

Sept. 11, 1928.

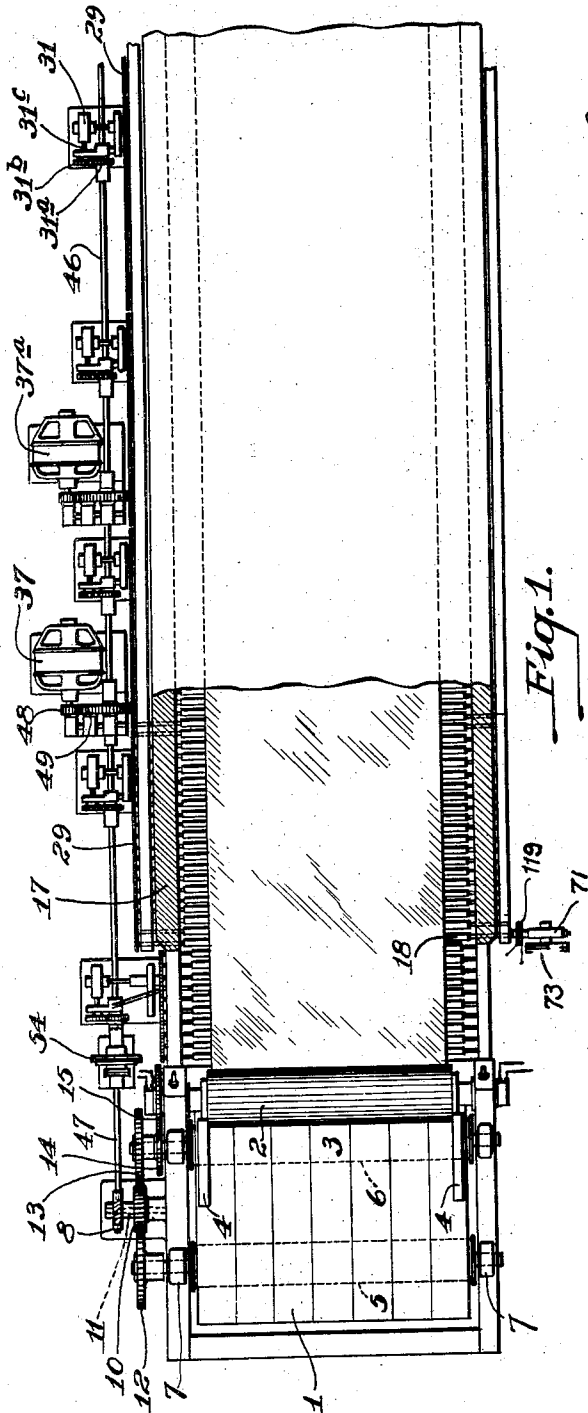
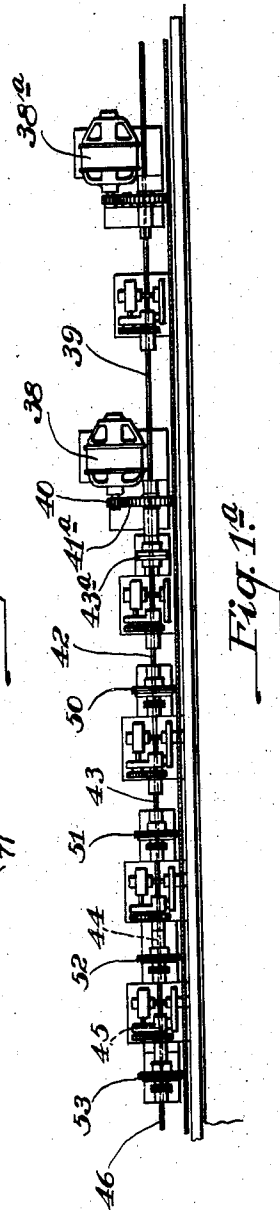
1,683,973

H. S. HEICHERT

LEER CONSTRUCTION

Filed July 29, 1926

5 Sheets-Sheet 1



INVENTOR

H. S. Hickert.

My
James C. Bradley
Care

Sept. 11, 1928.

H. S. HEICHERT
LEER CONSTRUCTION
Filed July 29, 1926

1,683,973

5 Sheets-Sheet 2

Fig. 2.

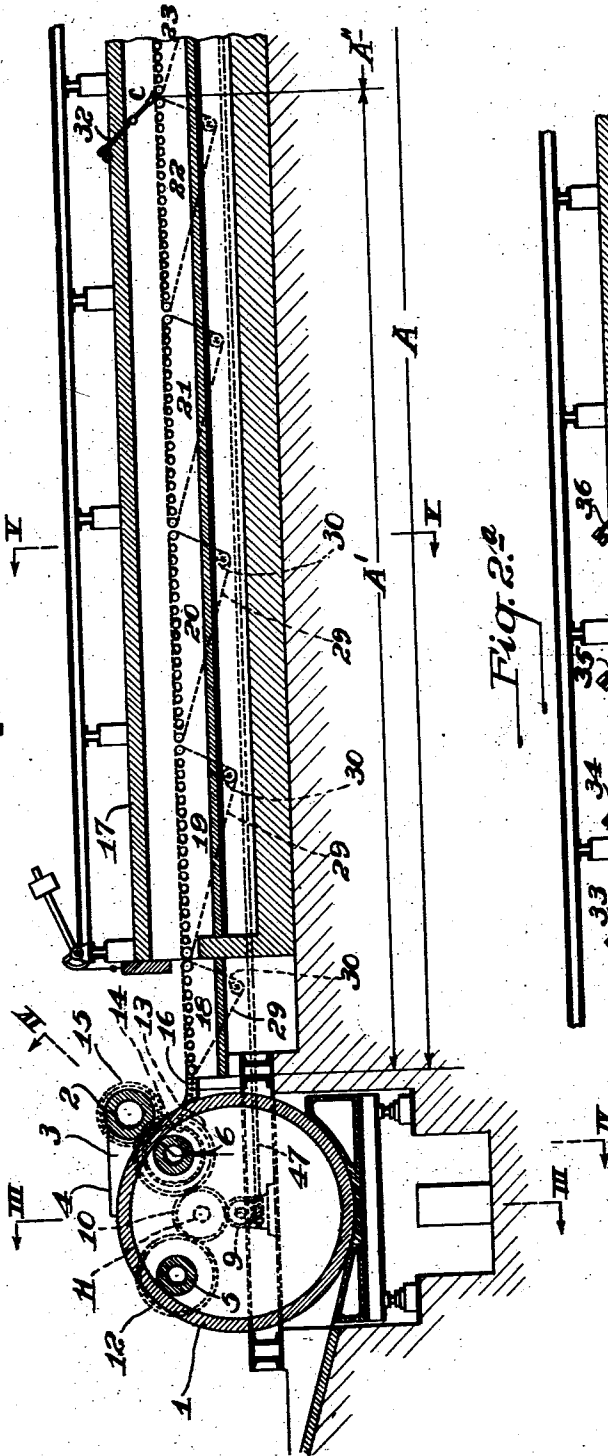
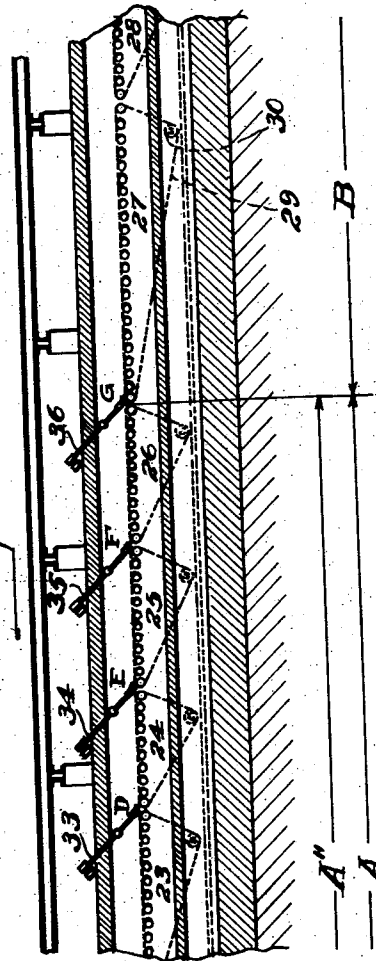


Fig. 2.



INVENTOR
H. S. Heichert.
by
James C. Bradley
att'y

Sept. 11, 1928.

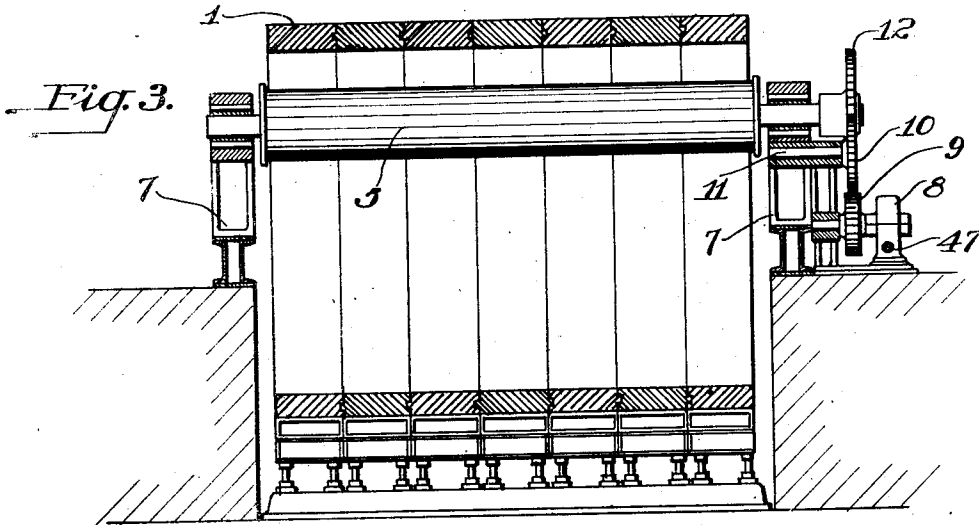
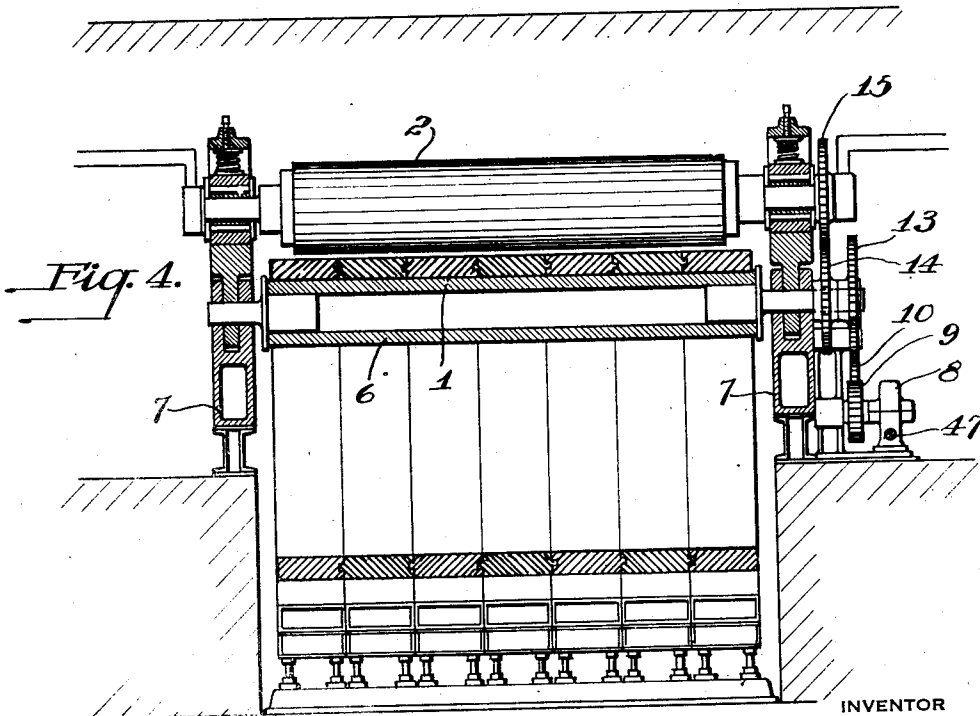
1,683,973

H. S. HEICHERT

LEER CONSTRUCTION

Filed July 29, 1926

5 Sheets-Sheet 3



INVENTOR

H. S. Heichert.

by J. L. Bradley atty

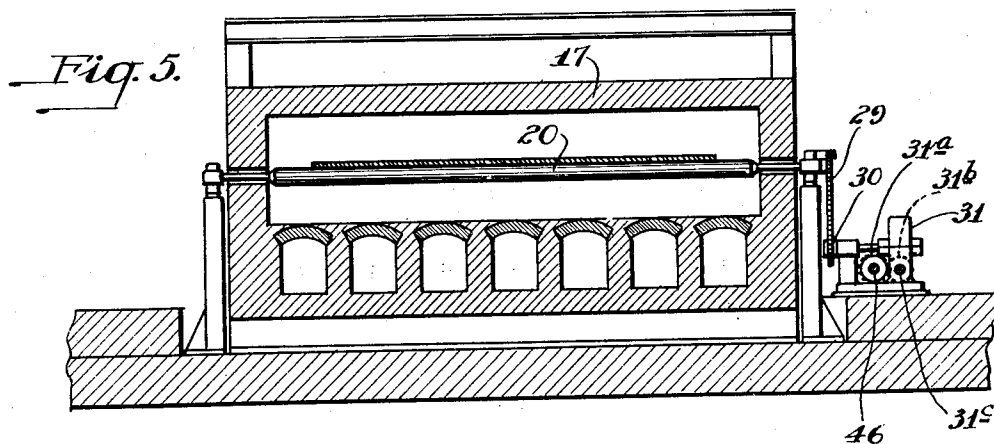
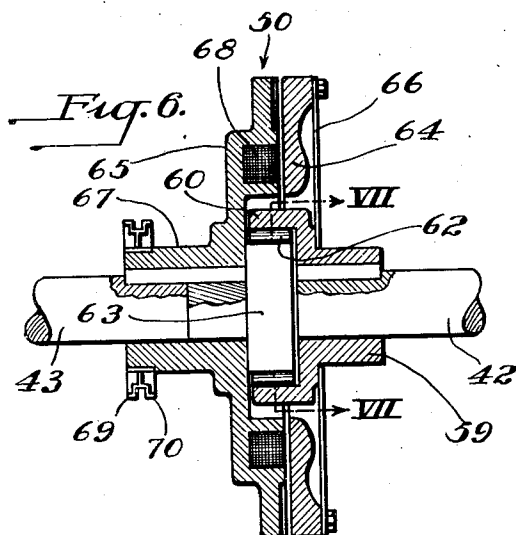
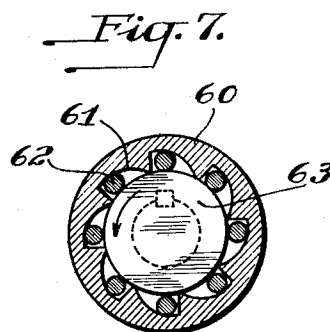
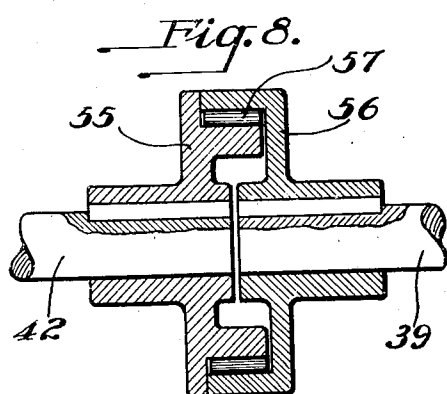
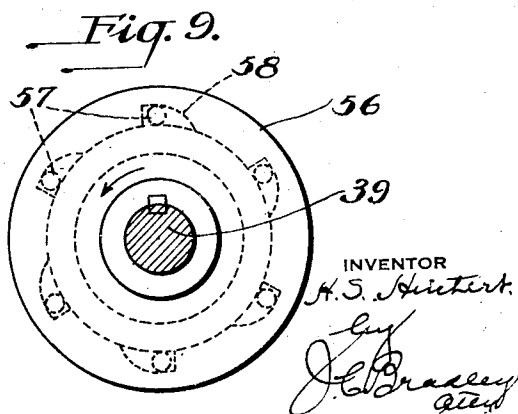
Sept. 11, 1928.

1,683,973

H. S. HEICHERT
LEER CONSTRUCTION

Filed July 29, 1926

5 Sheets-Sheet 4



Sept. 11, 1928.

1,683,973

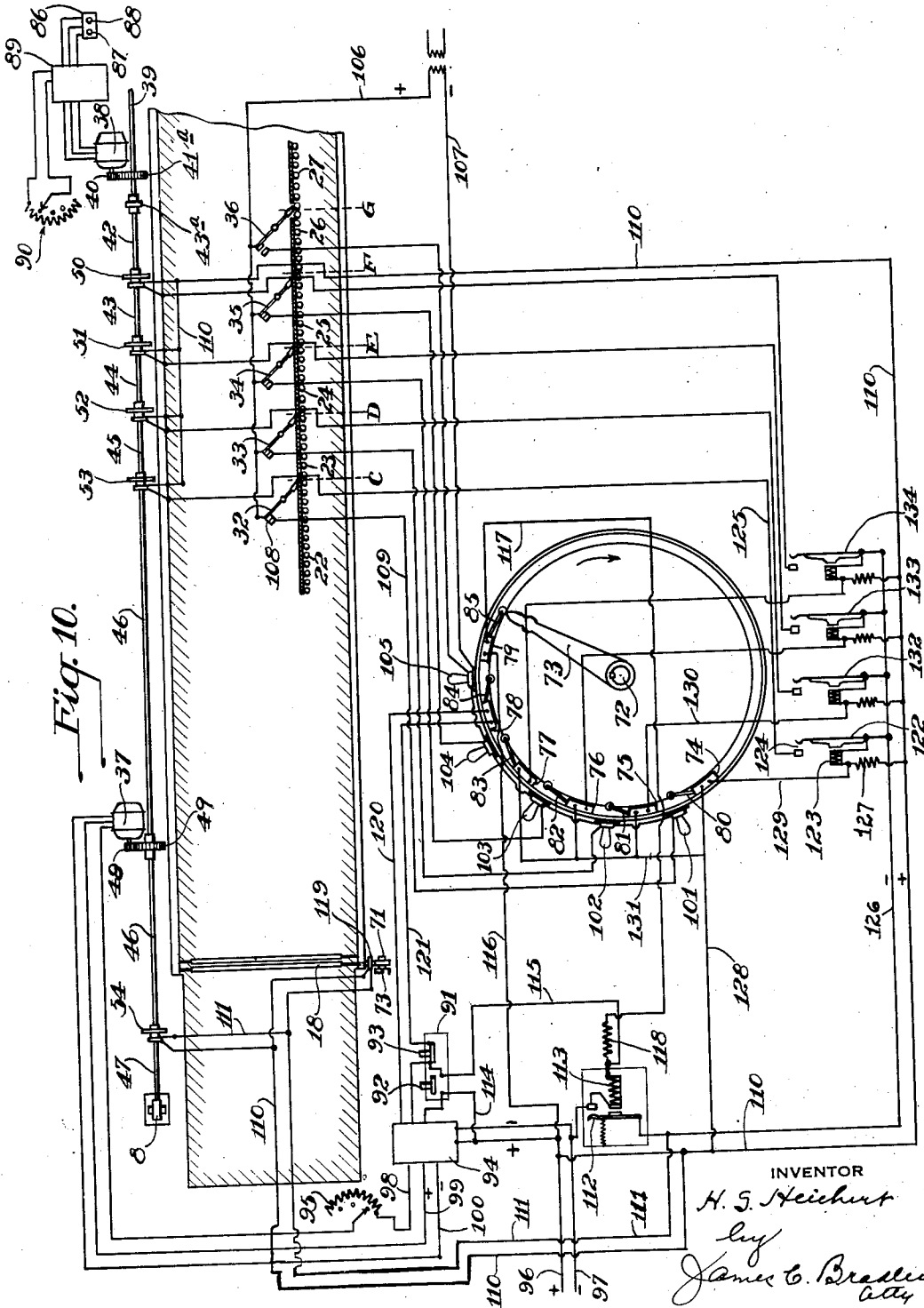
H. S. HEICHERT

LEER CONSTRUCTION

Filed July 29, 1926

5 Sheets-Sheet 5

Fig. 10.



UNITED STATES PATENT OFFICE.

HERMAN S. HEICHERT, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO PITTSBURGH
PLATE GLASS COMPANY, A CORPORATION OF PENNSYLVANIA.

LEER CONSTRUCTION.

Application filed July 29, 1926. Serial No. 125,670.

The invention relates to roller leer constructions and particularly to such constructions as used in an intermittent casting and rolling operation in the production of plate glass. In this operation, it is desirable from the standpoint of production and quality that the glass be rolled into sheets at a high rate of speed, preferably in the neighborhood of thirty feet a minute, although this may be greatly increased. Such a speed of production would necessarily call for a leer of very great length, if the glass sheet were carried entirely through the leer at the same high rate of speed at which it is produced. The leer of the present invention is designed so as to permit the glass to be carried through the front end of the leer at a high rate of speed and then through the following (and major) portion of the leer at a speed which is only a fraction of the speed in the front end. One of the principal objects of the invention is the provision of improved means whereby the successive sheets of glass may be brought into relatively close proximity in their passage through the leer, so that the full capacity of the leer may be utilized. A further object is to provide an improved means for making the shift from one speed to another in the entrance end of the leer automatic. A still further object is the provision of an improved arrangement of indicating means governed by the glass sheets themselves for informing the operator of the location of the ends of the sheets as they pass through the forward or high speed section of the leer. The arrangement is preferably such, as more fully appears later, that the glass sheet in passing from the high speed section of the leer to the low speed section is always supported by rolls which all have the same rate of peripheral speed, so that there is no tendency to buckle the sheet, which might occur, if a sheet were engaged at its forward end by the slow speed rolls, while it was still being supported at its rear end by the high speed rolls. The rolls are also so arranged and timed that the forward end of a sheet which is being moved ahead by the high speed rolls comes closely adjacent the rear end of the preceding sheet which is being moved forward by the low speed rolls before the rate of movement of the high speed rolls is reduced, which arrangement, as above stated, allows the use of the leer to its full capacity. The rolls in the high speed section of the leer preferably have a slow drive, of the one way clutch, and also a fast drive made effective by magnetic clutches, so that when these clutches are energized, the one way clutch connections with the slow drive, permit the rolls to be driven ahead, and when the clutches are released, the slow drive acting through the one way clutch devices immediately picks up and drives the rolls. Properly timed automatic switch devices control the magnetic clutches, although, if desired, the switches may be operated by hand. The hand operation of the switches is facilitated by the indicating devices, heretofore referred to, which show (by means of a series of lights) the location in the leer of the front and rear ends of the sheets. The indicating devices preferably include switches which are operated by the ends of the glass sheets as they progress through the leer. The switches which control the magnetic clutches might also be operated from the sheets themselves, but they are preferably operated by a timing arrangement, located at the rear end of the leer, as later more fully described. The term leer is used throughout in its broad sense, the high speed portion of the runway leading to the slow speed section of the leer being regarded as a part of the leer regardless of how much of, or to what extent, such high speed portion is left uncovered or unhooded in order to facilitate the cooling of the sheet when first formed and as it travels away from the rolling or generating apparatus. One embodiment of the invention is illustrated in the accompanying drawings, wherein:

Figures 1 and 1^a together constitute a partial plan view and partial horizontal section. Figs. 2 and 2^a together constitute a longitudinal section. Fig. 3 is a section on the line III—III of Fig. 2. Fig. 4 is a section on the line IV—IV of Fig. 2. Fig. 5 is a section on the line V—V of Fig. 2. Fig. 6 is a longitudinal section through one of the combined pin and magnetic clutches. Fig. 7 is a transverse section on the line VII—VII of Fig. 6. Fig. 8 is a

longitudinal section through the pin clutch which connects the slow speed line shaft with the high speed line shaft. Fig. 9 is an end view of one of the clutch sections of Fig. 8. And Fig. 10 is a diagrammatic view showing the wire connections.

The rolling apparatus for generating the sheet is similar to that shown in the Showers Patent No. 1,579,666 and comprises a large annular shell 1 and a driven sizing roll 2 between which the molten pot of glass to be formed into a sheet is poured, the recesses at 3 being large enough to receive the entire pot of glass and the ends of the recess being closed by triangular end members 4. The shell 1 is supported upon the transverse rolls 5 and 6 journaled in the end frames 7, 7' (Fig. 3), and driven as hereinafter described, the roll 6 being placed in opposition to the sizing roll 2, which is also driven. The driving power for the roll is supplied from the line shaft section 47. This line shaft section carries a worm which drives a worm wheel in the casing 8, such worm wheel being mounted upon a shaft provided with the pinion 9. This pinion meshes with an idler pinion 10 journaled upon the shaft 11, which in turn meshes with the spur gears 12 and 13 keyed to the ends of the rolls 5 and 6. The roll 6 also carries another spur gear 14 meshing with a gear 15 carried by the shaft of the sizing roll 2. Forward of the casting roll 1 is a water cooled apron 16 for receiving the sheet of glass after it is formed between the casting roll and the sizing roll.

The leer 17 through which the glass sheet is carried for annealing is of the roller type, the rolls being divided into a plurality of independently driven sets 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, etc. Intermediate the forward end of the leer and the apron 16 is another set of rolls 18 also independently driven. The ends of the roll shafts are provided with sprockets around which pass the chains 29, 29, 29, etc., such chains passing around suitable drive sprockets 30, 30, 30, etc. These sprockets 30 are driven from the drive shaft sections which extend longitudinally of the side of the leer, such drive shaft sections being provided with pinions 31^a meshing with gears 31^b upon countershafts 31^c. These countershafts carry worms which drive worm wheels in the casings 31, such worm wheels being keyed to the shafts carrying the sprockets 30. The rolls are divided into two general divisions, those lying in the section marked A of Fig. 2 being driven a part of the time at a relatively high speed and the other part of the time at a relatively slow speed, while the rolls lying in the section marked B are always driven at a relatively low speed. The section A will vary in length somewhat, but is ordinarily at least equal to the length of

the sheet produced. The sheet will, of course, vary in length, but will ordinarily range from 40 to 60 feet. The section B, of which only the extreme end is shown, is very much longer than the section A. Its length will vary, but will ordinarily be upwards of 500 feet in length. The high speed section A of the leer may be further subdivided into two sections marked A' and A''. The section A' is made up of the sets of rolls 18 to 22, which are all driven at the same speed at any one time, that is, either all high speed or all low speed, while the sets of rolls 23, 24, 25 and 26, making up the section A'' may be driven all at high speed or all at low speed, or with the rolls of one or more sets at a higher speed than those of the other sets, the means whereby the rolls are driven at the varying speeds being later described.

In operation, a pot of glass is poured into the recess 3 between the rolls 1 and 2 and a sheet is rapidly rolled out between the rolls and into the leer; the peripheral speed of the rolls 1 and 2 and that of the rolls in the sections 18 to 22 being approximately all the same. At this time, the sets of rolls 23 to 28 are all driven at slow speed. When the forward end of the sheet reaches the point C, the set of rolls 23 is automatically speeded up to correspond with the speed of the preceding sets 18 to 22. A similar speeding up occurs in the sets of the sections 24, 25 and 26 as the forward end of the sheet successfully reaches the points D, E and F. When the front end of the sheet reaches the point G, the speed of the sets 18 to 26 is automatically reduced to slow speed corresponding to that of the slow speed of the sets 27, 28, etc. When the sheet has advanced still farther so that its rear end lies somewhere in the section A'' of the leer, another pot of glass is cast into the recess 3 and the rolling of a second sheet started. At this time, the operator shifts the sets of rolls 18 to 22 to high speed. This second sheet, therefore, advances rapidly through the leer gaining upon the rear end of the first sheet which is advancing at perhaps one-fourth of the speed of the second sheet.

The cycle of increasing speeds in the section A'' after the forward end of the second sheet reaches this section proceeds as heretofore described in connection with the first sheet and the two sheets are so timed that immediately after the rear end of the first sheet passes the point G, the front end of the second sheet passes the point F. By the time the front end of the second sheet passes the point G, it is relatively close to the rear end of the first sheet, perhaps within 2 feet. In the normal operation of the apparatus, therefore, the sheets may be brought very close together so that the full length of the leer is utilized, which would not be the case

if it were not for the interposition of the varying speed section A'' between the section A' and B. The shift of speed at the points C, D, E, F and G is preferably made automatic as later described in connection with the wiring diagram of Fig. 10, but if desired, this automatic operation may be dispensed with and the shifting of speeds may be controlled by the operator who is located near the rolls 1 and 2 and who throws the proper switches at certain intervals, which are determined by the positions of the glass sheets in leer. With either automatic or non-automatic operation, it is desirable to provide some means for informing the operator at all times of the positions of the ends of the sheets in the leer in the high speed section, and for this purpose, the switch arms 32, 33, 34, 35 and 36 are provided, such arms being operated by the ends of the glass sheets moving through the leer. The electrical connections and circuits whereby this is accomplished will be later described in connection with the wiring arrangement, as shown in Fig. 10.

The arrangement whereby the sets of rolls in the leer are driven in accordance with the operation as above set forth will now be described, reference being had to Fig. 1, which shows the general arrangement. The drive is accomplished from two motors 37 and 38, the motor 37 providing the high speed drive, while the motor 38 provides the low speed drive. The low speed motor is geared to the line shaft section 39 by means of the pinion 40 and gear 41^a. This section 39 extends to the right the length of the leer and drives all of the various sets of rolls in the slow speed section, the method of transmitting the drive to the sets of rolls being the same as that heretofore described in connection with the parts 29 and 30. The left hand end of the section 39 is connected to the next section of line shaft 42 by means of the pin or roller clutch 43^a shown in detail in Figs. 8 and 9. This arrangement permits the shaft section 42 and all of the shaft sections to the left thereof to be driven at slow speed from the section 39, but at the same time, permits the section 42 and all of the sections to the left thereof to be driven at a higher rate of speed than the shaft section 39 when such sections are connected to the high speed motor 37, as hereinafter described. The clutch 43^a is in effect a ratchet connection which permits the section 42 to be driven from the section 39 or permits the section 42 to be driven in the same direction at a higher rate of speed than the section 39. Following the line section 42 and extending to the left are the successive line shaft sections 43, 44, 45, 46 and 47, all of which may be driven from the shaft section 39 at slow speed or may be driven from the motor 37 through the intermediary of

the shaft section 46, which is geared to the high speed motor by means of the pinion 48 and gear 49, the latter being keyed to the line shaft section 46.

Between the adjacent ends of the line shaft sections 42 to 47 are the combination pin or roller and magnetic clutches 50 to 54, all of which are similar in construction and are shown in detail in Figs. 6 and 7. The roller or ratchet drive of these clutches is similar to that of the pin drive 43^a shown in Figs. 8 and 9, which has not yet been described in detail. This roller drive 43^a between the shaft sections 39 and 42 comprises two interfitting casings 55 and 56 keyed to the ends of the shafts and locked together by means of the rollers 57 when the shaft 39 is driven forwardly. The casing 56 is provided with the cam recesses 58 and the pins or rollers 57 lie in these recesses and bear against the flange of the casing 55. Referring now to Figs. 6 and 7, which show the combination roller and magnetic clutch between two of the shaft sections, such for instance, as the clutch 50 between the sections 42 and 43, the roller section of the clutch consists of the casing 59 keyed to the shaft 42 and provided with a flange 60 having the cam recesses 61, such recesses carrying the pins or rollers 62, which bear against the hub 63 keyed to the end of the shaft section 43. The magnetic portion of the clutch comprises the two opposing ring members 64 and 65, the first of which is secured to the member 59 by means of the plate 66, while the other is secured to the shaft 43 by means of the hub 67. The member 65 is provided with the coils or windings 68 by which the clutch is energized and these coils are connected with the pair of brush rings 69 and 70, which are insulated from each other and to which the wires from the coils are connected. This is a commercial type of magnetic clutch well known in the art. This arrangement permits the shaft section 43 to be driven by the slow speed shaft section 42 through the intermediary of the roller clutch, or when the shaft section 43 is driven at a high speed, the roller clutch permits the section 43 to run at such high speed without interference from the shaft section 42. If it now becomes desirable to drive the shaft section 42 at a high speed from the shaft 43, the magnetic clutch is energized and the two shaft sections 43 and 42 are connected together and rotated at a high speed. It will be seen that this arrangement of clutches between the shaft sections controlling the high speed section A of the leer permits of a drive of the leer rolls from the single line shaft either at a high speed or at a low speed, with both motors 37 and 38 running continuously, and permits of a shift from high to low speed and vice versa. In order to provide for emergencies,

two other motor drives are provided, duplicating the motor drives 37 and 38. The motor drive 37^a corresponds to the motor drive 37, while the motor drive 38^a corresponds to the motor drive 38. These motors are geared to the line shaft in the same manner as the motors 37 and 38, and run continuously the same as 37 and 38, so that in case of accident to the motors 37 or 38, these supplemental motors take over the load automatically without discontinuing the operation of the leer.

The automatic controlling mechanism with the electrical connections is shown in Fig. 10. The end of one of the apron rolls 18 is provided with a clutch 119 driving a worm which meshes with a worm wheel mounted in the casing 71 and the shaft 72 of this worm wheel carries the control arm 73, which in the course of its movement operates the switches 74, 75, 76, 77, 78 and 79, such switches being provided with the switch arms 80 to 85. The switch arms 80 to 83 are normally held yieldingly in open position so that their switches are open, while the switch arms 84 and 85 are normally pressed downward so that the switches 78 and 79 are closed. The arrangement is such that after the arm 73 passes the switch arms 80 to 83, closing them in its passage, they then move to open position. The gear reduction, by means of which the arm 73 is rotated, is such that it will rotate to the switch 74, while the sheet of glass which is formed between the rollers 1 and 2, is moving to the point C (Fig. 2). The other switches are similarly located; the switch 78 being so positioned that its arm is engaged by the arm 73 when the forward end of the sheet in the leer reaches the point G. The slow speed motor 38 is stopped and started from the push button box 86 having the start and stop push members or buttons 87 and 88. The starting of the motor is controlled through the starting box 89 and the starting rheostat 90. This slow speed motor 38 is operated practically continuously and drives all the rolls in the leer and the casting and sizing rolls, except during the period in which the high speed motor 37 controls the movement of the rolls in the high speed section of the leer and of the casting and sizing roll, as later described. The high speed motor 37 is stopped and started from the push button box 91 having the starting button 92 and the stopping button 93, the starting of the motor being controlled through the starter 94 and rheostat 95, which are standard electrical equipment and require no description. The box 91 is of standard construction, of the type in which the circuit is completed when the button 92 is pressed in, but which is broken when the button 92 is released, or when the button 93 is pressed. Current is supplied for operating the sys-

tem through the lines 96 and 97. The circuit to the field of the motor is made through the line 98 and that to the armature through the line 99. The return circuit is through the line 100.

The lights 101, 102, 103, 104 and 105 which serve to indicate the position of the ends of the glass sheet and the leer and which are controlled from the switch arms 32 to 36 are operated from an alternating current line 106, 107. When the forward end of the sheet passes beneath the switch arm 32, it swings such arm so as to complete the circuit at 108 and current flows to the lamp 101, through the lines 106, 109 and 107. When the rear end of the sheet passes this same switch arm 32, it drops down breaking the circuit at 108 so that the lamp 101 goes out. The other lamps 102 to 105 are similarly lighted and extinguished, thus indicating the time when the ends of the sheet arrive at and pass the points D, E, F and G.

The operation is as follows, assuming that the button 87 of the low speed motor 38 has been pushed and that the leer rolls and also the casting and sizing rolls are being rotated at a slow speed from this motor. When a pot of glass is poured into the recess 3 between the casting and sizing rolls and distributed along a line parallel to its axis; the operator presses the starting button 92 in the box 91, thus completing the circuit through the starter, the lines 98, 99 and 100 and the motor 37. This motor immediately starts up, and through the line shaft sections 46 and 47, starts the rotation of the sets of rolls 18 to 22 and the sizing and casting rolls at high speed. The completing of the circuit through the lines 99 and 100 also completes the circuit through the magnetic clutch 54 via the lines 110 and 111 and the switch arm 112 so that the starting of the motor clutches the line shafts 46 and 47 together. The switch arm 112 is closed at this time since the pressing of the button 92 establishes a circuit through the coil 113 via the lines 96, 114, 115 and 97. When the button 92 is released the arm still remains closed due to another circuit, including the coil 113 and comprising the lines 96 and 116, the switch 79, the line 117, the resistance 118, and the line 97. The current through this circuit, because of the resistance 118 is not strong enough to close the arm 112, but when once closed, the current is sufficient to hold it closed. There is also a magnetic clutch at 119 between the roll 18 and the shaft which operates the indicating device, similar in construction to the magnetic clutches 50 to 54, and this clutch is also energized through the lines 110 and 111 when the button 92 is pressed so that at the moment the starter button is pushed, the indicator arm 73 starts to swing to the right in the direction of the arrow. This movement carries

the arm 73 from beneath the switch arm 85 of the switch 79, thus completing a circuit through the lines 116 and 117 and the resistance 118. The movement of the arm 73 from beneath the arm 84 a short time before the experiment with the arm 85 completes a circuit through the push button box 91 and the wires 120 and 121 leading to the starter and to the push button box. This circuit constitutes a part of the circuit in which the lines 99 and 100 lie, so that after the button 92 is released by the operator and snaps forward, breaking the circuit at this point, the circuit from the lines 96 and 97 through the motor is maintained by reason of the lines 120 and 121 and the contact in the switch box 78 which is made effective by the passing of the arm 73 from beneath the switch arm 84. The purpose of this arrangement, as will appear in the further description of the operation, is to provide a means for breaking the circuit at 78 and stopping the motor when the arm 73 has made a complete circuit and arrives at the position shown in the drawing. The rolling operation now continues at a high speed until the forward end of the sheet, which is being formed arrives at the point C (Fig. 2), at which time the arm 73 has rotated so that it passes beneath the switch arm 80 and completes a circuit in the switch 74. This causes the switch arm 122, under the influence of the winding 123 to close, making a contact at 124. This completes the circuit through the magnetic clutch 53 so that the shaft section 45 is clutched to the shaft section 46 and rotated at the same high speed as the shaft section 46. This shaft section 45 drives the set of rolls 23 so that the speed of these rolls is brought up to the speed of the rolls 19 to 22 as soon as the sheet arrives at the forward end of the set. The circuit as thus completed includes the line 110, windings of clutch 53, line 125, switch arm 122, line 126, switch arm 112, and line 97. In order to assist in the operation of the switch arm 122, a resistance coil 127 is employed. Before the switch at 74 is closed, current from the line 110 passes through both of the coils 123 and 127 back to the return line 126, and the resistance of the arm 122 to movement is so adjusted that under these conditions, the switch arm will not move to the left to complete the contact at 124. When, however, the circuit is completed at 74 between the wires 128 and 129, the resistance coil 127 is short circuited and the current from the wire 110 flows through only the single coil 123 and back to the line 126 through the wires 128 and 129. This causes the closing of the switch arm 122. As soon as the arm 73 passes the switch arm 80, this arm moves to the right, again breaking the circuit at 74, but the switch arm 122 still remains in closed position as the current flowing

through the coils 123 and 127 is still strong enough to hold the arm closed, after it is once closed, although not strong enough to move it to closed position.

When the end of the sheet moving still farther to the right over the set of rolls 23 reaches the point D in the leer (Fig. 2) the arm 73 reaches a point where its end swings the switch arm 81 of the switch 75 to the left, thus momentarily completing the circuit between the wires 130 and 131. This causes the closure of the switch arm 132 and the actuation of the magnetic clutch 52 so that the set of rolls 24 are speeded up by reason of the line shaft section 44 being clutched to the line shaft section 45. In this manner, as the sheet moves to the right still farther, the switch arms 82 and 83 are operated, causing the clutches 51 and 50 to be actuated so that the sets of rolls 25 and 26 are brought up to the same high speed as the preceding sets of rolls. This operation is secured by the actuation of the switch arms 133 and 134, the method of operating and the connections being obvious without further explanation. The sheet has now been completely generated and moved through the leer a distance such that it is feasible to slow up its movement without danger of its settling into waves between the rolls, and the next operation is the automatic breaking of the circuit to the motor 37 followed by the shifting of the sets of rolls 18 to 26 from high speed to low speed. This occurs when the forward end of the sheet arrives just short of the point G (Fig. 2), at which time the arm 73 reaches the roller of the switch arm 84. When the arm arrives at this point, it moves the switch arm 84 up, thus breaking the circuit through the lines 120 and 121 and that through the lines 99 and 100 passing to the motor, so that at this time, the speed of the motor 37 and of the line shaft operated from such motor, drops down to a point where it is picked up by the slow speed motor acting through the series of roller clutches 50 to 54. By the time this occurs, the arm 73 will have reached its starting position, as shown in the drawings, with its end in engagement with the roller of the switch arm 85, which is pushed upward, breaking the circuit between the lines 116 and 117. This interrupts the circuit through the winding 113 so that the arm 112 opens, interrupting the circuit between the return line 126 and the line 97 and causing the release of the magnetic clutches 50, 51, 52, 53, 54, and 119. It is desirable that the release of the magnetic clutches should occur after the motor 37 has slowed down rather than at the same time in order to insure that the sets of leer rolls 19 to 26 shall all run at the same speed until picked up by the slow speed motor, thus avoiding any jars or jerks incident to the shift, which

might show in the sheet of glass. The inertia of the motor armature is such that the shaft section 46 (and the sets of leer rolls 19 to 22) coupled directly to the motor would not slow down as rapidly as the shaft sections 42 to 45 and the sets of leer rolls connected thereto, so that, if the shaft sections were uncoupled when the motor circuit is interrupted, there would be a tendency to buckle the sheet between the section of the glass sheet lying on the rolls 19 and 22 and that lying on the rolls 23. This completes the cycle involving the production of one sheet, and another sheet may be formed and fed into the leer when the rear end of the sheet which has just been formed reaches a point lying somewhere in the section A'' of the leer. The operation as above described can now be repeated, starting with the pressing of the button 91, when the next pot of molten glass is deposited in the recess 3 between the forming rolls.

An important advantage, incident to the shift from the high speed drive of the rolls to the slow speed by the use of the roller clutches is, that the shock imposed upon the glass incident to the shift from one speed to the other is very slight, so that the glass is not deformed so as to give any indication of the shift. This is due to the fact that the sheet and rollers coast after the magnetic clutches are thrown out, and the reduction in speed during this coasting period is so gradual that when the slow speed drive catches up and the pin and roller clutches come into driving engagement, there is no jar or appreciable change in speed of the sheet or rolls at the instant the clutches begin to drive. The use of the plurality of rollers in each clutch insures against slippage at the beginning of the engagement of the clutch or after the drive is under way. These roller clutches have, in general, the function of pawl and ratchet connections and constitute, what may be termed "one way clutches". This term is used in the claims to designate any form of clutch having the same function of driving the one shaft section from another slow speed section and yet permitting the driven section to be driven ahead at a higher speed from another source of power without interference from the clutch or the slow speed section. For simplicity in illustration, the various connections and contacts governing the automatic control, are shown as single members throughout, but it will be understood that in practice it is contemplated that these parts may be in duplicate, as insurance against accident to, or failure in, one of the individual parts.

What I claim is:

1. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section

which receives the sheets from the rolling apparatus, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low rate of peripheral speed, means for driving the rolls of the high speed section either at a rate of speed corresponding to that of the rolls in the slow speed section, or at a much higher rate of speed, and means for shifting said rolls of the high speed section from one of said speeds to the other.

2. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low rate of peripheral speed, means for driving the rolls of the high speed section either at a rate of speed corresponding to that of the rolls in the slow speed section, or at a much higher rate of speed, and means for automatically shifting said rolls of the high speed section from the higher speed to the lower one after the glass sheet on said rolls has set sufficiently to prevent sagging of the sheet when the shift to the lower speed is made.

3. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low rate of peripheral speed, means for driving the rolls of the high speed section either at a rate of speed corresponding to that of the rolls in the slow speed section or at a much higher rate of speed, means for shifting the rolls of the high speed section from the low speed to the higher one, and automatic means for shifting said rolls back to the slower speed again before the sheet has passed off of said rolls and onto the rolls of the slow speed section.

4. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means for driving the sets of rolls making up the high speed section either at said relatively low peripheral speed or at a much higher one and means for shifting said sets of rolls successively from slow speed to high speed as the glass sheet advances along the high speed section and for shifting said

sets back to low speed before the sheet reaches the slow speed section.

5. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means for driving the sets of rolls making up the high speed section either at said relatively low peripheral speed or at a much higher one and automatic means for shifting said sets of rolls successively from low speed to high speed as the glass sheet advances along the high speed section.

6. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means for driving the sets of rolls making up the high speed section either at said relatively low peripheral speed or at a much higher one, and automatic means for shifting said sets of rolls successively from low speed to high speed as the glass sheet advances along the high speed section and for shifting said sets all back to low speed before the sheet reaches the slow speed section.

7. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means including one way clutches for driving the sets of rolls making up the high speed section also at said low peripheral speed, other means including a source of electric current and magnetic clutches for driving said sets of rolls at a much higher rate of speed, and means for successively energizing said magnetic clutches to shift the sets of rolls from low speed to high speed as the glass sheet advances along the high speed section.

8. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed,

means including one way clutches for driving the sets of rolls making up the high speed section also at said low peripheral speed, other means including a source of electric current and magnetic clutches for driving said sets of rolls at a much higher rate of speed, means for successively energizing said magnetic clutches to shift the sets of rolls from low speed to high speed as the glass sheet advances along the high speed section, and means for causing the release of said magnet clutches at one time before the glass sheet reaches said slow speed section.

9. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means including one way clutches for driving the sets of rolls making up the high speed section also at said low peripheral speed, other means including a source of electric current and magnetic clutches for driving said sets of rolls at a much higher rate of speed, automatic means for successively energizing said magnetic clutches to shift the sets of rolls from low speed to high speed as the glass sheet advances along the high speed section, and automatic means for causing the release of said magnetic clutches at one time before the glass sheet reaches said slow speed section.

10. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means including one way clutches for driving the sets of rolls making up the high speed section also at said low peripheral speed, other means including a source of electric current and magnetic clutches for driving said sets of rolls at a much higher rate of speed, means for successively energizing said magnetic clutches to shift the sets of rolls from low speed to high speed as the glass sheet advances along the high speed section, and means for causing the release of said magnet clutches at one time before the glass sheet reaches said slow speed section, said automatic means including a member geared to move in timed relation to the movement of the rolls of the leer, and switches controlled by said member and governing the supply of current to said magnetic clutches.

11. The combination with apparatus for

intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, means including one way clutches for driving the sets of rolls making up the high speed section also at said low peripheral speed, other means including a source of electric current and magnetic clutches for driving said sets of rolls at a much higher rate of speed, automatic means for successively energizing said magnetic clutches to shift the sets of rolls from low speed to high speed as the glass sheet advances along the high speed section, and automatic means for causing the release of said magnetic clutches at one time before the glass sheet reaches said slow speed section, said automatic means including a member geared to move in timed relation to the movement of the rolls of the leer, and switches controlled by said member and governing the supply of current to said magnet clutches and the interruption of such current.

12. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low rate of peripheral speed, means for driving the rolls of the high speed section either at a rate of speed corresponding to that of the rolls in the slow speed section or at a much higher rate of speed, means for shifting said rolls of the high speed section from one of said speeds to the other, and electrical means including a source of electric current and switches governed by the ends of the glass sheets in the leer for indicating the position of such ends longitudinally of the leer.

13. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low rate of peripheral speed, means for driving the rolls of the high speed section either at a rate of speed corresponding to that of the rolls in the slow speed section or at a much higher rate of speed, means for shifting said rolls of the high speed section from one of said speeds to the other, and electrical means including a source of electric current and switches governed by the ends of the glass sheets in the leer and lights adjacent the rolling apparatus for indicating to the

operator the position of such ends longitudinally of the leer.

14. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low rate of peripheral speed, such means including a motor and a line shaft section extending longitudinally of the leer, and means for driving the rolls making up the high speed section of the leer including a motor and line shaft section, and a one way clutch between said line shaft sections, so that the first motor will drive both line shaft sections when the second motor is not supplied with electric current to drive the second motor.

15. The combination with apparatus for intermittently rolling sheets of glass, of a roller leer comprising a high speed section which receives the sheets from the rolling apparatus, and which is divided into a plurality of sets of rolls, and a slow speed section following the high speed section, means for driving the rolls of the slow speed section at a relatively low peripheral speed, said means including a motor and a line shaft section extending longitudinally of the leer, and means for driving the sets of rolls making up the high speed section of the leer including a motor, a line shaft section driven therefrom having driving connection with the first set of rolls in the leer, a plurality of other line shaft sections in series extending along the leer toward the slow speed line shaft section, a one way clutch between the end one of the high speed line shaft sections and the slow speed line shaft section, a one way clutch and a magnetic clutch between each pair of adjacent ends of the high speed shaft sections, and a source of current for energizing the magnetic clutches.

16. In an apparatus of the class described, means for forming a quantity of molten glass into a flattened length of glass at a relatively high speed, a leer, conveyor means for delivering the formed glass completely into the leer at the speed of forming of the glass, means for continuing the movement of the glass through the leer at a relatively lower speed, and means operable to change the speed of movement of at least a portion of said first conveyor means to correspond to the reduced speed of movement of the last-mentioned conveyor means.

17. In an apparatus of the class described, a leer, a conveyor means for feeding ware through the leer and divided into an entrance section and a continuing section, separate means for driving each of said sections, means operable to alternately connect

said entrance section to said separate driving means whereby said sections may be driven first at different speeds and then at the same speed, and means for forming and delivering a section of flattened glass to the entrance section of the leer conveyor.

18. The combination with an intermittent sheet glass forming machine, of a leer receiving glass from the forming machine as formed, rollers within the leer to receive the sheet from the forming machine, rollers

within the leer having a substantially constant speed which is less than that of the sheet formation, and means whereby the speed of the first set of rollers may be varied from a speed equal to that of sheet formation to speed equal to that of the second set of rollers.

In testimony whereof I have hereunto subscribed my name this 23rd day of July, 1926.

HERMAN S. HEICHERT.