No. 805,608. PATENTED NOV. 28, 1905.

B. C. WHITE.

GLASS ROLLING MACHINE.

APPLICATION FILED MAR. 21, 1905.

3 SHEETS—SHEET 1.

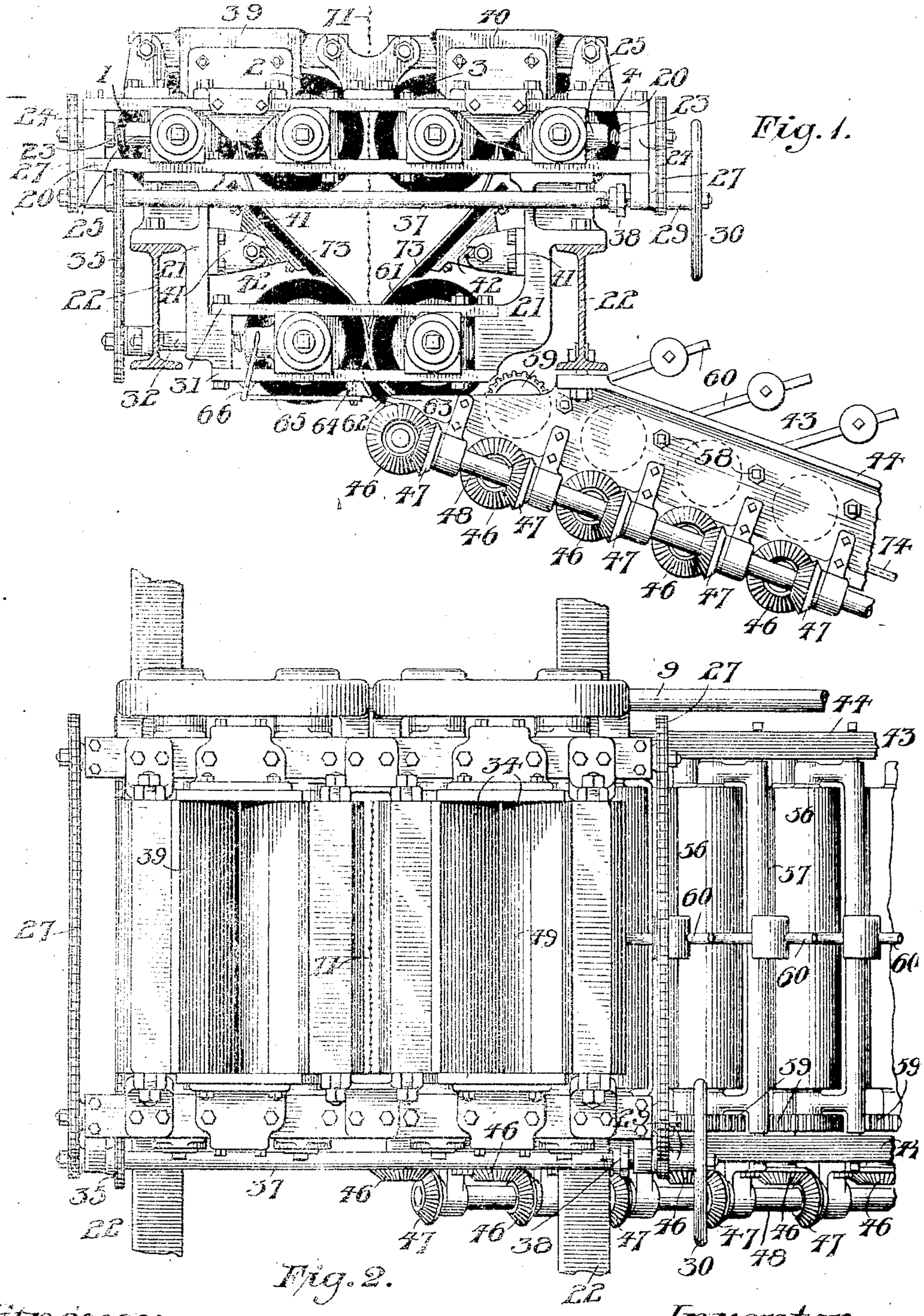



Fig. 1.

Fig. 2.

Witnesses:
M. A. Buchman
E. L. Stanwick

Inventor,
Burke Clark White,
by Pierce & Baker,
his Attorneys

No. 805,608. PATENTED NOV. 28, 1905.

B. C. WHITE.

GLASS ROLLING MACHINE.

APPLICATION FILED MAR. 21, 1905.

3 SHEETS—SHEET 2.

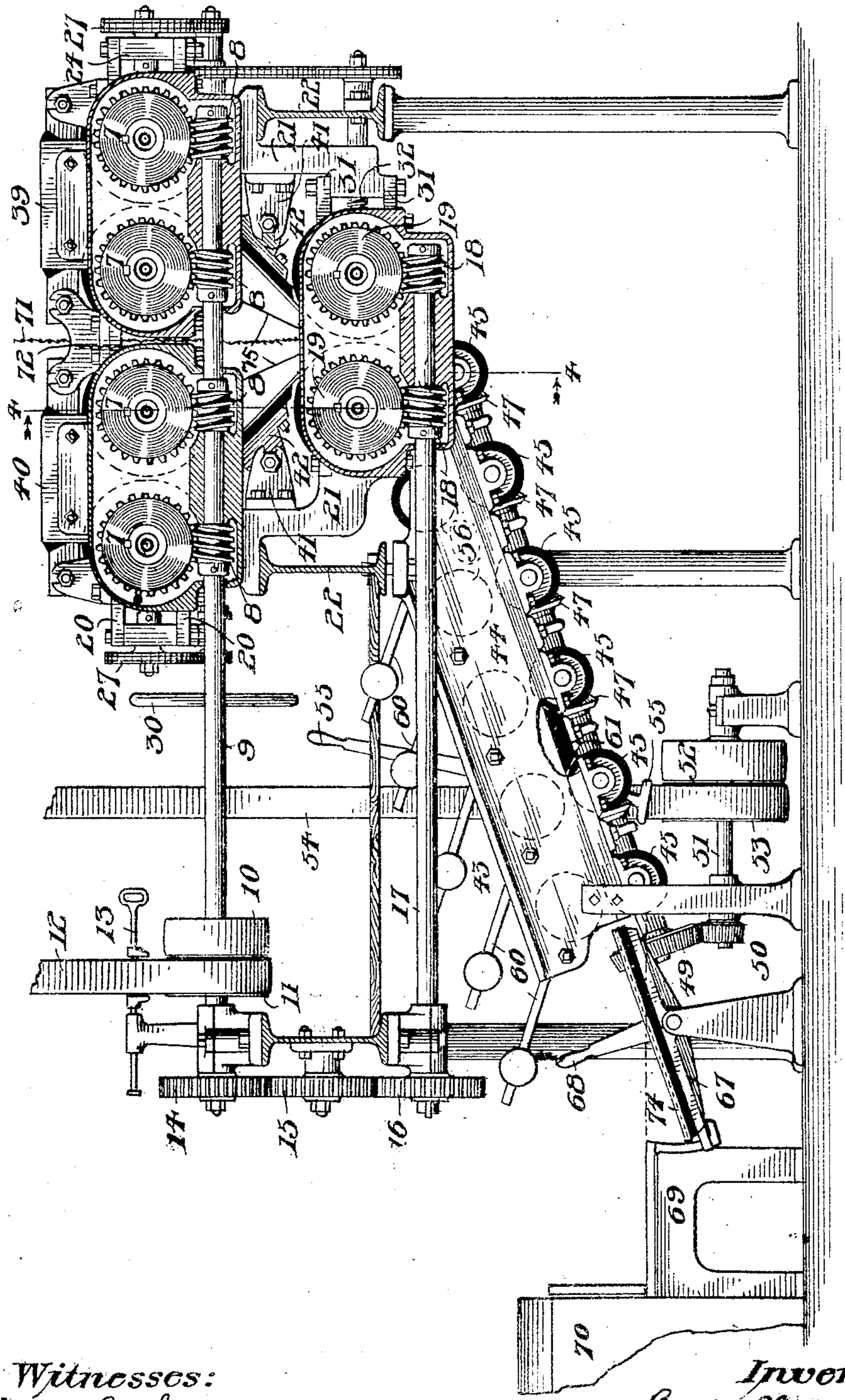



Fig. 3.

Witnesses:
W. A. Buchman
Chas. Stanick

Inventor,
Bruce Clark White,
by Pierce & Barber,
his Attorneys

No. 805,608. PATENTED NOV. 28, 1905.

B. C. WHITE.

GLASS ROLLING MACHINE.

APPLICATION FILED MAR. 21, 1905.

3 SHEETS—SHEET 3.

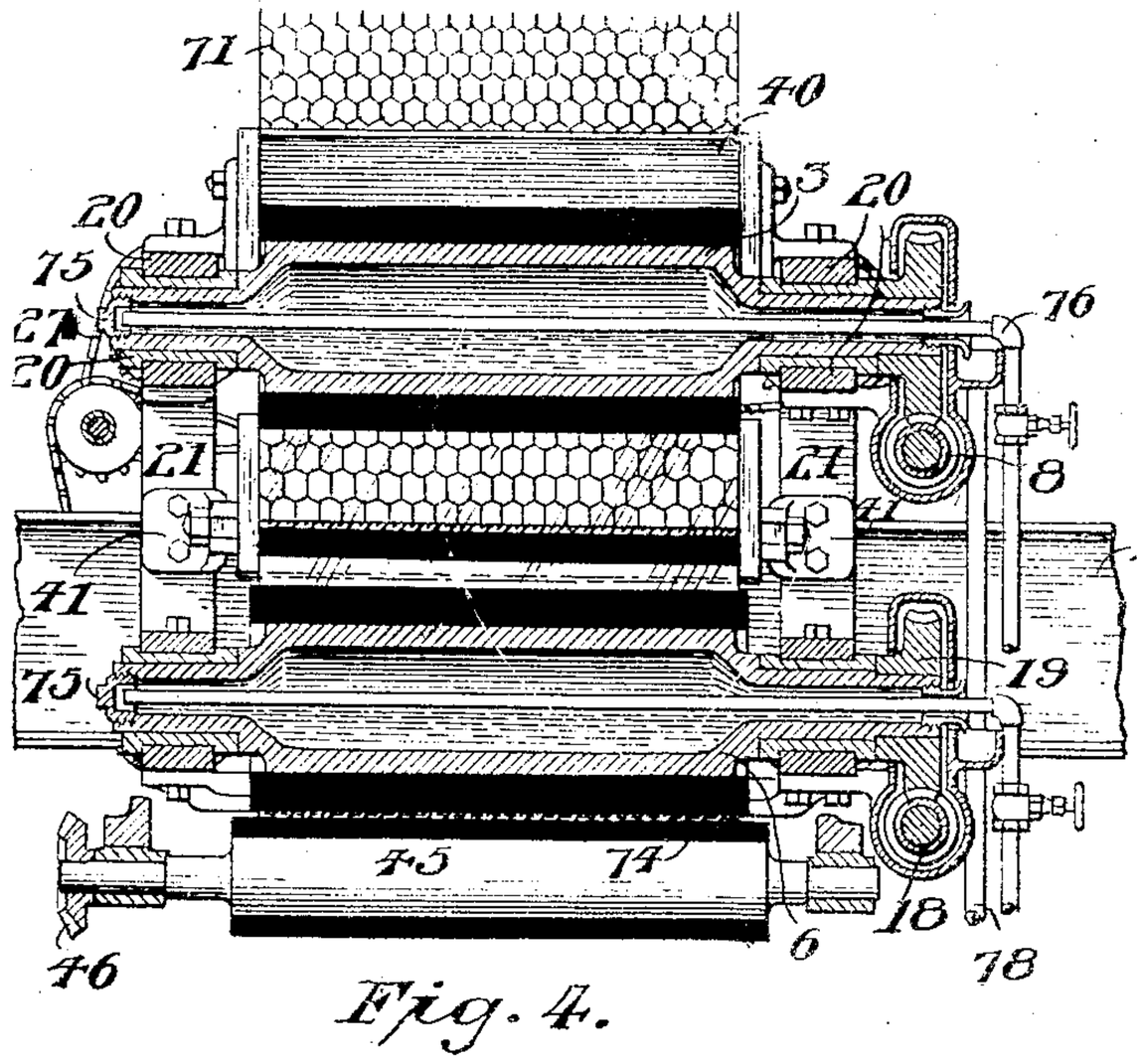
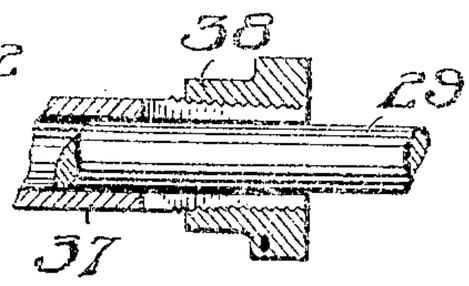



Fig. 4.

Fig. 6.



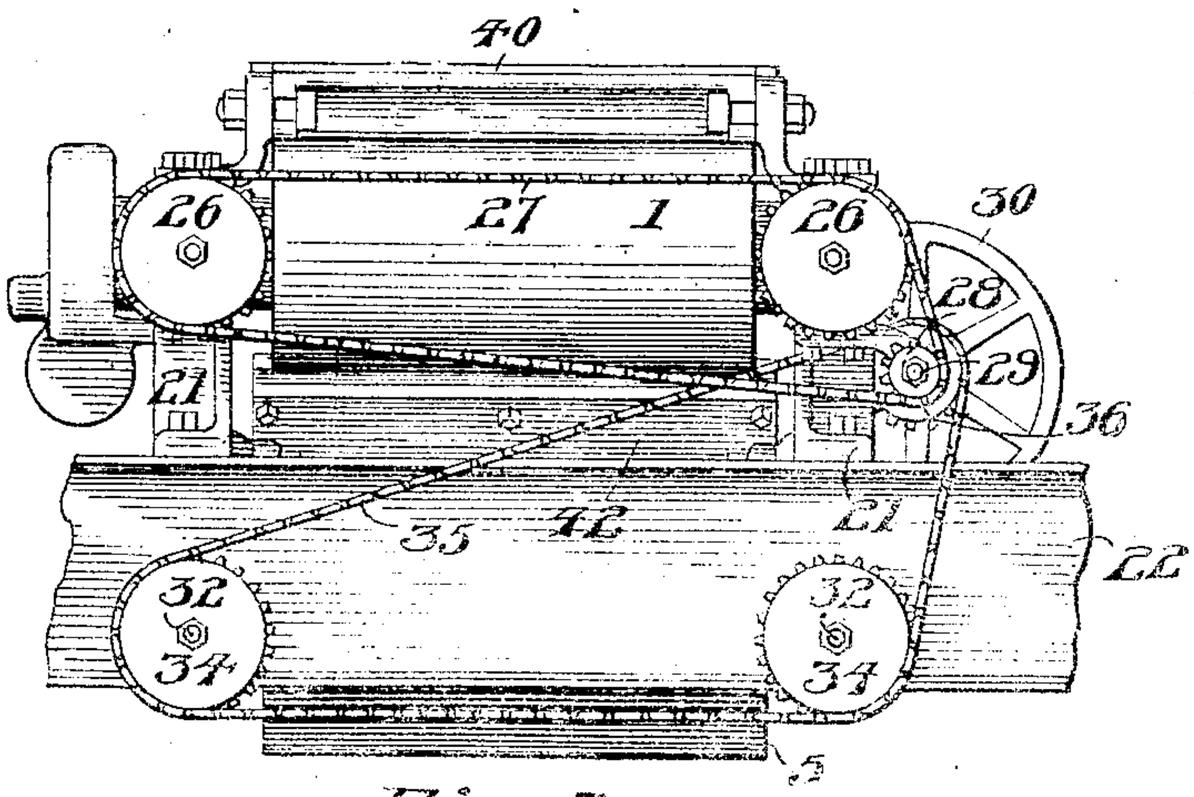
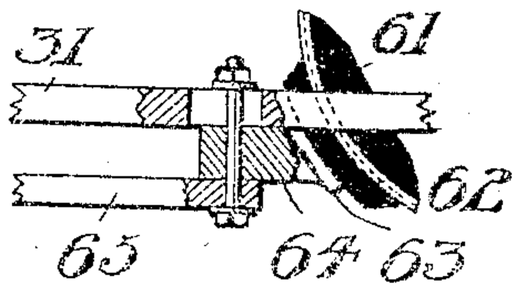




Fig. 5.

Fig. 7.




Witnesses:
W. A. Buchman
H. Stanich

Inventor,
Bruce Clark White
by Pierce & Barber
Attorneys.

# UNITED STATES PATENT OFFICE.

BRUCE CLARK WHITE, OF MOSGROVE, PENNSYLVANIA.

## GLASS-ROLLING MACHINE.

No. 805,608. Specification of Letters Patent. Patented Nov. 28, 1905.

Application filed March 21, 1905. Serial No. 251,188.

*To all whom it may concern:*

Be it known that I, BRUCE CLARK WHITE, a citizen of the United States, residing at Mosgrove, in the county of Armstrong and State of Pennsylvania, have invented or discovered new and useful Improvements in Glass-Rolling Machines, of which the following is a specification.

My invention has relation to machines for rolling a plurality of glass sheets separately and uniting them into a single sheet with or without an included wire-netting or other open metal network.

My invention has also relation to certain details of construction.

It is the object of my invention to produce a single sheet of glass by forming separate sheets of glass between separate pairs of rolls and then uniting the sheets by means of another pair of rolls and, if desired, simultaneously including a woven or twisted wire netting or its equivalent open metal network in the finished sheet.

My invention has in view other objects whereby the glass may be conveyed from the forming-rolls at the desired speed and transferred to a leer or leers.

Other objects will appear in the description to follow.

Referring to the drawings, Figure 1 is a side elevation of my invention, the lower portion of the conveyer being broken off; Fig. 2, a plan thereof; Fig. 3, an elevation of the side of my machine opposite that shown by Fig. 1, parts being in section; Fig. 4, a cross-section on the line 4 4 of Fig. 3; Fig. 5, a left-hand end view of the upper part of Fig. 1; Fig. 6, a sectional detail showing the means for locking together the shafts 29 and 37, and Fig. 7 a fragmentary sectional detail showing the movable guide for the glass beneath one of the lower rolls.

On the drawings I show three pairs of rolls 1 2 and 3 4 and 5 6, the pairs 1 2 and 3 4 being preferably in the same plane and the pair 5 6 arranged in such relation to the other two pairs that the space or pass between the pair 5 6 is between the planes of delivery of the pairs 1 2 and 3 4. The necks of the rolls 1 to 4 are provided with gear-wheels 7, meshing with the worms 8 on the shaft 9, which has thereon the fixed and loose pulleys 10 and 11, driven by the belt 12.

13 is a shifter for the belt 12.

The shaft 9 carries a spur-gear 14, meshing with the idler 15, which in turn meshes with the spur-gear 16 on the shaft 17. The latter has the worms 18, which mesh with the gear-wheels 19 on the necks of the rolls 5 and 6. The relative speeds of the upper and lower rolls can be varied by substituting for the gear-wheels 14 and 15 other wheels of different sizes.

The journal-blocks of the upper rolls are located between the parallel pairs of bars 20 on the top of the frame-castings 21, resting on the I-beams 22. The journal blocks or boxes of the rolls 2 and 3 are stationary, while the journal-blocks of the rolls 1 and 4 are adjustable toward and from their companion rolls by means of the screws 23, journaled in the blocks 24 between the ends of the bars 20, the screws working in the bosses 25 on the blocks. The outer ends of the screws carry sprocket-wheels 26, connected by the chains 27 to the sprocket-wheels 28 on the shaft 29, which is operated by the hand-wheel 30, as shown on Fig. 5.

The journal blocks or boxes of the lower rolls 5 and 6 are supported between the bars 31, secured to the lower ends of the castings 21, the roll 5 being shown adjustable toward and from the roll 6 by means of the screw-shafts 32, working in the bosses 33 on the journal-blocks. The shafts 32 are provided with sprocket-wheels 34, geared by the chain 35 to the sprocket-wheel 36, which is secured to the tubular shaft 37, sleeved on the shaft 29. The shaft 37 has one end slit longitudinally and threaded, and on the threads runs the nut 38, by which the slit end of the shaft may be contracted, so as to frictionally unite the shafts 29 and 37. The sprocket-wheel 36 is preferably twice the diameter of the wheel 28.

Supported by the upper bars 20 are two hoppers 39 and 40, the former located above the rolls 1 and 2, so as to feed molten or plastic glass down between said rolls, and the latter arranged to feed glass down between the rolls 3 and 4.

The castings 21 support the brackets 41, having slots in which the two guides 42 are secured and adjusted. These guides lead one from the pass of the rolls 1 and 2 to the pass of the rolls 5 and 6 and the other from the pass of the rolls 3 and 4 to the pass of the said rolls 5 and 6.

Leading from the pass of the rolls 5 and 6 is the roller-feed table 43. It has the parallel side plates 44, to the under side of which are journaled the lower set of rollers 45, all lying

transversely of the table and parallel to each other. The necks of these rollers are provided with bevel gear-wheels 46, which mesh with the bevel gear-wheels 47 on the shaft 48. The latter is driven by the bevel gear-wheel 49 thereon, which meshes with the gear-wheel 50 on the drive-shaft 51, carrying the fixed and loose pulleys 52 and 53, actuated by the belt 54. The shifter 55 serves to move the belt from one to the other of said pulleys. Each of the rollers 45, save the upper one, which coöperates with the roll 6, has above it a companion roller 56, journaled in a swinging frame 57, pivoted on the bolts 58. The rollers are preferably driven by the gear-wheels 59, connecting the pairs of rollers. The rollers 56 are counterweighted by adjustable weights on the arms 60 of the frames 57. Between each successive two of the rollers 45 is a guide 61 to support and guide the glass from one roll to another, and between the roll 5 and the upper roller 45 is the guide 62. The guide 62 is secured to the bar 63, having the slotted ears 64 secured to the bottom bars 31. The bar 63 is secured by the links 65 to the levers 66, having their upper ends in the path of possible outward travel of journal-blocks of the roll 5. If ribbed or other figured glass is to be made, the lower of the rolls 45 will be correspondingly ribbed or figured, as will be readily understood.

At the outer end of the table 43 is a preferably tilting table 67, operated by the handle 68 or otherwise. When in one position, this table is in line with the pass between the rollers of the table 43, but when shifted it is in line with the table or ledge 69, leading to the leer 70 or other place of deposit, from which table the glass may be shoved horizontally into the leer.

Preferably I cover all the hoppers, the guides 42, 61, and 62, the rolls 1 to 6, the rollers 45 and 56, and the table 67 with carbon, as indicated by layers of black on these several elements of my machine. I find that carbon has a very low conductivity for heat as compared with iron and steel, and so prevents the glass which is in contact therewith from hardening so rapidly. Its coefficient of expansion is so small as to be negligible with the temperatures used, which prevents it from breaking and the gage of the glass is preserved in thickness. The friction of glass with carbon is very decidedly less than with metal, permitting the glass to flow freely without being marked, as when it flows or travels over iron or steel surfaces. The carbon is very porous and acts as if air in the pores keeps the glass from actual contact with the carbon.

The operation is as follows: The wire 71 or equivalent fabric or structure is fed through the guide 72 between the rolls 2 and 3 and is supported with its lower end between or very close to the rolls 5 and 6. Molten glass is poured into the hoppers 39 and 40 and the shifter operated to start the rolls 1 to 6. The shifter 55 is also operated to drive the rollers 45 and 56, which may be allowed to run continuously, if desired. The glass in the hoppers runs down between the two pairs of forming-rolls, forming the two sheets 73, which slide along the guides 42 toward and into the pass of the rolls 5 and 6, where the two sheets unite into the sheet 74 and take the wire fabric 71 along with them through the pass between the rollers 45 and 56, which deliver the sheet of wire-glass upon the inclined table 67. The rolls will be stopped when the glass leaves them; but the rollers may be allowed to rotate. As soon as the glass has been delivered from the table 43 the table 67 is shifted so as to be in line with the table 69, when the sheet is put into the leer or other desired place. If the glass should be delivered faster than the leer could anneal it, the table 67 could be made slidable transversely, so as to deliver to other leers. The foregoing details of operation refer to glass sheets of definite or short lengths; but the apparatus is capable of use with wire fabrics of any length, the table 43 delivering to the leer or elsewhere without the employment of the pivoted table 67. The weights on the arms 60 will be adjusted to give the pressure required on the glass, and the speeds of the rollers can be varied to suit the conditions, as they are driven independently of the rolls. The rollers serve to support, feed, smooth, and flatten the sheets and deliver them to the table 67. Other sheets are made as above described, the operation being carried on indefinitely. The rolls 1 and 2 and 3 and 4 can be adjusted as desired by the rotation of the wheel 30 and the roll 5 adjusted in the same manner if the nut 38 has been rotated to unite the shafts 29 and 37. By making one set of rolls adjustable the thickness of the glass delivered from the upper to the lower rolls can be varied relatively to the size of the pass between the lower rolls. When the ratio of the passes between the upper and lower rolls has been obtained, different thicknesses of glass may be made without disturbing the ratio by turning the wheel 30, first tightening the nut 38, because the adjustment of the roll 5 is the sum of the adjustments of the rolls 1 and 4. If for any reason it be desired to pass the glass from the rolls 5 and 6 without allowing it to go down the table 43, it can be done by pushing the guide 62 against the roll 6, leaving a free open space for its escape below. If the hand-wheel 30 be operated to cause the roll 5 to operate the lever 66, the guide 62 will be moved against the roll 6. The rolls will then be separated widely, and all material between them will readily pass out without entering the table 43.

In order to cool the rolls, I make them hollow and provide a water circulation therein

as follows: I make the necks of each roll hollow and close one neck by the plug 75 or otherwise. Through the opposite neck I introduce a pipe 76, which extends toward or to the opposite end of the roll. The pipe does not fit the neck closely, so that the water which flows into the roll through the pipe 76 flows out through the open neck of the roll into the trough 77, delivering into the waste-pipe 78. The cooling of the rolls prevents the metal shell from expanding and cracking the carbon cylinder secured upon it.

In continuous rolling of metal where a series of two or more rolls operate in succession, each producing a reduction, it is necessary that each succeeding pair of reducing-surfaces should have a speed higher than that of the preceding surfaces proportional to the reduction effected by the succeeding pair; otherwise the metal between the two pairs of surfaces will be thickened up or will be caused to bend and form a loop. To prevent such thickening or distortion of the glass as it passes between the sheet-forming roll to the pressing-rolls, provision is made for driving the pressing or lower rolls at a higher speed than the forming-rolls proportional to the reduction in thickness produced by the pressing-rolls, so that there may not be any distortion of the sheets. If a stretching action is required, the speed of the pressing-rolls may be increased beyond that required to compensate the reduction effected by them. The speed of the pressing-rolls can be varied by removing wheels 14 and 15 and substituting wheels of different size. This compensation for reduction is effected by the compressing-rolls where two pairs of rolls are employed forming two sheets and one of said pairs is also employed for pressing the two sheets together. This will be readily understood when it is considered that the portions of the pair of rolls which compress the sheets have the same peripheral speed as the portions which form the sheets, and as reduction must occur during the pressing the pressing portions of the rolls will not take the sheets away as fast as they are fed thereto. Hence the space between the pressing and forming portions of the rolls will be filled quickly. The lower rolls may be made longer than the upper rolls to receive the sheets as they widen under the action of said rolls.

In order to protect the metal network 71 from the heat and consequent oxidation, I may provide the shields 75 of refractory material, as shown in Fig. 3.

If preferred, ribbed glass may be made by making the highest roller 56 ribbed and removing the remaining upper rollers or providing them with a very soft material which would not injure the glass.

Though I have described my invention with considerable detail, I do not desire to be restricted to the details and combinations described, as the principles involved may be variously adapted; nor do I desire to be restricted to the making of wire-glass or the like, as the wire may be omitted.

Having described my invention, I claim—

1. In a machine for rolling glass sheets, two pairs of horizontal rolls, each pair being arranged to roll a sheet of glass from a mass of molten glass, in combination with a pair of horizontal rolls arranged to receive the two sheets so formed and to unite them while plastic into one sheet.

2. In a machine for rolling glass sheets, two pairs of horizontal parallel rolls, each pair being arranged to roll a sheet of glass from a mass of molten glass, in combination with a pair of rolls so placed as to receive between them the sheets so formed and unite the said sheets between the meshes or strands of woven or twisted wire or other open metal network.

3. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, means for rotating the said two pairs of forming-rolls at the same speed and independent means for rotating the said receiving-rolls at a speed different from that of the forming-rolls.

4. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, means for rotating the said two pairs of forming-rolls at the same speed, independent means for rotating the said receiving-rolls at a speed different from that of the forming-rolls, and means for adjusting the speed of the receiving-rolls in relation to that of the forming-rolls.

5. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, and means for adjusting the space between the two rolls of each pair simultaneously.

6. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, and means for adjusting the space between the receiving-rolls independently of the forming-rolls.

7. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, means for adjusting the forming-rolls and means for adjusting the receiving-rolls, and means for connecting the two adjusting means so that both forming and receiving rolls may be adjusted simultaneously.

8. In a machine for rolling glass sheets, two

pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, means for adjusting the forming-rolls, means for adjusting the receiving-rolls, and means for connecting the two adjusting means so that both kinds of rolls may be adjusted simultaneously, the adjustment of the receiving-rolls being made proportional to that of the forming-rolls.

9. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, and guides to receive the two sheets from the forming-rolls and deflect them toward the space between the receiving-rolls.

10. In a machine for rolling glass sheets, an inclined finishing-table, and a receiving-table to receive the sheets from the inclined table, the receiving-table movable in line with the inclined table and also into a horizontal position.

11. In a machine for rolling glass sheets, two pairs of forming-rolls, each pair being arranged to roll a sheet of glass between them, a pair of receiving-rolls arranged to receive and unite said sheets, and a secondary roll coacting with one of the receiving-rolls to deflect the sheet.

Signed at Pittsburg, Pennsylvania, this 18th day of March, 1905.

BRUCE CLARK WHITE.

Witnesses:
ANNA R. BEATTY,
ELVA STANIEH.