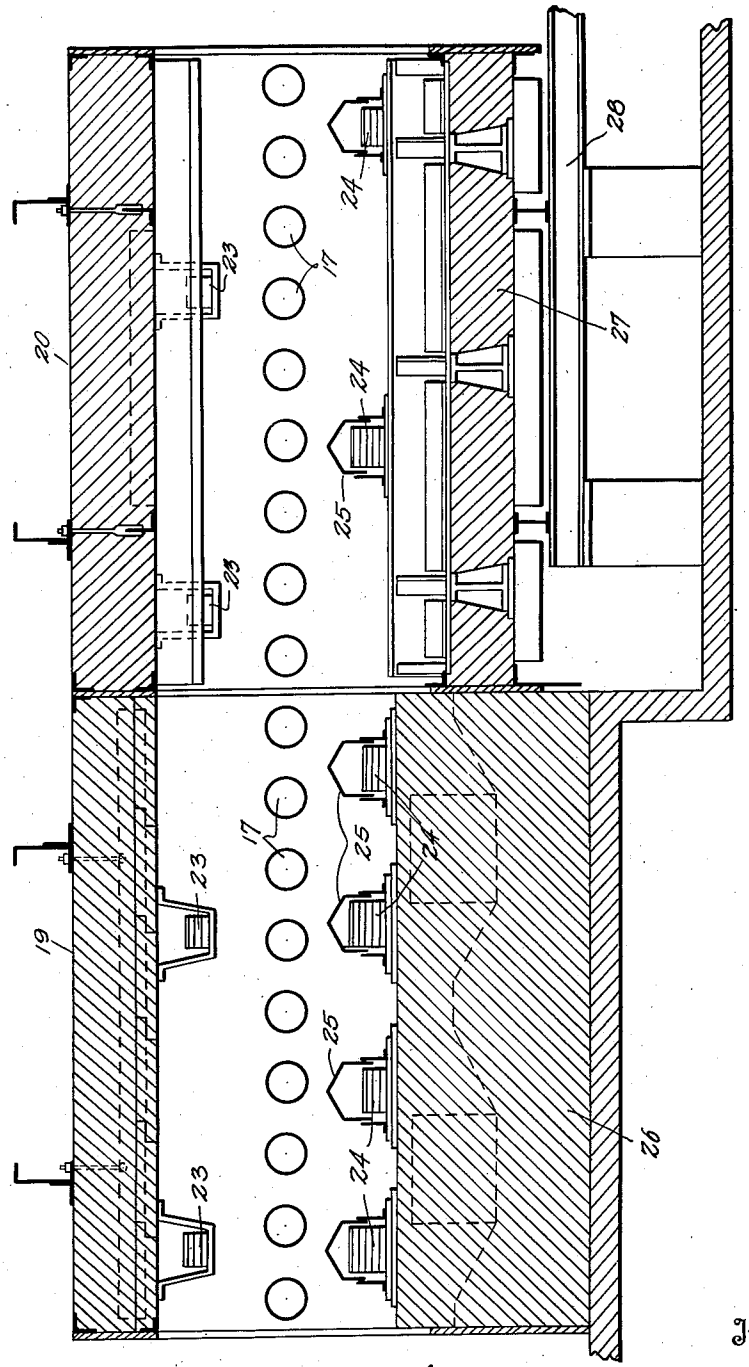

Fig. 2.

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ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 3

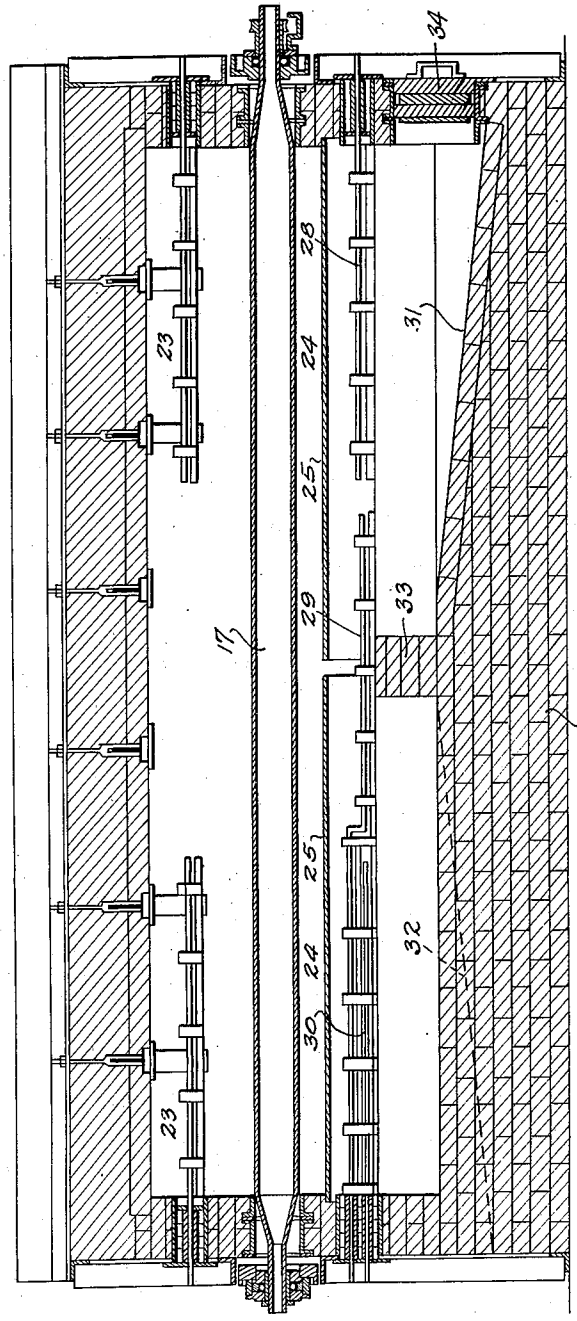

Fig. 3.

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ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 4

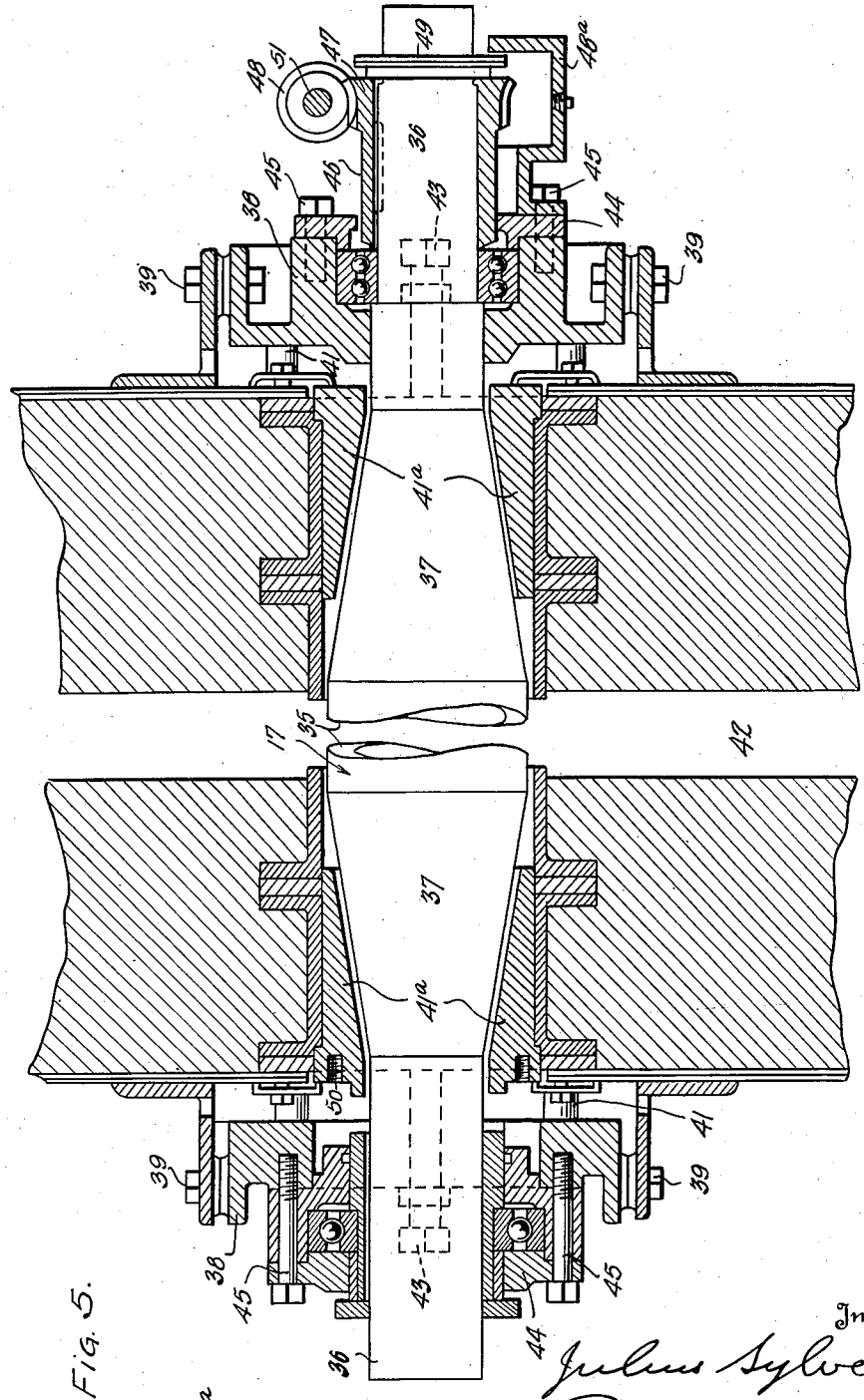

Fig. 4.

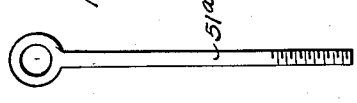

Fig. 5.

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May 3, 1932. J. SYLVESTER 1,856,668

ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 5

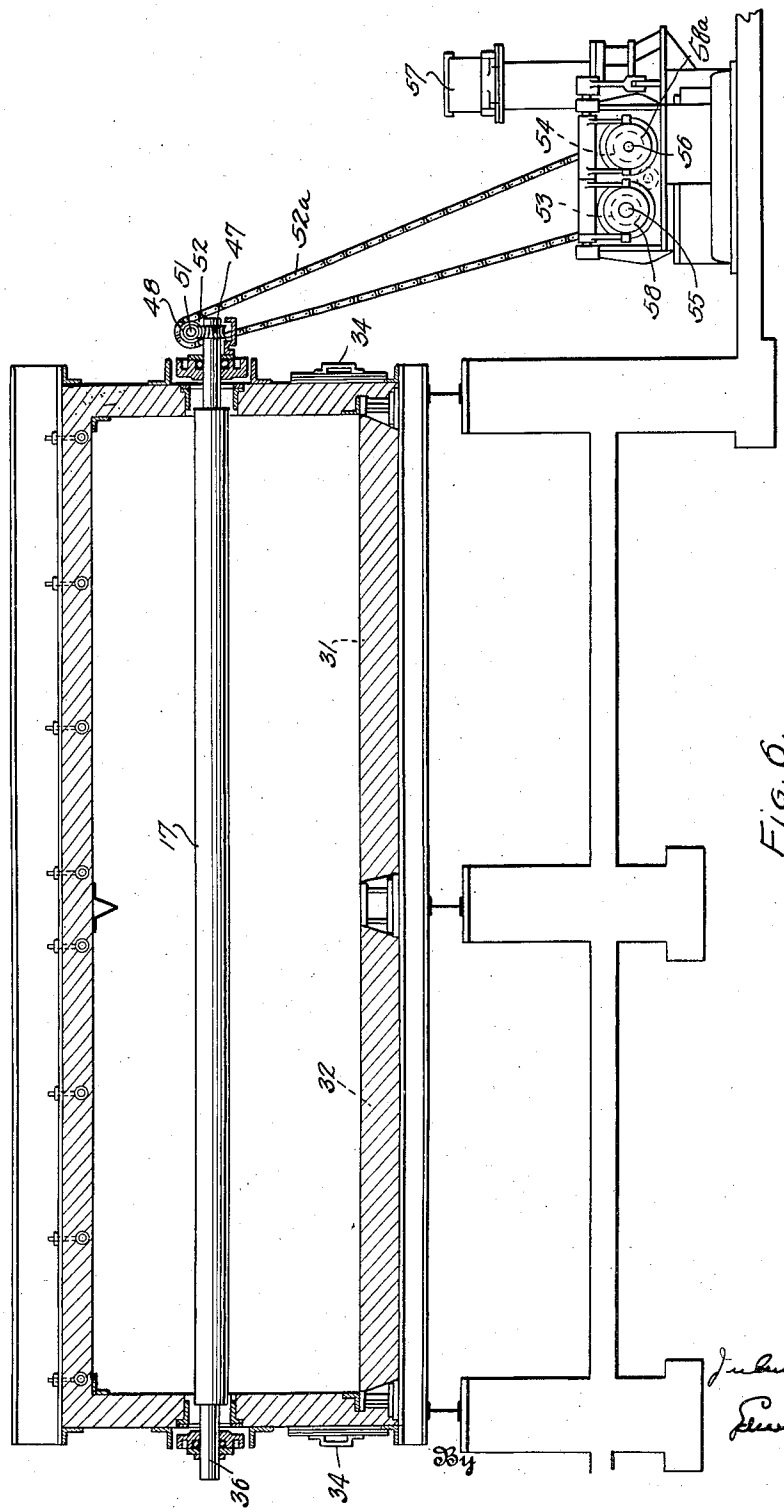

Fig. 6.

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May 3, 1932. J. SYLVESTER 1,856,668

ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 6

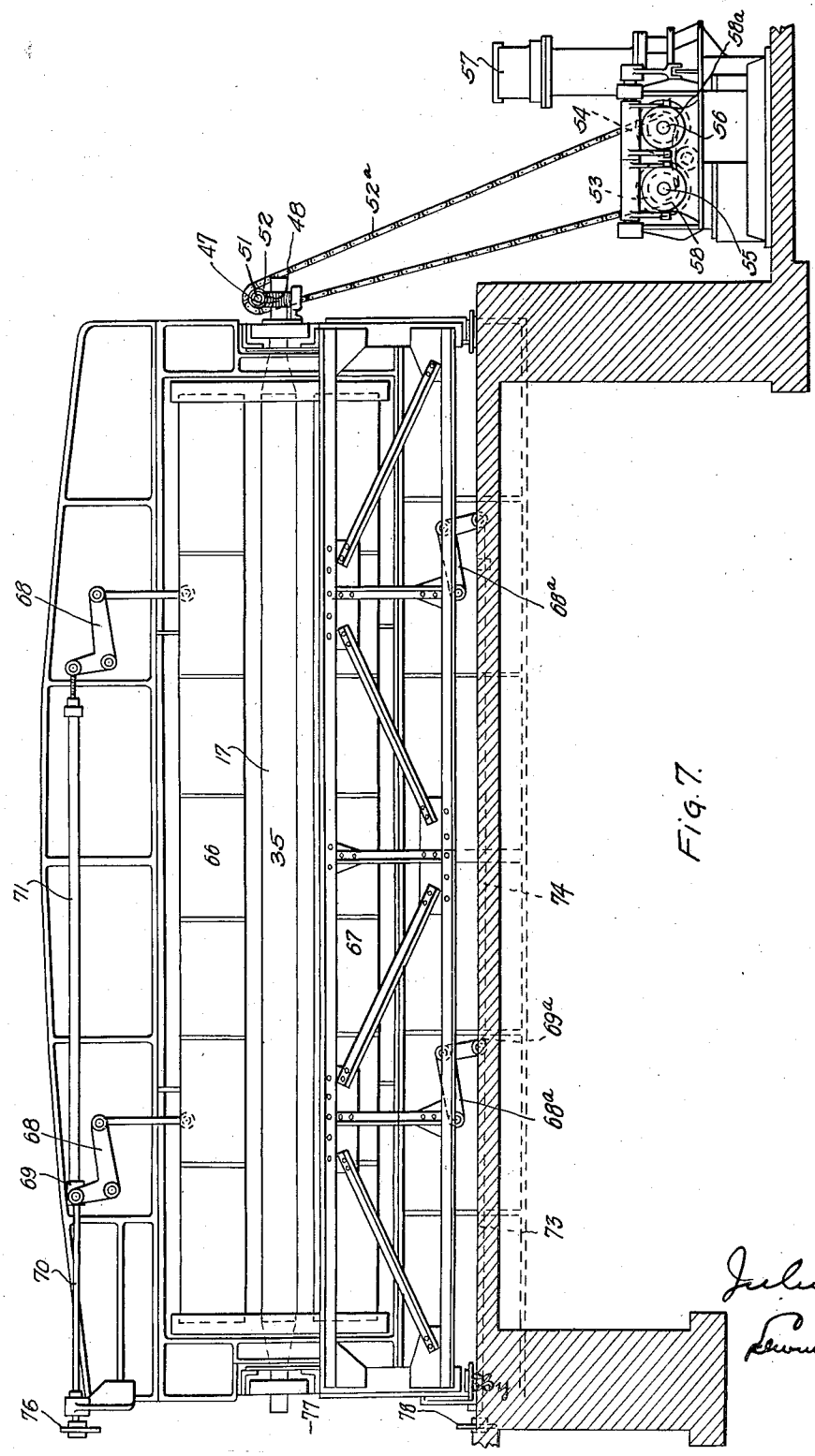

Fig. 7.

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Original Filed Jan. 21, 1929 16 Sheets-Sheet 7

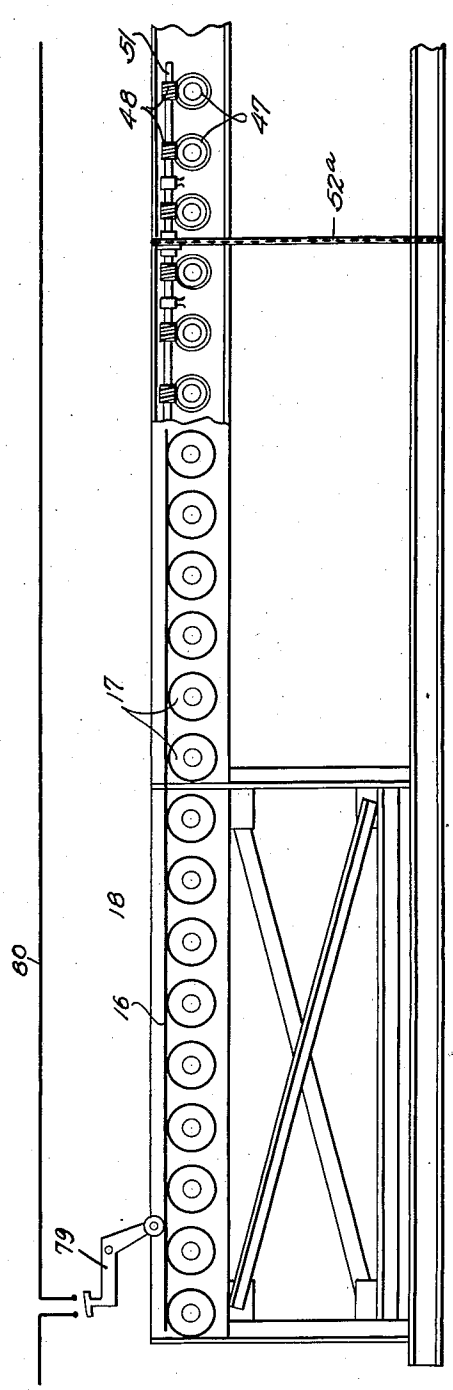

Fig. 8.

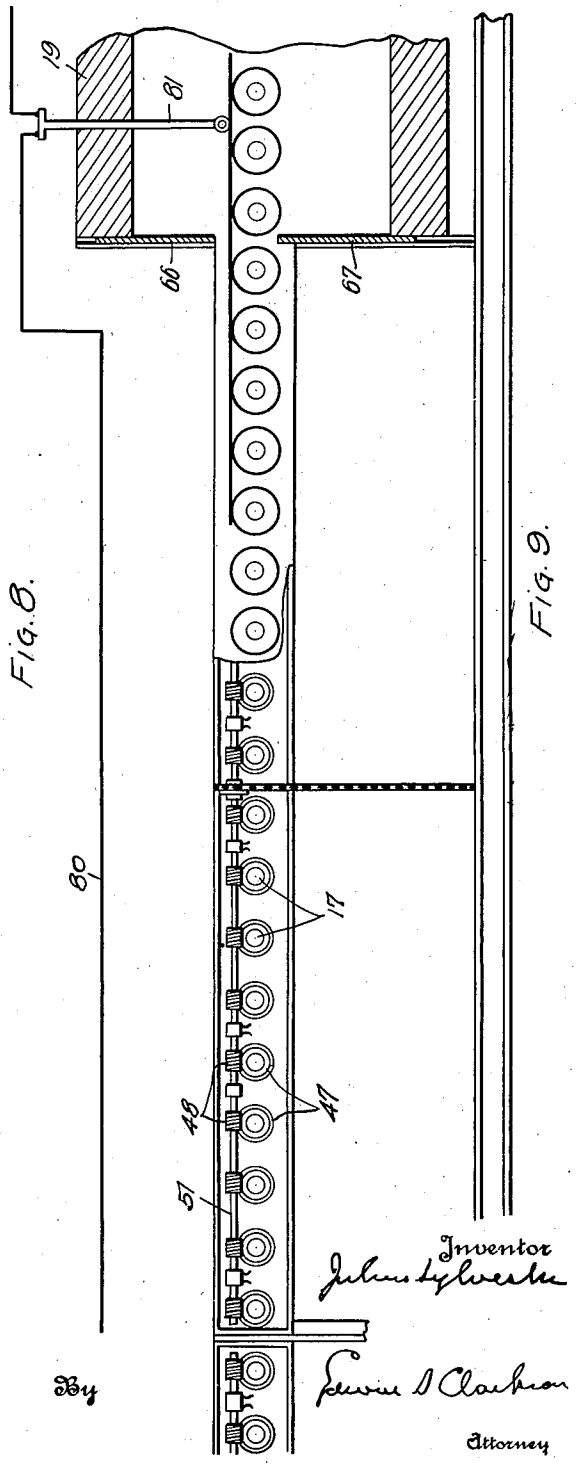

Fig. 9.

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Original Filed Jan. 21, 1929 16 Sheets-Sheet 8

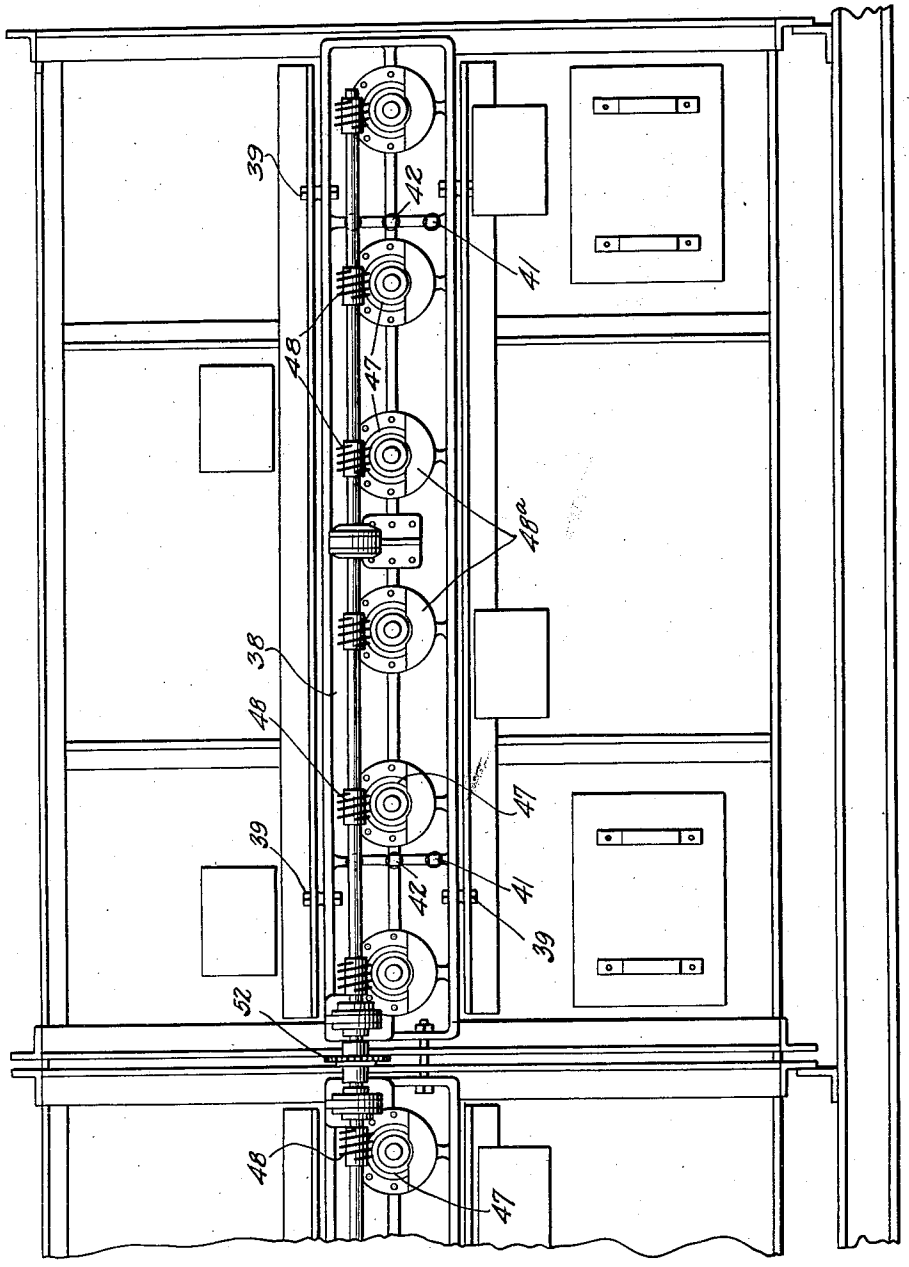

FIG. 10.

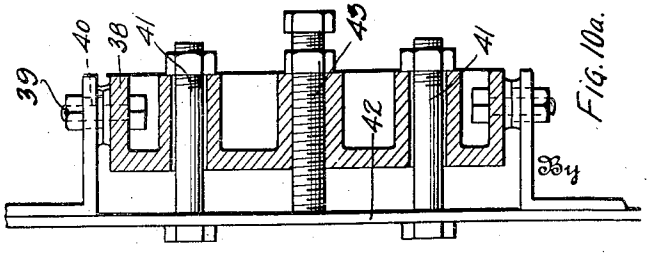

FIG. 10a.

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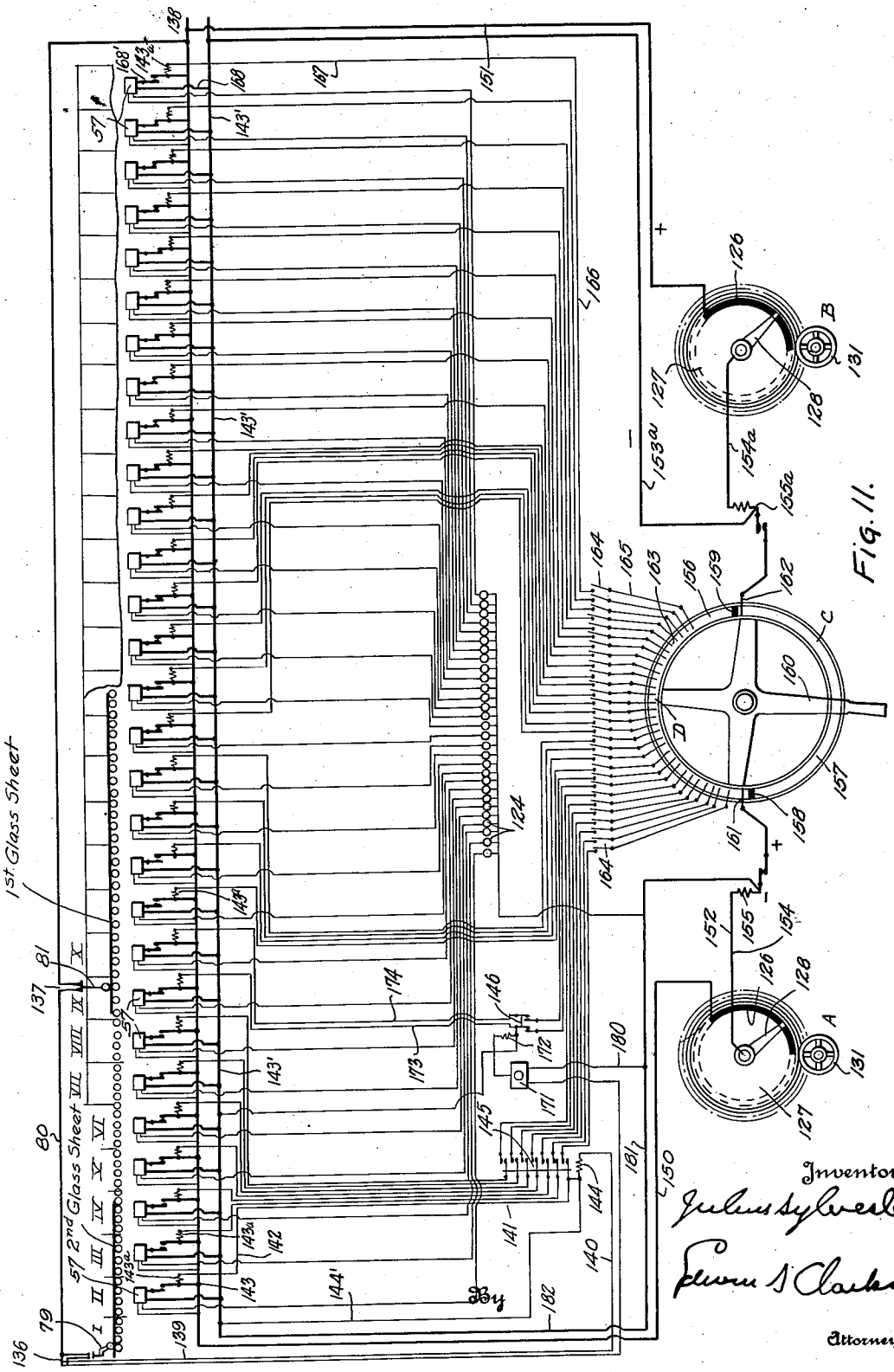

Fig. 11.

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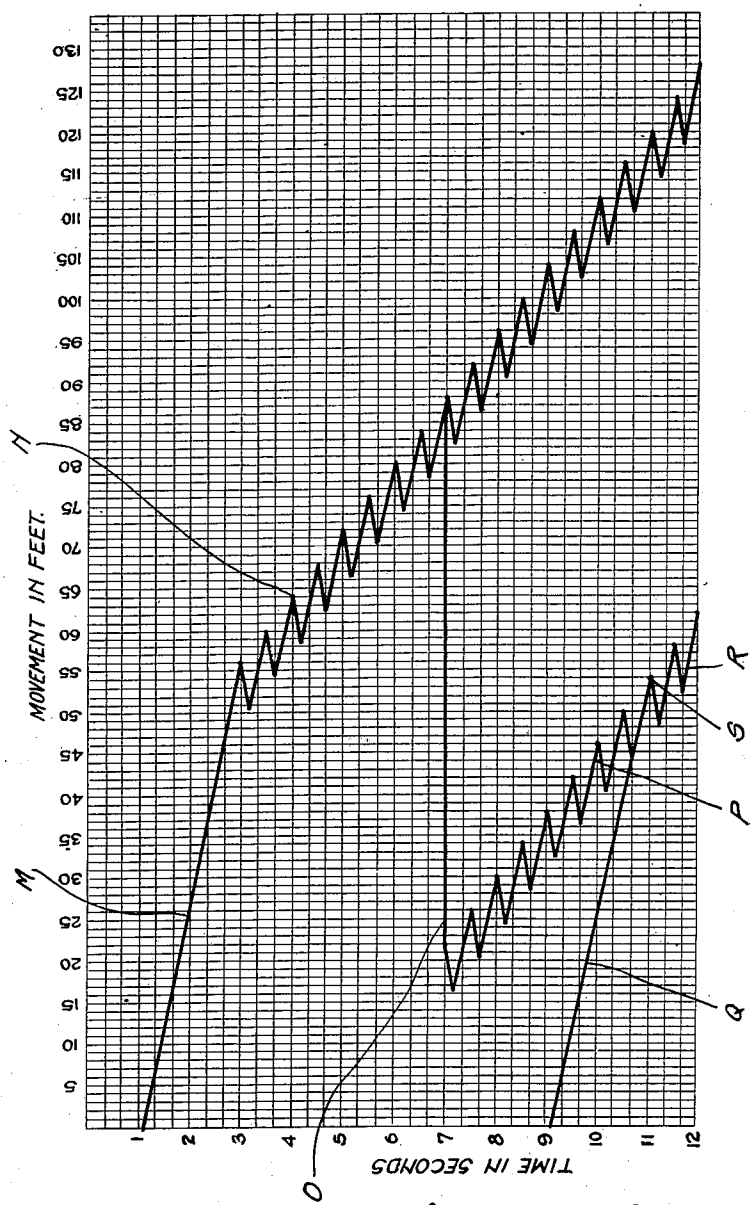
Fig. 12.



Inventor

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May 3, 1932. J. SYLVESTER 1,856,668

ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 11

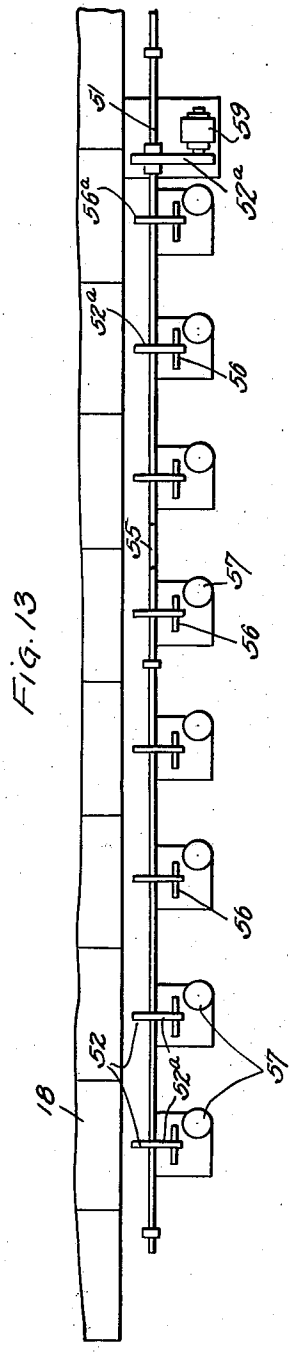

Fig. 13.

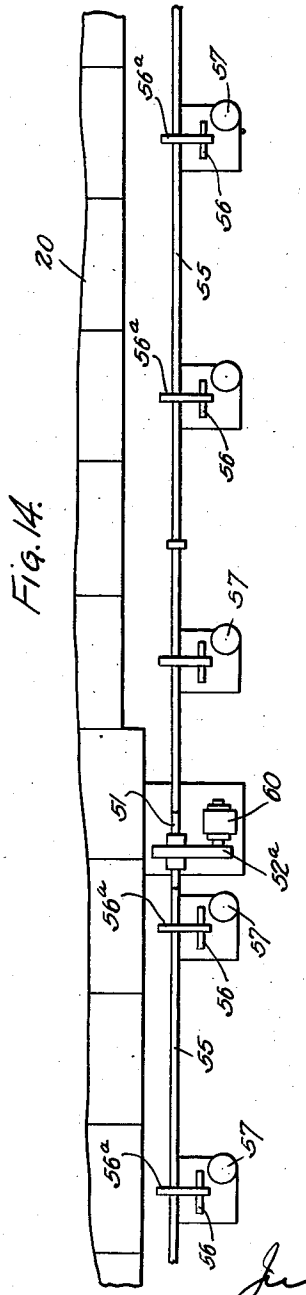

Fig. 14.

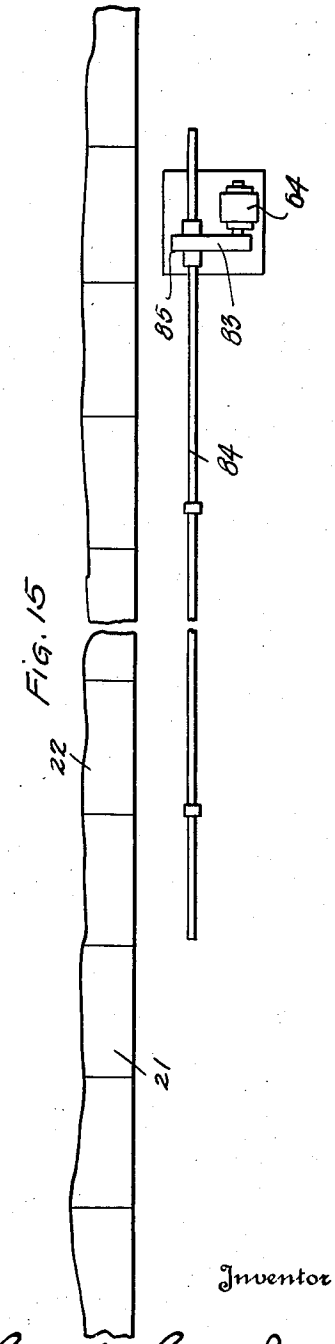

Fig. 15.

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ANNEALING LEER

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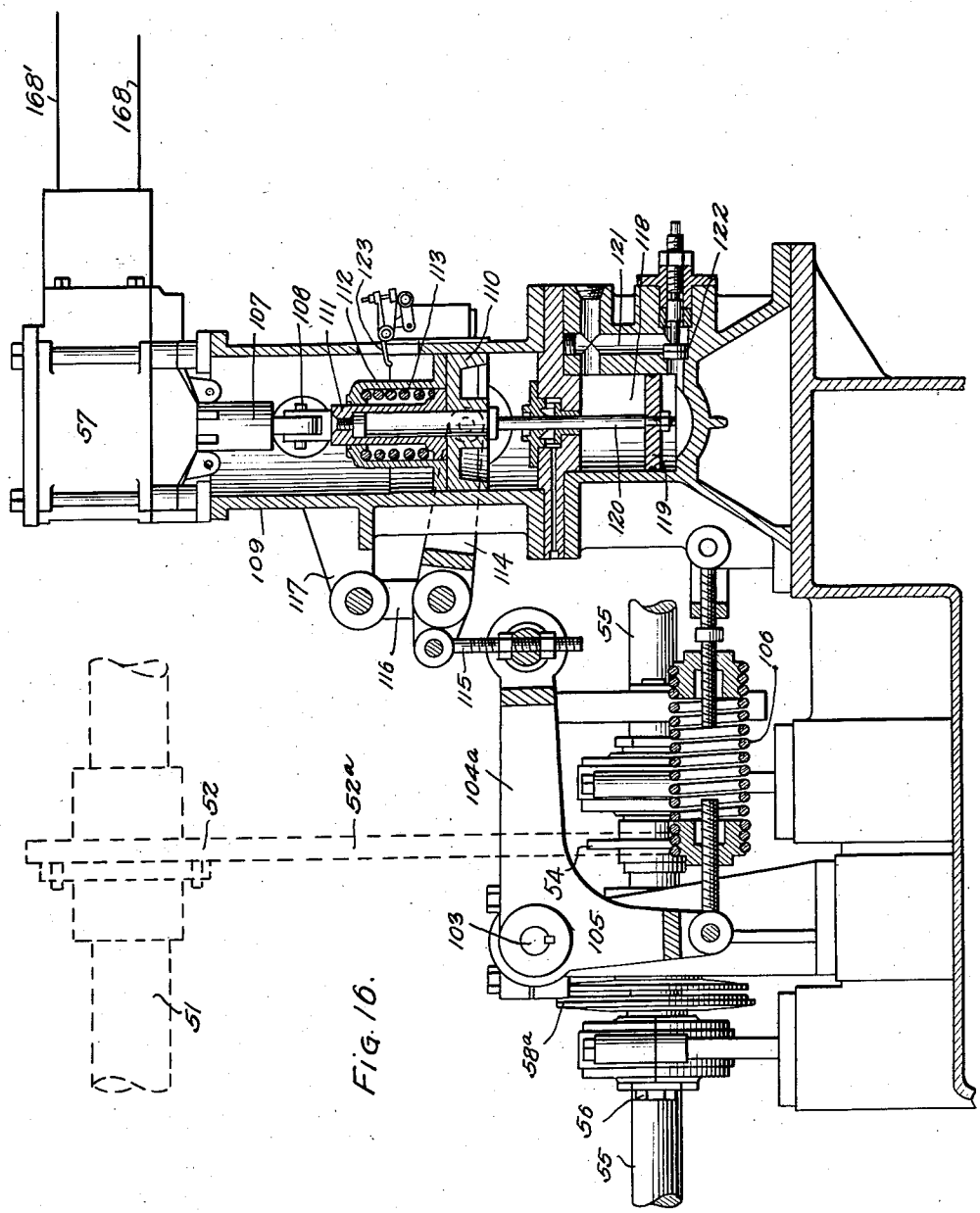

Fig. 16.

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ANNEALING LEER

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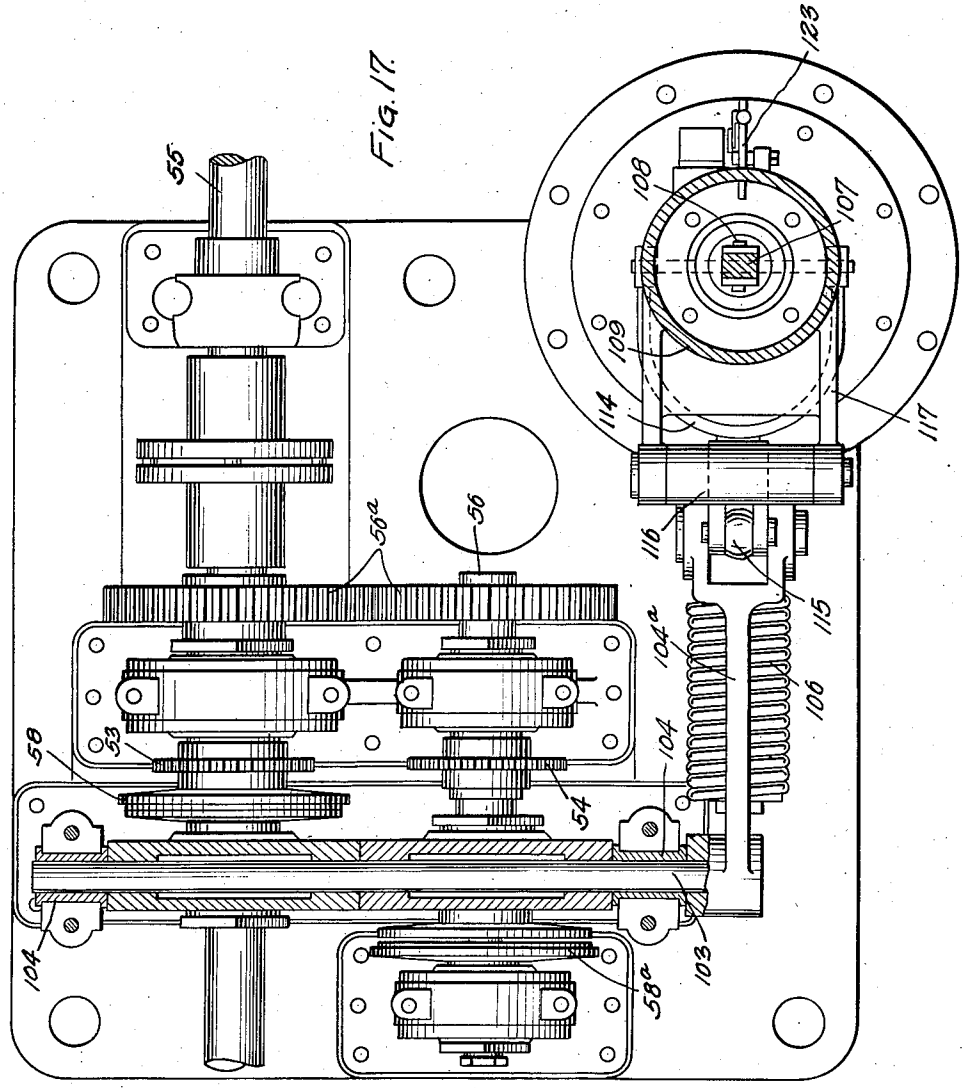
Fig. 17.



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May 3, 1932. J. SYLVESTER 1,856,668

ANNEALING LEER

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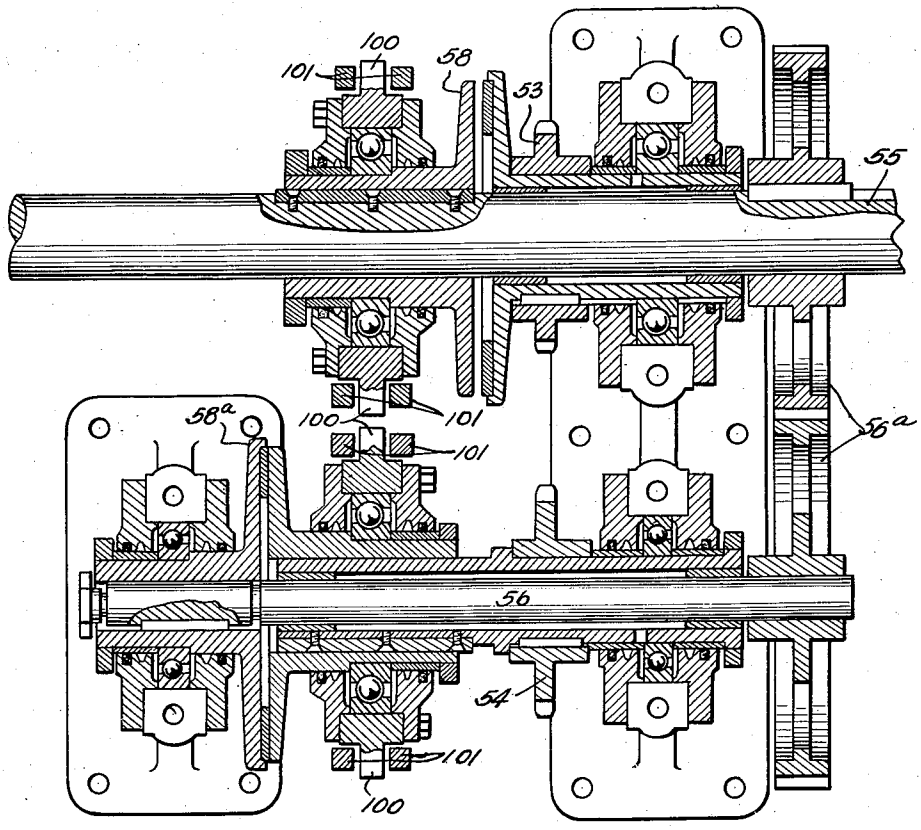

FIG. 18.

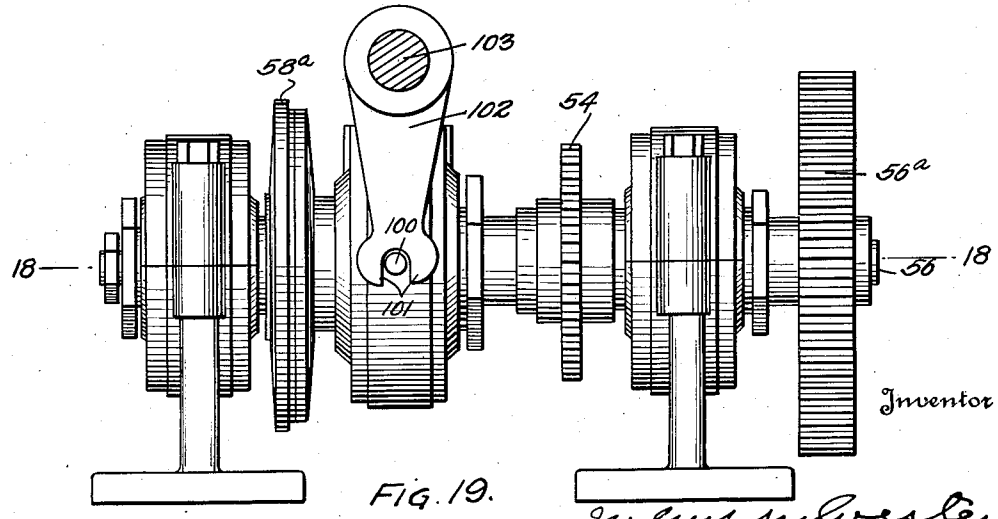

FIG. 19.

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ANNEALING LEER

Original Filed Jan. 21, 1929 16 Sheets-Sheet 15

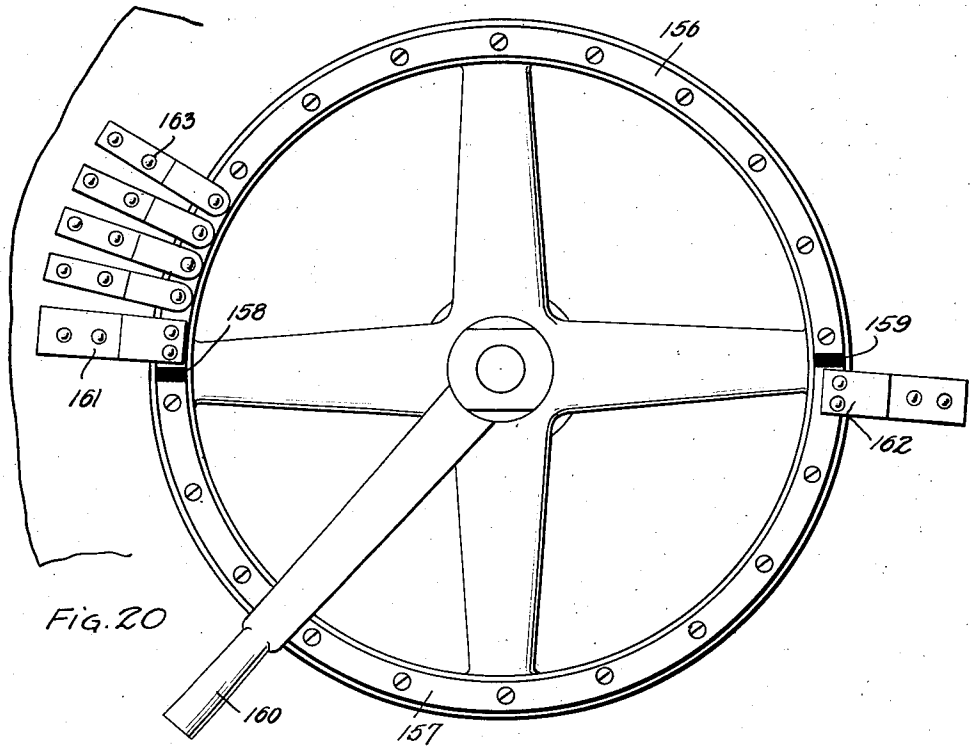

Fig. 20

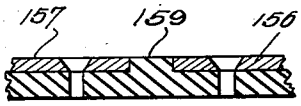

Fig. 21

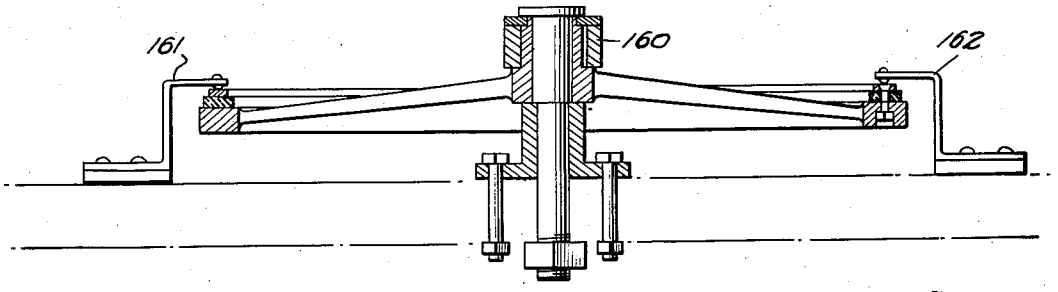

Fig. 22.

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ANNEALING LEER

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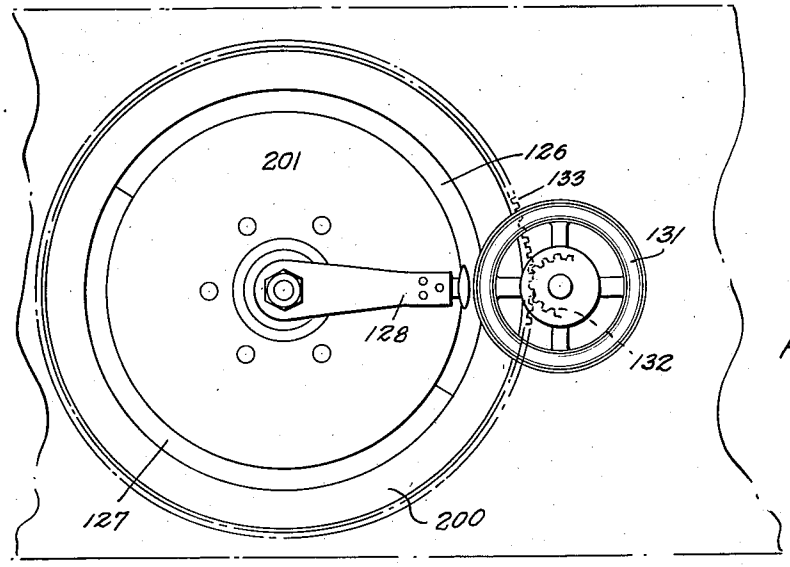

FIG. 23.

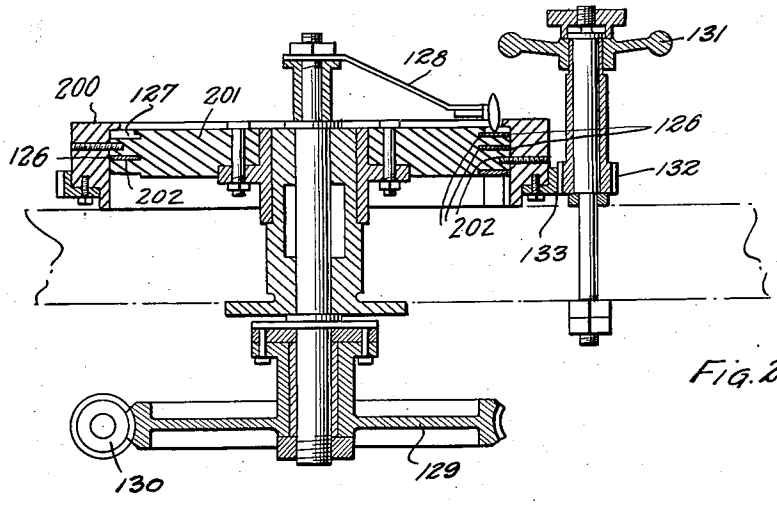

FIG. 24.

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Patented May 3, 1932 1,856,668

UNITED STATES PATENT OFFICE

JULIUS SYLVESTER, OF WASHINGTON, PENNSYLVANIA, ASSIGNOR TO SIMPLEX ENGINEERING COMPANY, OF WASHINGTON, PENNSYLVANIA, A CORPORATION OF DELAWARE

ANNEALING LEER

Original application filed January 21, 1929, Serial No. 333,887. Divided and this application filed January 4, 1930. Serial No. 418,575.

This invention relates to improvements in annealing leers, and the present application is a division of my prior application filed January 21, 1929, Serial No. 333,887.

In my said application Serial No. 333,887 I have shown a sheet glass forming and annealing apparatus embodying a roller leer in which all the rolls rotate at a high speed, equal to the rate of sheet formation, and in which, by means of a drive mechanism governed by an electrical control system, a portion of the rolls are caused to normally rotate constantly forward while another portion of the rolls are caused to rotate periodically and successively forward and backward, so that the progress of the intermittently formed sheets of glass through the leer as a whole is substantially slower than the feed rate of the first-named rolls, or the rate of sheet formation. As disclosed in said application Serial No. 333,887, the leer rolls preferably comprise a primary set of rolls normally rotating constantly forward to convey the sheets on a preliminary traverse at a high rate of speed, a secondary set of reversing rolls driven at the same rate of speed as the primary set but which are periodically reversed so that they will periodically impart a differential back and forth movement to the sheets on their final traverse such that the sheets progress at a less rate on such traverse than on their preliminary traverse, and an intermediate set of transfer rolls which are alternately rotated backward and forward and synchronized successively with the primary and reversing sets of rolls for the transfer of the sheets from the primary set to the reversing set of rolls without buckling of the sheets; the arrangement being such that the sheets are supported by conveyor rolls rotating throughout at a constant high speed to prevent deformation of the glass while governed in part with respect to direction of rotation to cause the sheets to take a course of travel of greater length and greater duration of time than required by a direct travel of the sheets through the leer at initial or sheet formation speed. The rolls may also by means of the electrical control system be governed to regulate their reversing periods, and the rolls may further be arbitrarily caused in whole or in part to rotate forward or backward at will to meet varying conditions of service.

The present invention applies to the provision of a roller or equivalent conveyor such as disclosed in my aforesaid application Serial No. 333,887, for general use for the transportation and treatment of ware of various kinds where the treatment period is comparatively long and requires a range of travel of the ware greater than the length of the kiln, or a differential motion of the conveyor and ware to make the rate of progression of the ware such that it may be treated within a leer of reasonable length. The present invention is not limited to the use of the conveyor in connection with a leer in which the working action of the control system and rolls is dependent upon the intermittent action or sheet formation rate of a conjoined sheet forming device, or to any other type of leer or treatment chamber, or to the feed and treatment by the apparatus of sheet glass as the conveyor may be used for transporting glass, porcelain or other articles or ceramic or other goods generally, either placed directly upon the conveyor or upon trays or other holders intermittently supplied for transport by the conveyor along or through any kind of treatment chamber or course.

The object of the present invention is to provide a conveyor which is so controlled and operated as to permit of the movement of the ware along a desired course at a desired speed while permitting the ware to have a long range of travel or treatment period without making the course of prohibitive length.

The invention will be more fully understood by reference to the accompanying drawings disclosing a desirable embodiment of the invention. It will be obvious, however, that the invention is not to be limited to the particular embodiment shown, as many modifications may be employed without departing from the spirit of the invention.

The invention is shown in the accompanying drawings in the form of an electrically heated glass annealing leer including a roller

conveyor, but it is to be understood that the invention is not restricted to the particular structures shown for purposes of exemplification, but may be embodied in any of the various types of leer or other conveyors for which it is adapted.

In the drawings:—

Fig. 1 is a diagrammatic side elevation of a leer showing the use of my invention as embodied in a leer conveyor.

Fig. 2 is a longitudinal sectional view of two adjacent sections of the leer at the juncture between the highly heated portion of the leer and the cooling portion of the leer.

Fig. 3 is a transverse section on line 3—3 of Fig. 2.

Fig. 4 is a detail view on an enlarged scale of the detachable roll of Fig. 3 and the bearings therefor.

Fig. 5 is a detail view showing a special tool employed in removing the rolls shown in Fig. 4.

Fig. 6 is a vertical transverse section through the leer, showing the driving mechanism for one of the rolls.

Fig. 7 is a view looking toward the closed end of the leer tunnel.

Figs. 8 and 9 are diagrammatic views showing the progress of a sheet of glass through the first portion of the leer.

Fig. 10 is a side elevation of one section of the leer showing one of the roll operating shafts.

Fig. 10*a* is a sectional view on an enlarged scale on line 10*a*—10*a* of Fig. 10.

Fig. 11 is a wiring diagram of the electrical conveyor controlling means.

Fig. 12 is a graphic representation of the normal progress of a sheet of glass through the kiln.

Figs. 13, 14 and 15 are diagrammatic representations of the roll driving apparatus.

Fig. 16 is a detail view partly in side elevation showing the clutch operating mechanism.

Fig. 17 is a view partly in section and partly in plan showing the clutch operating mechanism.

Fig. 18 is a horizontal sectional view of the clutch assembly on line 18—18 of Fig. 19.

Fig. 19 is an end view of the clutch assembly.

Figs. 20, 21 and 22 are detail views on an enlarged scale showing the emergency control device.

Figs. 23 and 24 are enlarged details showing one of the master controls.

The leer, kiln or treatment chamber, defining the treatment course, is indicated diagrammatically in Fig. 1, and comprises first an open portion 18 along which the sheet of glass or other ware 16 is advanced by means of rotating rollers 17 to the tunnel, closed or chambered portion L of the leer. Vertically movable doors 66 and 67 at the entrance to the leer are opened at the beginning of the glass making operation to permit the sheets to pass into the leer, but may be closed to prevent loss of heat from the leer when glass is not being annealed.

The door operating mechanism comprises an upper and a lower pair of bell cranks 68, 68*a*, which are pivoted intermediate their ends to the frame of the leer. The bell cranks 68 at the left of the leer are attached to blocks 69, 69*a*, which are internally threaded and are engaged by threaded rods 70 and 73. These rods are rotated by means of wheels 76 and 78 connected and operable by means of a chain 77. The bell cranks 68 and 68*a* at the right of the leer are connected to the blocks 69 and 69*a* by means of upper and lower connecting rods 71 and 74.

The closed portion of the leer is heated by suitable means herein shown as electrical heating units 23 and 24. This closed portion of the leer is made up of two principal divisions which may be referred to as the highly heated portion 19 and the less highly heated portion 20. Each of these portions is made up of a plurality of sections. The characteristics of the highly heated portion are the more expensive construction designed to prevent heat radiation and the closer spacing of the heating units as indicated in Fig. 3, which figure shows the two adjacent sections of the highly heated and cooling portions of the leer. Typical cross sections of the highly heated and cooling portions of the leer are shown in Figs. 4 and 6 respectively. The temperatures within the leer chamber may be regulated as desired, but preferably range from a maximum of about 1200° F. at a point near the entrance to the highly heated portion of the leer, to a temperature of about 150° F. at the end of the cooling portion of the leer, the temperature more or less gradually decreasing between maximum and minimum, as indicated in the diagrammatic showing in Fig. 1.

The operation of the conveying rollers 17 in conveying the glass sheets through the leer will be described in greater detail hereinafter in reference to the control mechanism. Briefly set forth, however, the glass sheet passes first into a series of rolls rotating in a forward direction only at a predetermined high speed, while the rolls in the principal portion of the leer are revolving successively forwardly and then rearwardly, but at a peripheral speed at least as great as that of the rolls which move forwardly only. These alternately reversing rolls normally rotate in a forward direction for a longer period than in the rearward direction, or, in other words, have a differential forward and backward motion, in order that there may be a general advance of the sheet through the leer as a whole. In order for the sheet of glass to pass from the forwardly moving rolls to the re-

versing rolls it is necessary to provide an intermediate set of transfer rolls to prevent buckling or breaking of the sheets of glass. These transfer rolls take up first the movement of the first or forwardly moving rolls until the sheet of glass rests entirely upon the transfer rolls. The transfer rolls are then automatically synchronized with the reversing rolls in the remainder of the leer, until the first sheet has passed onto the reversing rolls and another sheet is ready to be transferred from the forwardly moving rolls to the reversing rolls. The transfer rolls are then automatically synchronized with the first or forwardly moving rolls (see diagram Fig. 12). This automatic synchronism is accomplished by contact of the glass sheets with switches 79 and 81 in a circuit 80, as shown in Figs. 8 and 9, and as will be more fully described hereinafter by reference to the control diagram in Fig. 12.

In passing from the closed portion 20 of the leer the glass is received upon idler rolls 21 beyond which are located a plurality of power-operated but manually controlled rolls 22. The length of the idler section is such that a sheet of glass will entirely bridge this section so that one end of the sheet may still rest upon the reversing rolls in the closed portion of the leer, when the other end has reached the manually controlled rolls 22.

The rolls 22 may each be operated by a motor 64, Fig. 15, which drives the roll through a chain 83, shaft 84 and worm gearing 85, the motor being started and stopped by means of a suitable hand switch (not shown). In this manner the glass sheets may be transferred from the leer to the rolls 22 and the rolls 22 then stopped by cutting off the motor 64.

To sum up the operation of the mechanism so far described, the glass passes to the leer on the forwardly revolving rolls of the leer, which rotate at a predetermined high peripheral speed. The rolls in the major portion of the leer rotate successively forwardly and rearwardly and the sheet is transferred to these reversing rolls from the forwardly moving rolls by means of automatically synchronized transfer rolls. The purpose of periodically reversing the direction of movement of the rolls within the leer, while maintaining the peripheral speed of rotation the same as the rate of sheet formation, is to obtain the maximum annealing effect for a given length of leer, without slowing up the speed of rotation of any of the rolls while supporting the glass and thereby permitting the glass to sag between the rolls, and permitting deformation of the rolls themselves due to slow rotation. The glass is annealed within the leer by suitable heating devices, and when fully annealed it is gradually cooled and then passed from the leer over idler rolls to manually controlled discharging rolls and thence to a discharge station or table. Here the sheet may be lifted by power mechanism and rolled by hand from the table, suitable means in practice being provided for this purpose.

In order to provide for uniform heating of the leer a special arrangement of electrical heating units has been designed, shown most clearly in Figs. 2 and 3. These heating units are arranged in two groups, 23 and 24, one above and the other below the conveyor rolls 17. Thus both the top and bottom of the glass passing over the rolls will receive heat. The lower group of heating units is preferably protected from short circuiting by means of covers 25 which prevent broken glass from the rolls from falling upon the heating coils. The units 24 are closely spaced in the highly heated section of the leer, and farther apart in the cooling section. Furthermore, suitable control mechanism (not shown) is provided for regulating the amount of current supplied to the individual units along the length of the leer in order to insure the proper lowering of temperature from the entrance end to the discharge end. The highly heated portion of the leer is provided with solid masonry 26 designed to prevent loss of heat, while the cooling section has a comparatively thin floor 27, supported on framework 28 (Fig. 2).

Preferably the units of the lower group of heating coils are arranged in three sections 28, 29, 30, which may be individually controlled. This arrangement, shown clearly in Fig. 3, permits the sides of the leer to receive as high a degree of heat as the center. This insures evenness of glass annealing and prevents deformation of the rolls.

Beneath the rolls 17 are cleanout passages 31, 32, which slope from the center of the leer 33 downwardly and outwardly to remove doors 34. This permits the removal of broken glass which falls between the rolls.

Preferably the rolls 17 employed in the leer are of two kinds, the form shown in Figs. 3 and 4 being employed in the high temperature portion of the leer, and that shown in Fig. 6 being employed in the lower temperature section. The high temperature rolls are more suitable for resisting the influence of heat and are of more expensive material than the low temperature rolls.

The rolls of the leer are arranged in sections, any one of which sections may be removed without disturbing the other sections. Moreover the leer itself is made up in sections, as clearly illustrated in Figs. 2 and 10, thus facilitating repairs.

One of the high temperature rolls is shown in Fig. 4, and comprises a cylindrical center portion 35, reduced cylindrical end portions 36 extending through bearing blocks 38, and tapered portions 37 connecting the cylindrical portions 35 and 36. In the low tem-

perature rolls the tapered portions 37 are omitted (Fig. 6), but otherwise the construction is the same, though different materials are used for the high and low temperature rolls.

The rolls in each section are carried by detachable and adjustable bearing blocks 38 (Figs. 4, 10, 10*a*, 3 and 6) which are secured to the frame of the leer by means of bolts 39, which pass through slots 40 (Fig. 10*a*). These bearing blocks may be adjusted angularly by means of tension bolts 41 which engage the inside of the leer 42, and compression bolt 43 which engages the outside of the leer. By this angular adjustment of the bearing blocks at the ends of the rolls the rolls themselves may be given a tensioning stress which tends to depress the ends of the rolls and to elevate the centers. The purpose of this tensioning or bending operation is to overcome the deflection of the rolls, especially when highly heated, and the adjustment given the bearing blocks will be just enough to counteract this deflection downward.

The rolls of each adjacent section are operated by a single shaft 51 (Fig. 10) which is provided with a plurality of worms 48 meshing with gear 47, carried by the individual rolls. According to my invention each of the individual rolls may be removed without interfering with the operation of the other rolls. The construction which makes this possible is shown in detail in Fig. 4.

Referring to Fig. 4, it will be noted that the ends 36 of the rolls are carried by removable bearings 44 held in place by bolts 45. The driven end of the roll is provided with a sleeve 46 splined thereto, and carrying the gear 47 meshing with the worm 48. This sleeve is held in place by means of a nut 49. A drip pan 48*a* is removably secured below the sleeve 47.

For the tapered rolls at the high temperature end of the leer bearing blocks 41*a* are employed adjacent the tapered portions 37.

To remove the roll the drip pan 48*a* is first unbolted and taken off, then the nut 49. This permits the sleeve 46 to be withdrawn to the right, due to the curvature of the gear 47. The bearing 44 at the left of the roll may now be unbolted and removed. Then the conical bearing 41*a* is withdrawn by means of special tools 51*a* which are inserted into openings 50 provided for that purpose. The roll 17 may then be removed to the left. Preferably, a long rod is inserted through the roll and the roll withdrawn over the rod to prevent the roll from being damaged during withdrawal.

The general arrangement of the roll driving mechanism is shown in Figs. 6, 7, 10, 10*a*, 14, 15 and 16. The rolls of each section in the main portion of the leer are driven by shafts 51, Fig. 10, near the center of each of which is located a sprocket 52 which is turned by a chain 52*a* passing over sprockets 53, 54, Figs. 4 and 6, carried by a main shaft 55 and a countershaft 56 respectively. The sprockets 53 and 54 are caused to rotate with either the main or countershafts by means of clutches 58, 58*a*, shown in detail in Figs. 16, 17 and 18, which clutches are operated by solenoids 57. As shown in Fig. 13, the main shaft 55 extends the entire length of the leer, the countershafts 56 being geared thereto as at 56*a*, and rotating in a direction reverse to the main shaft. The main shaft is driven from a plurality of motors 59 and 60 geared thereto, and having pin clutches interposed between the motors and the shaft, whereby any one of the motors may be removed for repairs without interfering with the operation of the leer (Fig. 13).

In Fig. 13 portions of the leers are represented diagrammatically. The main shaft extends the entire length of the leer proper beginning with the open section 18 and ending at the end of cooling section 20. This shaft is constantly rotating and all the rolls of the leer proper are operated from this shaft over one of the countershafts, at a constant peripheral working speed and the direction of motion will be either forward or rearward depending on whether the rolls are operated directly from the main shaft or from the countershaft. The main shaft does not extend along section 21 as this section is occupied by the idler rolls and the rolls 22 at the discharge end are not actuated from the main shaft but from the shaft 53 by means of the motor 64, as previously described.

The clutches and clutch operating mechanism which serve to connect each roller shaft 51, which drives a section of rolls 17, alternately to the main shaft 55 and to the countershaft 56 to thereby rotate the rollers 17 of one section of the leer alternately in a forward and rearward direction are best shown in Figs. 16, 17, 18 and 19. It will be understood that one set of clutches and operating mechanism therefor is employed for each set or section of rolls except the first, and the description of one such mechanism is applicable to all.

As shown the main shaft 55 is constantly geared to the countershafts 56 and the sprockets 53 and 54 are loosely mounted upon these rotating shafts, but each may be caused to rotate with its respective shaft by means of the clutches 58 and 58*a*. These clutches are provided with pins 100 which are engaged by fingers 101 of the crank arms 102 carried by a shaft 103 journaled at its ends in bearings 104. The shaft 103 is rotated by means of an arm 104*a* of a bell crank, the other arm 105 of which is engaged by the spring 106 which tends to operate the clutch 58 upon the main shaft 55; so that when no power is

applied to the arm 104*a* of the bell crank the rolls of this section of the leer will be operated from the main shaft and in a forward direction.

The arm 104*a* of the bell crank is operated by the solenoid 57 in such manner that when the arm 104*a* is depressed the clutch 58*a* causes the sprocket 54 to rotate with the countershaft 56 and thus produce reverse rotation of the rolls of the section controlled by this solenoid.

As shown in Fig. 16 the connection between the core 107 of the solenoid and the clutch operating arm is as follows: The core 107 is connected by means of a universal joint 108 to a compound plunger reciprocable in a cylinder 109. The compound plunger is composed of an outer plunger 110 and an inner plunger 111, the latter being directly connected to the core of the solenoid, and slidable within a housing 112, of the outer plunger. A spring 113 reacts between the inner plunger and the housing 112. The outer plunger is connected through crank arms 114 passing through slots in the cylinder 109, to an adjustable link 115, which is carried by clutch operating arm 104*a*. The forked member 114 is pivoted intermediate its ends and is suspended by means of a swinging link 116 to a fixed frame member 117.

Below the cylinder 109 is a dash pot or retarder 118 which is filled with oil or the like under pressure. A piston 119 works in the dash pot and is connected to plunger 110 by means of a piston rod 120. A bypass connection 121 opens above and below the piston 119, which bypass may be cut off to any desired extent by means of a screw operated valve 122. In this manner the action of the piston 119 and of the plunger 110 may be retarded to any desired extent.

The purpose of the retarding action of the dash pot is to prevent jars due to sudden reverse of direction of rotation of the rolls, which might cause breakage of glass. By the use of the retarder the reversal is gradual and without shock.

As shown a finger 123 projects into the cylinder 109 and is engaged by the plunger 110 in either direction of its movement. The finger 123 controls a circuit in which is located a signal light which is designed to indicate to the operator of the leer whether a particular solenoid is in operation. A plurality of such signal lights are shown at 124 in the control diagram, Fig. 11.

The solenoid 57 is alternately energized and deenergized by means of a master control switch or timer 125, which timer may through a suitable arrangement of relays and main operating circuits control all of the solenoids of all the roll sections. As shown the timer comprises a dial upon the face of which is located a conductor portion 126 and an insulating portion 127, the two portions making up a complete circle. A rotary contactor or hand 128, which is preferably operated by suitable gearing from the main drive shaft of the leer, engages alternately the conducting portion 126 of the dial, and then the insulating portion 127. During the period of engagement with the conducting portion a circuit is closed through the solenoid, which draws the core 107 upward, and with it the inner plunger 111, which serves to compress spring 113. The spring 113 moves the plunger 110 upwardly, with a delayed action due to the dash pot 118. The upward movement of the plunger 110 raises arm 104*a* of the clutch operating mechanism against the resistance of spring 106 and causes the sprocket 54 to rotate with the countershaft 56, thus producing reverse rotation of the rolls in the section controlled by the solenoid.

As soon as the contactor arm 128 reaches the insulating portion 127 of the control dial the circuit to the solenoid is broken and an action opposite to that just described takes place, and the section of rolls of the leer which has been rotating in a reverse direction are now rotated in a forward direction by the main shaft.

The timer switch is shown in further detail in Figs. 23 and 24. In Fig. 24 the numeral 129 denotes a gear wheel which is operated through worm 130 and suitable intermediate mechanism from the main drive shaft 55 of the leer for rotating the contactor arm 128.

By regulating the relative lengths of the conducting strip 126 and insulating strip 127 the relative periods of reverse and forward movement of the rolls can be varied at will. Thus, with balanced gear ratios, if the two strips were of equal lengths the rolls would rotate forwardly and rearwardly for equal periods of time, and there would be no progress for a sheet of glass on such rolls. In the normal operation of the leer the insulating portion of the dial is longer than the conducting portion; thereby the rolls rotate for a greater period forwardly than rearwardly, and there is a gradual advance of the glass sheet through the leer. It is also possible to cause a general reverse movement of the glass by having the conducting portion of the control switch longer than the insulating portion. It is also possible to cause all the rolls to rotate continuously forwardly or continuously rearwardly by having the arm 128 contact with insulating material only, or with conducting material only. A regulation of the relative effective lengths of the conducting and insulating strips may be accomplished by means of a hand wheel 131 which rotates a gear 132 in mesh with a toothed wheel 133, which serves to regulate the length of time of contact between the arm 128 and the insulating and conducting strips, 127 and 126 respectively.

The toothed wheel 133 is connected to an

insulating block 200 which latter is connected by means of screws to an insulating block 201. The block 201 has a helical groove 202 to receive the conducting strip 126 which is in the form of a helix, one end being fastened to a stationary part of the leer, for example by the bolt 203 whilst the other end is free. By rotating the insulating block 200 by means of the gears 132, 133 the helical conducting strip can be wound into the interior of the insulating block and thereby expose the free end to the desired degree depending on the amount of rotation given to the gears.

Turning the gears in one direction will expose a greater amount of the helical conducting strip, while turning them in the opposite direction will expose a lesser amount of the strip.

In Fig. 11 two master control switches or timers A and B are shown, such as that designated by 125 and described in reference to Fig. 16. These switches are connected to a positive source of current by means of leads 150 and 151, while the contactors 128 are connected to a negative supply by means of leads 152 and 153. Leads 154 and 154*a* are provided by means of which additional circuits are closed leading to emergency control switch C through relays 155 and 155*a*. The details of the emergency control switch are shown in Figs. 20, 21 and 22. This emergency control consists of an annular member comprising two conducting halves 156, 157 separated by insulating blocks 158, 159. The annular member may be rotated by means of a handle 160 so as to bring the insulating blocks to any desired position. Contact may be made between master switches A and B and the emergency control C by means of fixed contactor fingers 161 and 162, which may be connected with either section 156 or 157 of the emergency control. In addition to the main contact fingers 161 and 162 there are a plurality of smaller contact fingers 163, each of which controls a circuit through one of the solenoids 57. The number of the contact fingers 163 is equal to the number of solenoids which in turn is equal to the number of roll sections to be controlled. Manually operated switches 164 are interposed in each solenoid circuit so that any one of the solenoids may be cut out by opening its switch 164. It will be observed that the timer switches A and B operate to cause pulsations of relays 155, 155*a* and 143*a*, whereby the relays 143*a* are alternately energized and deenergized to close and open main operating circuits for the solenoids 57 from the main leads 143, 143'. Such a main operating circuit is represented, for example, by wires 168, 168', the latter containing a relay switch 143*a* energized and deenergized by the closing and opening of circuits including the conductors 150, 152 and 151, 153 by the action of the switches A and B

A typical circuit from the emergency control device C through the solenoids is represented by the last solenoid circuit at the right of the control device, leading from contact fingers 163 through wire 165, finger switch 164, wires 166, 167, relay 143*a* and wire 168' connected to line 143, solenoid 57, thence through wire 168 back to the line 143'. The lines through the other contact fingers are the same except that the first nine lines at the left, or any desired number of lines, are provided with auxiliary control switches 145, 146, actuated automatically from the switches 79 and 81, which in turn are operated by the movement of glass through the leer, as previously described briefly in connection with the description of Figs. 3 and 4. These auxiliary control switches 145 and 146 are in addition to the controls in the remaining circuits. When these auxiliary controls are closed the circuits from the emergency control through the solenoids of the first nine lines at the left are identically the same as the circuits for the remaining sections, previously described. When the switches 145 and 146 are open no current is supplied to the solenoids of the first nine lines, and consequently the rolls of the sections controlled by these solenoids are rotating constantly forward. The switch 145 controls the first seven solenoids, and the switch 146 the eighth and ninth solenoids.

By the use of the emergency control device all the contact fingers 163 and, consequently, all the solenoids may be placed in circuit with master control A, this arrangement being that shown in Fig. 11. By turning the handle 160 of the emergency control slightly to the left so that the insulating blocks will be moved just beyond the main switches 161 and 162 all the solenoids may be placed in circuit with master control B. The master controls may be set for any desired operation of the rolls by regulating the relative lengths of the conducting and non-conducting portions of the dials as previously set forth. Instead of connecting all the lines to one master switch A or B a part of the lines may be connected to one switch, and part to the other master switch by setting one of the insulating blocks 158 or 159 of the emergency control device at a point intermediate the ends of the row of contact fingers 163. Thus by placing the insulating block 158 at the finger contact indicated at D the solenoid in the particular line leading from this contact will be cut out of operation. The lines to the left of position D will then be in circuit with master control A, while those to the right will be in circuit with master control B. Assuming that control A is set to produce equal forward and reverse rotation of the rolls and control B is set to produce a general forward movement it will be seen that by the above described operation sheets of glass in rear of a section of broken glass could be prevent-

ed from advancing and thus destroying the good sheets, while the sheets of glass in advance of the defective section could be caused to move uninterruptedly out of the leer. Obviously, innumerable other modes of operation may be employed depending on emergencies which may arise under actual service conditions. Complete control of all sections of the leer may be had by the arrangement herein described.

It is desirable that in case of failure of any one of the solenoids to operate, this fact may at once be brought to the attention of the operator. For this purpose the signal lights 124 are provided which, as previously set forth, are controlled by switches operated by the plungers of the solenoids so that in case one solenoid is not functioning the corresponding light 124 will go out.

While the leer is capable of flexible operation and emergency control, as above described, the normal operation is that illustrated graphically in Fig. 12, in which the movement of the glass in feet is designated by the abscissa at the top of the sheet, and the time in seconds is illustrated by the vertical numerals or ordinates.

In the figure the line M N is intended to represent the movement of the front end of a sheet of glass passing through the leer, the portion M of the line indicating the initial forward movement on the primary and transfer rolls of the leer, while the portion N indicates the intermittent forward and rearward movement in passing through the major portion of the leer. The movement of the rear end of the sheet of glass is indicated by the second line O P, while the third line Q R illustrates a portion of the path of the front end of a second sheet of glass in advance of its proper position and set forward in order to indicate the relationship assumed by the sheets when the preceding sheet has reached a certain point in its travel through the leer. It will be noted that the path of the rear end of the first sheet of glass and that of the front end of the second sheet merge at S, and that from there on the movement of the two sheets through the leer is synchronized. The successive sheets are started at determined intervals of time, as indicated by the graph, but by the time the sheets enter the main portion of the leer and take up the alternate forward and rearward movement they occupy practically the entire space in the leer, the front end of one sheet reaching practically to the rear end of the sheet in front of it. In this manner the leer is operated with the utmost efficiency. Moreover, the alternate forward and rearward movement of the glass gives the effect of a much longer leer than that actually employed, i. e., a travel range for the glass sheets between the entrance and exit ends of the leer which is of a distance greater than the length of the leer, and much more efficient annealing than is possible with any other device, is obtained.

The normal operation of the leer will now be described in connection with the wiring diagram, Fig. 11.

As previously set forth the leer is composed of rolls arranged in a plurality of sections. All the roll sections except the first section, are controlled by individual solenoids, the operation of which has already been described.

Reference will now be made to the control of the leer as a whole, including all the sections of rolls from the second section to the end of the closed portion of the leer. As previously stated, the rolls beyond the closed section at the discharge end of the leer are first the idler rolls 21, and then the manually controlled power driven rolls 22, the operation of which has already been described, and which will not be included in the following discussion.

Referring to Fig. 11, the rolls of the first ten sections of the leer are indicated by roman numerals I to X, inclusive, as the operation of these sections is somewhat different from the remaining sections beginning with the eleventh section and extending to the end of the closed portion of the leer. These latter sections during normal operation of the leer rotate successively forward and rearward controlled by their respective solenoids 57, which in turn are controlled by the timer switch A.

At the entrance to the open portion of the leer is the switch arm 79, which as shown in Fig. 8 is pivoted intermediate its ends as at 135, whereby, when a sheet of glass enters section I the line 80 will be broken at 136. The second switch arm 81 is located near the entrance to the closed portion of the leer, and closes the circuit 80 at 137 only when the arm 81 is raised by contact with a sheet of glass, the line 80 being normally open at this point.

The first or primary section of rolls I rotates forwardly only and has no solenoid for controlling its operation, this set of rolls being constantly operated from the main drive shaft. Rolls II to VIII, inclusive, are provided with solenoids which are controlled by both the switches 79 and 81, and the rolls IX and X are controlled by the switch 81 alone. The rolls II to X inclusive may be termed the transfer rolls, as their function is to transfer a sheet of glass from the primary set of rolls I which rotates constantly forwardly to the secondary rolls, which comprise most of the leer and extend from the eleventh section on, and which are periodically reversing in direction of rotation. These transfer rolls are necessary to prevent buckling of the sheets, which would occur if a sheet were passed directly from the forward-

ly rotating rolls to the reversing rolls. The transfer rolls may be automatically synchronized with the primary or constantly rotating rolls, and then with the secondary or reversing rolls.

Before the first sheet of glass is delivered to the leer the switch 79 is closed while the switch 81 is open. Therefore, the rolls of the first ten sections are rotating forwardly only, while the rolls in the remaining portion of the leer are rotating successively forwardly and rearwardly. When the first sheet enters section I the switch 79 is opened, which, however, does not change the operation of the first ten sections of rolls, as the circuit is already opened by switch 81. The sheet continues to advance forwardly until its rear end passes from under switch 79, and subsequently the front end closes switch 81. Thus the line 80 is completely closed allowing current to pass from the main line lead 143 at 138 through wires 80, 139, 140, 141, 142, switch 145 and from conductor 144 through a conductor 144′ to the main line lead 143′. A magnetic relay is provided in conductor 140 at 144 by means of which switch 145 when switch 81 is closed is operated as above described, thus closing a plurality of circuits which include the solenoids 57 of roll sections II to VIII inclusive, whereby the rolls of these seven sections are synchronized with the rest of the leer and rotate successively forwardly and rearwardly. Likewise the rolls of the ninth and tenth sections rotate in the same manner in synchronism with the rest of the leer, a circuit from main lead 143 having been closed by means of switch 81 through wire 170, timer 171, relay 172, and through a conductor 172′ to the main lead 143′. The energization of relay 172 closes switch 146, thus completing the circuit from the emergency control C, from one side of the supply line through wires 173 and 174, thence through relays 143*a* to the solenoids of the ninth and tenth sections, and back to the other side of the supply line. The action of the timer switches A and B in alternately engaging the relays 143*a* has been previously described.

At a proper interval after the first sheet a second sheet enters the leer as the first sheet is moving forwardly and rearwardly on the transfer rolls. As soon as the front end of the second sheet reaches switch 79 sections II to VIII inclusive are caused to rotate forwardly only. This movement continues until the rear end of the second sheet has passed from under switch 79, whereupon the circuit is closed.

This would cause the rolls in sections II to VIII to commence the reversing movement, except for the fact that the interval between the pouring of the first and second sheets is such that by this time the rear end of the first sheet has passed from under switch 81, thus breaking the circuit at this point and causing the rolls in sections II to VIII to rotate forwardly only. Sections IX and X also take up this forward movement after a delayed interval, which allows the first sheet to pass entirely from these two sections, the delayed action being due to the timer 171, which controls the solenoids of sections IX and X, this time being connected to the negative line by means of wires 180, 181 and 182, as shown, and through relay 172, wires 173 and 174 and associated relays 143*a* to the solenoids of said sections and to the positive line 143. When the front end of the second sheet reaches the switch 81 sections II to X, inclusive, take up the reversing movement in synchronism with the rest of the leer. This synchronism of the transfer rolls with the constantly forwardly moving rolls of the first section and then with the reversing rolls in the remainder of the leer continues as each additional sheet of glass is fed up unless the operation is varied by the action of the emergency control device, as hereinbefore described.

From the foregoing description, it will be seen that in the operation of the apparatus the glass sheet passes first onto a series of rolls rotating in a forward direction only at a determined peripheral speed, which, as set forth in my aforesaid application Serial No. 333,887, at least as great as the speed of sheet formation when the roller leer is combined with a sheet glass casting device, while the rollers in the principal portion of the leer are revolving successively forwardly and then rearwardly, but at a peripheral speed at least as great as that of the rolls which move forwardly only. These alternately reversing rolls normally rotate in a forward direction for a longer period than in the rearward direction, thus establishing a differential action in order that there may be, with a decreased rate of progress, a general advance of the sheet through the leer as a whole. By the use of the transfer rolls which transfer the sheet of glass from the forwardly moving rolls to the reversing rolls any danger of breaking or buckling of the sheet of glass is prevented. The purpose of periodically reversing the direction of movement of the rolls within the leer while maintaining a predetermined peripheral speed of rotation of all the rolls is to obtain a maximum annealing effect for a given length of leer or the travel of the glass through an annealing course of greater length than the length of the leer as a whole, without slowing up the speed of rotation of the rolls at the time they are acting on the sheet and thereby permitting the glass to sag between the rolls and causing deformation of the rolls themselves due to slow rotation. The glass is annealed within the leer by suitable heating devices, and when fully annealed it is gradually cooled in that part of the leer in which its rate of progression is relatively slow, and is then

passed from the leer over idler rolls to manually controlled discharging rolls and thence to a discharge station or table.

It is, of course, not necessary, in the use of the apparatus for annealing sheet glass, to have the glass formed by a forming apparatus coupled to the roller leer as the glass sheets may be formed by a separate mechanism and intermittently fed through suitable intervening means to the rolls 17 of section 18 of the leer for travel through the leer to obtain the annealing action described. The principle of the invention may also be applied to the annealing of glassware, porcelainware, or ceramicware suitably formed and placed upon the roller leer for transport, as by arranging the articles in trays or other receptacles placed intermittently and at predetermined intervals upon the rollers 17 of the leer section 18 for transmission through the leer. The apparatus may, in fact, be used for the annealing of various materials where the material must be subjected to treatment for a length and time duration of travel greater than that required for its normal direct travel from end to end of the leer, so that materials may be transported and subjected to prolonged treatment without the use of a leer of prohibitive length. It is possible that for some purposes the operations of the sets of rolls in the direction of feed of the material may be reversed, that is to say, that the first set of rolls or any number of sets of rolls in the preliminary traverse of the material may be reversing rolls, to give a slow rate of progress, while the rolls conveying the material on its final stage of traverse may move continually in one direction to give the material a high speed rate of progress. In all cases, however, the timing of the action of the rolls may be so governed that at the time the rolls are acting on a sheet they will operate at the same peripheral speed, whether moving forwardly or rearwardly, so that a fast rate of progress as a whole of the material may be obtained without injury to frangible or delicate materials or to delicate surfaces thereof liable to be damaged by irregular actions. Within the scope of the invention, also, conveyor units of other than roller type may possibly in some cases be used, particularly in the handling of certain materials and by the employment of conveyor units of restricted length.

Having thus fully described my invention, I claim:—

1. In a ware conveyor, conveyor means operating at a predetermined surface speed for conveying the ware along a course, conveyor means operating at a surface speed at least as great as the first-named conveyor means for continuing the movement of the ware along the course, and means for periodically reversing the direction of travel of at least a part of the second-named conveyor means.

2. In a ware conveyor, a conveyor operating at a predetermined surface speed for conveying the ware along a course, a second conveyor movable at a surface speed at least as great as the first conveyor for continuing the movement of the ware along the course, means for periodically reversing the direction of movement of the second conveyor, and a third conveyor automatically synchronized with the first and second conveyors successively, for receiving the ware from the former and transferring the same to the latter.

3. In a ware conveyor, a set of rolls for conveying the ware along a course, a set of rolls for continuing the movement of the ware along the course, operating means for normally rotating the sets of rolls in ware advancing direction and periodically reversing the direction of motion of the second set of rolls, a third set of rolls between the aforesaid set of rolls, and means for rotating the third set of rolls for synchronizing actions with the first and second set of rolls successively so as to receive the ware from the first set of rolls and transfer the same to the second set of rolls.

4. In a ware conveyor, a set of conveyor rolls operating at a predetermined surface speed for conveying the ware along a course, a second set of conveyor rolls operating normally at a surface speed at least as great as the first set for continuing the movement of the ware along the course, and means for controlling the second-named set of rolls for periodically reciprocating the ware.

5. In a ware conveyor, conveyor means for conveying the ware along a course, and means for reducing the rate of forward progress of the ware by causing the conveyor means to differentially move the ware backward and forward after travel to a predetermined degree along said course.

6. In a ware conveyor, conveyor means for normally conveying the ware along a course, and means for conveying said conveyor means to reciprocate the ware backward and forward, a plurality of times for retarding the rate of forward travel of the ware beginning at a stage of travel of the ware with respect to an earlier stage of travel of said ware.

7. In a conveyor, a primary set of conveyor rolls for conveying the ware along a primary part of a course, a secondary set of conveyor rolls for continuing the movement of the ware along the course, transfer rolls for receiving the ware from the first-named conveyor rolls and transferring the same to the second-named conveyor rolls, means for driving all the rolls and normally rotating the primary and secondary sets of rolls in a forward direction, means for periodically rotating the second-named rolls rearwardly, and means for periodically driving the transfer rolls forwardly and rearwardly and automatically synchronizing said rolls with the

primary and secondary rolls successively, for the reception of ware from the former and delivery of the ware to the latter.

8. In a ware conveyor, a primary set of conveyor rolls for transporting the ware, a secondary set of conveyor rolls for further transporting the ware, transfer rolls for receiving the ware from the first-named conveyor rolls and transferring the same to the second-named conveyor rolls, means for driving all the rolls and normally rotating the primary and secondary sets of rolls in a forward direction, means for periodically rotating the second-named rolls rearwardly, means for automatically synchronizing said transfer rolls with the primary and secondary rolls successively, for the reception of the ware from the former and delivery of the ware to the latter, and means for governing the rolls to cause rotation of all the rolls in a backward direction.

9. In a ware conveyor, a primary conveyor normally movable in a forward direction for transporting the ware, a secondary conveyor for continuing the movement of the ware, a transfer conveyor for transferring the ware from the primary conveyor to the secondary conveyor, means for driving the conveyors at the same surface speed and normally in a forward direction, means for periodically reversing the motion of the second conveyor, means for changing the direction of movement of the transfer conveyor for coaction with the primary and secondary conveyors, and controlled means regulating the actions of said reversing and direction changing means.

10. In a ware conveyor, a primary conveyor for conveying the ware, a secondary conveyor for continuing the conveyance of the ware, a transfer conveyor for transferring the ware from the primary conveyor to the secondary conveyor, driving means for normally driving the conveyors in a forward direction, means for periodically reversing the direction of motion of the second conveyor, means for changing the direction of motion of the transfer conveyor for synchronization successively with the primary and secondary conveyors for the reception of ware from the former and delivery of the ware to the latter, time controlled means governing said motion reversing and motion changing means, and ware controlled means controlling said governing means to regulate the action of the transfer conveyor.

11. In a ware conveyor, a primary conveyor for conveying the ware, a secondary conveyor for continuing the conveyance of the ware, a transfer conveyor for transferring the ware from the primary conveyor to the secondary conveyor, driving means for normally driving the conveyors in a forward direction, means for periodically reversing the direction of motion of the second conveyor, means for changing the direction of motion of the transfer conveyor for synchronizing the same with the primary and secondary conveyors successively, for the reception of ware from the former and delivery of the ware to the latter, time controlled means governing said motion reversing and motion changing means, ware controlled means governing said governing means to regulate the action of the transfer conveyor, and means for varying the timing of the governing means.

12. In a ware conveyor, a primary conveyor for conveying the ware, a secondary conveyor for continuing the conveyance of the ware, a transfer conveyor for transferring the ware from the primary conveyor to the secondary conveyor, driving means for normally driving the conveyors in a forward direction, means for periodically reversing the direction of motion of the second conveyor, means for changing the direction of motion of the transfer conveyor to adapt the same to coact with the primary conveyor for the reception of ware therefrom and then to coact with the secondary conveyor for the delivery of the ware thereto, time controlled means governing said motion reversing and motion changing means, ware controlled means for throwing said governing means into and out of action, and means for governing the action of the governing means to effect a reversal of all the conveyors.

13. In a ware conveyor, a primary conveyor for conveying the ware, a secondary conveyor for continuing the conveyance of the ware, a transfer conveyor for transferring the ware from the primary conveyor to the secondary conveyor, driving means for normally driving the conveyors at the same surface speed and normally in a forward direction, means for periodically reversing the direction of motion of the second conveyor, means for changing the direction of motion of the transfer conveyor for the reception of ware therefrom and then to coact with the secondary conveyor for the delivery of the ware thereto, automatic means governing the driving and reversing and motion changing means, a ware actuated switch controlling the governing means for effecting a forward movement of the transfer conveyor with the primary conveyor, and a ware actuated switch controlling the governing means for maintaining the forward movement of a part at least of the transfer conveyor upon cessation of action of the first-named switch until the ware has passed to the second conveyor.

14. A ware conveyor comprising successively acting units, and automatically controlled driving and governing means for driving an initial portion of the conveyor units constantly in a forward direction and driving a succeeding portion of the conveyor

units periodically and differentially forward and backward.

15. In combination, a roll conveyor, driving means for the rolls of the conveyor operative for driving all the rolls at the same peripheral speed, and means automatically governing said driving means for causing an initial portion of the rolls to constantly rotate forwardly at such speed and for causing a succeeding portion of the rolls to rotate intermittently forwardly and rearwardly for different relative time periods.

16. In a ware conveyor, a primary set of conveyor rolls, a secondary set of conveyor rolls, a set of transfer rolls between the primary and secondary sets of conveyor rolls, driving means for all the rolls, and means governing the driving means to cause the primary set of rolls to constantly rotate in a forward direction, the secondary rolls to periodically revolve in a forward direction and then in a backward direction, and the transfer rolls to synchronize successively with the primary rolls and the secondary rolls.

17. In a ware conveyor, a primary set of rolls, a secondary set of rolls arranged in a plurality of groups, and transfer rolls between the primary and secondary rolls, and driving means for driving all the primary set of rolls in a forward direction and simultaneously driving the groups of the secondary rolls some forwardly and some rearwardly and periodically reversing the rolls or each group for backward and forward rotations for different time periods and causing the transfer rolls to rotate first in the same direction as the primary set of rolls and then in the opposite direction with the adjacent group of the secondary set of rolls.

18. In a ware conveyor, a roller conveyor, a constantly driven power shaft for rotating all the rolls of the conveyor, means for periodically reversing the direction of rotation of said rolls, and means governing said means for causing all or a portion of said rolls to rotate forwardly or rearwardly or intermittently forwardly or rearwardly.

19. In a ware conveyor, a plurality of rolls, a main shaft for driving all the rolls in a given direction at a given peripheral speed, countershafts geared to the main shaft and rotating in the opposite direction at a speed at least as great as that of the main shaft, and means for periodically connecting a portion of said rolls successively to the main shaft and to the countershafts.

20. In a ware conveyor, a plurality of rolls, a main shaft for driving all of the rolls in a given direction at a given peripheral speed, countershafts geared to the main shaft and rotating in the opposite direction thereto, gearing for connecting the main shaft to the rolls, gearing for connecting the rolls in groups to the main shaft, and means for periodically and alternately throwing the first and second named gearings into and out of operation.

21. In a ware conveyor, rotatable rolls arranged in primary and secondary sets, a main shaft for furnishing power for all the rolls, countershafts geared to the main shaft for rotating certain of the rolls in the opposite direction to their direction of rotation by the main shaft but at a speed at least as great as that of the main shaft, and means for periodically connecting a portion of the rolls of at least the secondary set to the main shaft and to the countershafts.

22. In a ware conveyor, a conveyor comprising rolls, a main shaft for furnishing power for all the rolls, countershafts geared to the main shaft and rotating in the opposite direction thereto, means for periodically connecting a portion of said rolls successively to the main shaft and to the countershafts, and means forming part of the aforesaid means for varying the period of connection between the rolls and the shafts whereby the rate of travel of an object being conveyed by the rolls may be varied as a whole during the range of its conveyance by the conveyor.

23. In a ware conveyor, a conveyor for conveying ware to and through the leer chamber comprising rolls arranged in sections, a main shaft for furnishing power for all the rolls, countershafts geared to the main shaft and rotating in the opposite direction thereto, and means for periodically and successively connecting the rolls in a given section successively to the main shaft and to a countershaft.

24. In a ware conveyor, a conveyor comprising primary conveyor units, and a plurality of secondary conveyor units, driving means for the units, and automatic controlling means for rendering the driving means operative at one or more points in the travel of an article being transported by the conveyor to give a differential back and forth motion to at least some of the secondary units of the conveyor independently of the primary conveyor units so as to reduce the rate of progression of the article with respect to its rate of progression when conveyed by the primary conveyor units.

25. In a ware conveyor, a conveyor comprising primary, secondary and intermediate sets of conveyor rolls, driving means for the rolls, and automatic controlling means for rendering the driving means operative to periodically and differentially drive the secondary conveyor rolls differentially backward and forward and to effect synchronization of the intermediate rolls alternately and successively with the primary rolls and the secondary rolls.

26. In a ware conveyor, a conveyor comprising primary and secondary sets of rolls, driving means for rotating all the rolls in a forward direction, driving means for driv-

ing the rolls of the secondary set rearwardly without changing the direction of rotation of the primary rolls, and automatic means for alternately coupling the first and second named driving means for different periods to the secondary rolls.

27. In a ware conveyor, conveyor rolls, driving means adapted to be coupled to the rolls to drive them in groups forwardly or rearwardly, a control device for governing said driving means to rotate the rolls alternately forward and backward, a ware actuated means governing said driving means to maintain certain rolls in connection with the driving means for forward rotation and travel of the ware over said rolls to succeeding rolls, and means for regulating said control device to vary the time periods of the forward and backward rotations.

28. In a ware conveyor, conveyor rolls, driving means adapted to be coupled to the rolls to drive them in groups forwardly or rearwardly, a control device for governing said driving means to rotate the rolls alternately forward and backward, a ware actuated means governing said driving means to maintain certain group of rolls in connection with the driving means for forward rotation and travel of the ware over said rolls to succeeding rolls, a second ware actuated means for continuing the forward driving action of final rolls of the group after the ware has passed beyond the preceding rolls of the group and is about to clear the said final rolls, and means for regulating said control device to vary the time periods of the forward and backward rotations.

29. In a ware conveyor, a conveyor comprising primary and secondary sets of conveyor rolls, the rolls of the secondary set of conveyor rolls being arranged in groups, driving means for normally driving all the rolls in a forward direction, driving means for independently driving the groups of the secondary rolls in a rearward direction without changing the direction of rotation of the primary rolls, and automatic means for periodically and alternately connecting the secondary rolls in groups to the driving means for differential forward and rearward driving actions, respectively.

30. In a ware conveyor, a conveyor comprising primary and secondary sets of conveyor rolls, the rolls of the secondary set of conveyor rolls being arranged in groups, driving means for driving all the rolls in a forward direction, transfer rolls between the primary and secondary rolls, and means for periodically and alternately effecting the backward and forward driving of the transfer rolls and groups of secondary rolls and synchronizing the transfer rolls successively with the primary and secondary rolls.

31. In a ware conveyor, a conveyor comprising primary and secondary sets of conveyor rolls, the rolls of the secondary set of conveyor rolls being arranged in groups, driving means for driving all the rolls in a forward direction, driving means for independently driving the groups of the secondary rolls in a rearward direction, and means governing the driving means to normally drive the primary rolls forwardly and the secondary rolls backwardly and forwardly for different time periods or to cause all the rolls to be driven either forwardly or backwardly.

In testimony whereof I affix my signature.

JULIUS SYLVESTER.