Sept. 11, 1928. 1,684,029

G. E. HOWARD

METHOD AND APPARATUS FOR POLISHING GLASS

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Fig. 1.

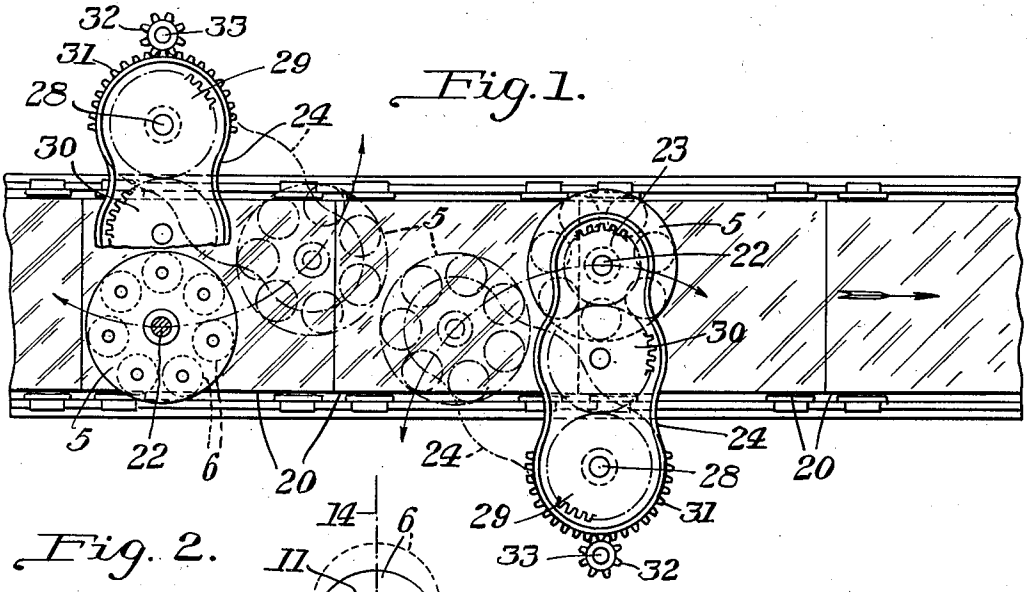


Fig. 2.

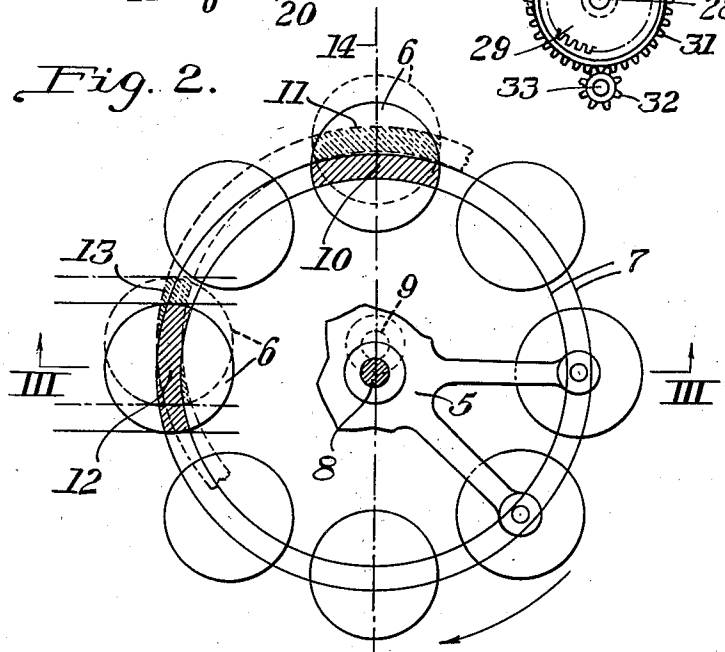
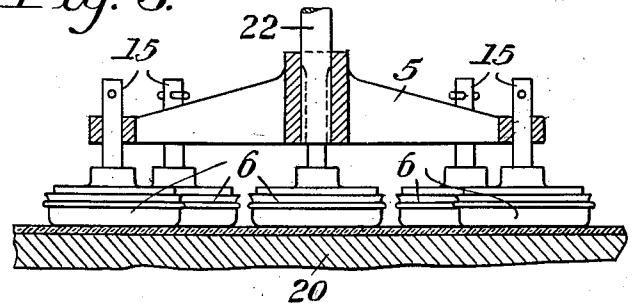


Fig. 3.



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Fig. 4.

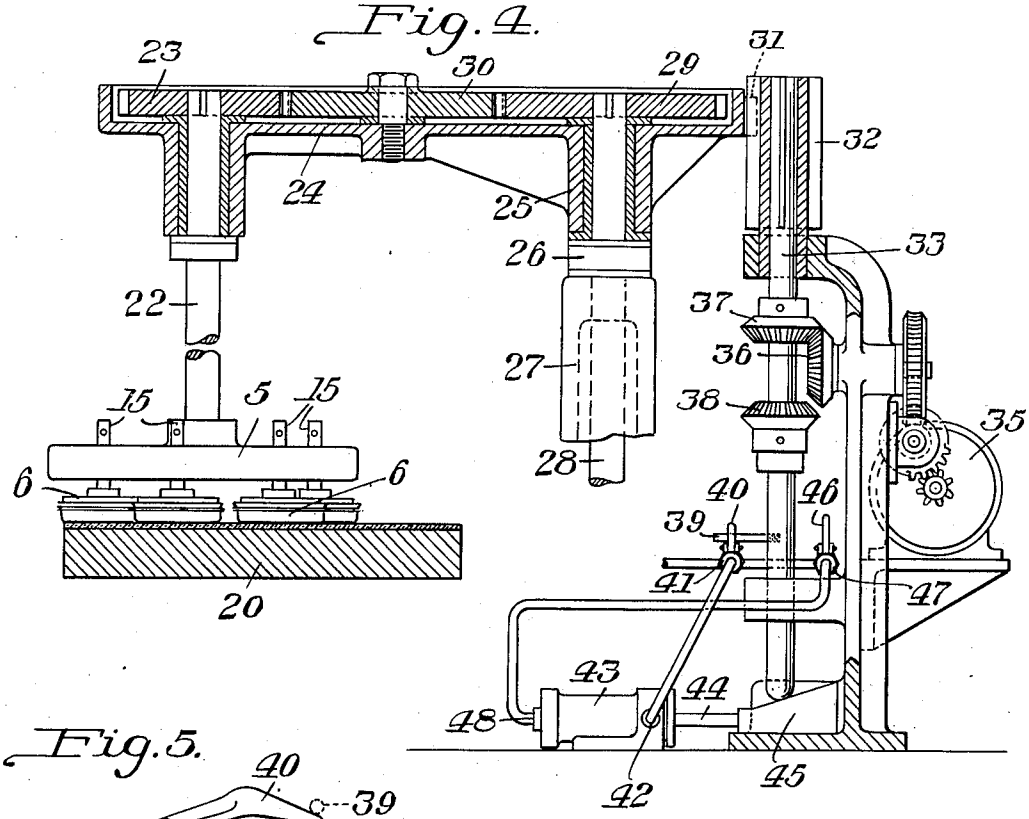


Fig. 5.

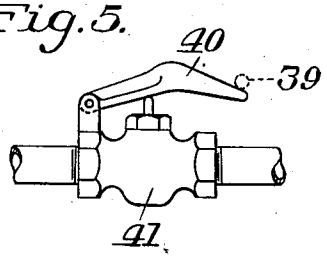
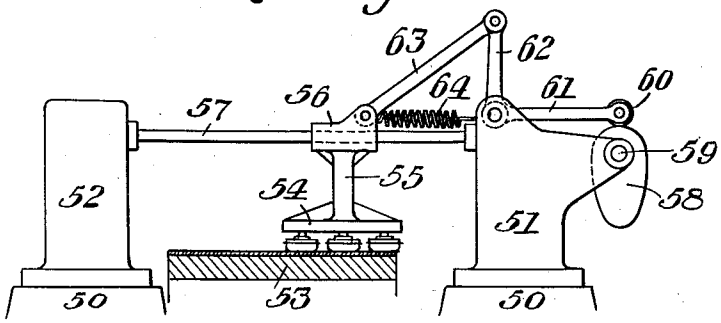


Fig. 6.



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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR POLISHING GLASS.

Application filed December 11, 1926. Serial No. 154,254.

My invention relates to methods and apparatus for polishing glass, and particularly plate glass.

In the grinding of plate glass by what is known as the continuous method, which involves the passing of grinding tables under a rotatable grinder, it is common practice to employ a series of tables connected at their adjacent ends in order to provide a continuous movement of glass past rotatable grinder heads. The same system can be employed in connection with the polishing of the sheet after it has been ground.

However, difficulty has been experienced in polishing glass by said method, because some portions of the glass sheets are subjected to a greater amount of polishing action than is desirable or necessary, and such portions may become overheated with resultant breakage of the glass, or the polishing thereof has to be continued until the more slowly polished portions of the sheet have become fully polished.

My invention has for one of its objects the provision of a method and a means whereby a substantially uniform polishing operation may be performed upon a longitudinally moving sheet of glass in all of the longitudinal zones thereof.

Another object of my invention is to provide a means and a method whereby a sheet of glass may be uniformly polished, throughout its entire surface, by a rotatable polisher.

This application is filed as a substitute for my application, Serial No. 91,348, filed March 1, 1926.

Some of the forms of apparatus by which my invention may be practised are shown in the accompanying drawings, wherein Figure 1 is a plan view of one form of polishing mechanism which I may employ; Fig. 2 is a diagrammatic view illustrating the theory of my invention; Fig. 3 is a view taken on the line III—III of Fig. 2; Fig. 4 is an elevational sectional view of a portion of the apparatus of Fig. 1; Fig. 5 is an enlarged detail view of a portion of the reversing valve mechanism of Fig. 4, and Fig. 6 is a view showing a modified form of apparatus for moving a polishing head across a sheet of glass.

In order that the operation of the devices of Figs. 1 to 4 may be more clearly understood, I will first refer to Fig. 3 wherein is shown a rotatable head 5 that carries a series of polishing blocks 6 which are arranged in a horizontal plane in position to operate upon sheets of glass that pass beneath the same. While the sheet of glass will be ordinarily moved slowly past the polishing head 5, I will assume that it is stationary. If the polishing head 5 be then rotated, it will be seen that an annular portion of the plate that is disposed between the circles 7 will be polished substantially equally at all circumferential points since all portions of such annular zone are in contact with an equal quantity of polishing felt. However, since the sheet of glass is constantly moving during its travel, as from a point 8 to a point 9, a section 10 of the circle will move to a position 11, and a section 12 will move to a position 13. The section 10 during such movement is subjected to only substantially one-half the polishing action of the section 12, since the section 10 is moved in a direction substantially radially of the polishing head, while the section 12 is moved tangentially thereof. It will be apparent therefore that that portion of the glass which is adjacent to the longitudinal center line 14 of the sheet will be in contact with the polishing heads for a shorter period of time than the portions of the sheet to each side thereof. During this traveling movement of the table although portion 10—11 will twice come in contact with the polishing head, yet the overlapping of zones at 12 and 13 will give greater polishing effect on particular spots at least, than on those portions in the zone 10—11. In addition to this principle there is a differential in the effect, as between a large polishing head and a small polishing head. Assuming that the polishing surface extended substantially the full width of the polishing head, the polishing effect at the center of the head would be practically nil, and there would be excessive polishing action adjacent to the periphery of the polishing head.

Such an arrangement would be unsuitable, not only because of the difference in rate of travel as between the inner and outer portions of the polishing surface, but because there would be a wide difference in temperature as between that portion of the glass beneath the middle of the polisher and the edge portions thereof. Uniformity of temperature is highly desirable, and in fact essential, in the polishing of glass, because the smoothing effect is obtained by a "flowing" of the surface particles of the glass sheet, as

distinguished from the abrasion or breaking away of protruding particles of glass in a grinding operation.

Even distribution of the effective zone of the polishing action over the surface of the glass is essential because a substantially uniform heating effect must be produced in order to secure the proper surface flow of the glass in polishing, as well as to prevent overheating of portions thereof, and consequent cracking.

Ordinarily, the greater the diameter of the polishing head, the greater the difference between the polishing action under the mid portion of said head, and the polishing action adjacent to the periphery thereof. By the arrangement here shown and described, I secure substantial uniformity of polishing on all those portions of a sheet which pass beneath the polishing heads. To contribute to this result, I provide a series of pads 6 upon the rotatable head 5, arranged in annular formation as above described, and each pad having individual rotative movement upon the head 5. Each pad 6 is provided with a shaft-like extension 15 that is rotatably mounted in the framework of the polishing head 5. As the head 5 is rotated, there will be a differential in frictional force upon the undersides of the pads 6, as between those portions of the pads which are most remote from the axis of the head 5, and those portions which are nearer to such axis, so that the pads will rotate slowly on their respective axes, and their contacting surfaces will be worn uniformly.

In Figs. 1 and 4, I have shown one means for moving polishing heads laterally of advancing glass-carrying tables 20, in order to effect uniform polishing of the glass sheets carried by such tables. Two polishing heads 5 are shown that are mounted upon depending shafts 22 to the upper ends of each of which a gear wheel 23 is secured. The gear wheels 23 of the shafts 22 are carried in housings 24. Each of these housings is provided with a hub portion 25 that is supported upon a collar 26 that in turn rests upon a pillar 27. The collar 26 is secured to a shaft 28 that is driven by any suitable means (not shown) and carries a gear wheel 29 which meshes with a second gear wheel 30 that is journaled in the housing 24. As the shaft 28 rotates, the polishing head 21 is caused to turn with its shaft 22.

In order to facilitate oscillatory movement of each of the housings 24 and the polishing head carried thereby, in a manner indicated by the curved arrows in Fig. 1, I provide teeth 31 upon one edge of the housing, in position to mesh with a wide faced pinion 32 that is supported on the vertical shaft 33. The lower end of the shaft 33 is supported by a wedge-shaped block 45. The shaft 33 is driven by a motor 35 that drives a bevel pinion 36 that meshes with bevel gear wheels 37 and 38 alternately. The gear wheels 37 and 38 are connected to the shaft 33.

Upon energization of the motor 35 the pinion 36, by reason of its engagement with the gear wheel 37, for instance, causes the housing 24 to swing about the shaft 28 as an axis. When the housing 24 has reached one extremity of its movement, the arm 39 that is secured to the shaft 33 engages a valve-operating lever 40 that admits pressure through a valve 41 to an opening 42 in the cylinder 43, to move a piston (not shown) forwardly. The forward movement of the piston carries with it a piston rod 44 and the wedge block 45. The block 45 slides beneath the shaft 33 and raises the shaft so that the bevel gear wheel 38 is brought into engagement with the pinion 36, at the same time breaking driving connection between the gear wheel 37 and the pinion 36. The shaft 33 is then caused to rotate in the opposite direction, to effect return movement of the polishing head. When the housing 24 and the polishing head reach their other extremity of movement, the arm 39 operates the valve lever 46 of a valve 47, to admit pressure to the forward end 48 of the cylinder 43 and cause retractive movement of the block 45, thus permitting the shaft 33 to move down and start another cycle of movement.

For any given set of conditions, such as width of table, size and location of polishing discs, the regulation of the degree of lateral motion coupled with the overlapping of the disks can be arranged so that a practically uniform effect can be produced, and having ascertained the best travel for these discs and the best period of time for each position of its lateral travel, then it is possible to employ some form of cam motion such as shown in Fig. 6, whereby the lateral travel of these discs will be automatically confined to the preferred degree of movement or cycle. This degree or phase of longitudinal travel would be so worked out that where the overlapping of the discs tended to reduce unevenness of polishing, a longer dwell would be given to the discs in this particular lateral position. Where the polishing action would tend to unevenness, then the dwell at these points would be reduced. As the conditions of polishing are dependent upon a number of factors to secure the best results, it will be necessary to determine the exact phase of this lateral travel from the effects of the polishing, but it will be understood that this invention contemplates broadly such variations in said factors and travel as will give the maximum results.

Referring more in detail to Fig. 6, the numerals 50 represent bases upon which supporting brackets 51 and 52 are mounted at opposite edges of a glass grinding table 53. A polishing head 54 is provided with a stem

55 that is secured to a slide block 56 which is slidably mounted upon a bar 57 whose ends are secured to the brackets 51 and 52.

A cam disc 58 is secured to a shaft 59 that is driven from any suitable source of power (not shown). The cam 58 has operative engagement with a roller 60 which is mounted upon one arm of a bell crank lever 61. The bell crank 61 is pivotally connected to the bracket 51 and has an arm 62 which has pivotal connection with a link 63 that is in turn pivotally joined to the sliding block 56. A tension spring 64 acts on the block 56 to maintain the roller 60 in engagement with the cam.

It will be observed that as the cam rotates, the polishing head 54 will be moved across the table in one direction, and that it will be returned to its starting position by the spring 64. The cam can be of such irregular form as will result in the desired variation of speed of travel of the mirror head at various stages of its movements.

I claim as my invention:—

1. The method of polishing sheet glass, which comprises advancing a sheet of glass beneath a polishing unit composed of a rotatable head upon which a series of freely rotatable polishing pads are disposed concentrically to the axis of the head, and traveling said head transversely of the path of movement of the glass a distance not materially less than one-half the diameter of the head.

2. The method of polishing sheet glass, which comprises advancing a sheet of glass beneath a polishing unit composed of a rotatable head upon which a series of freely rotatable polishing pads are disposed concentrically to the axis of the head, and traveling said head transversely of the path of movement of the glass a distance not materially less than one-half the diameter of the head, the diameter of the polishing unit being more than one-half of the width of the glass, and less than the width of the glass.

3. The method of polishing sheet glass, which comprises advancing a sheet of glass beneath a polishing unit composed of a rotatable head upon which a series of polishing pads are disposed concentrically to the axis of the head, and traveling said head transversely of the path of movement of the glass a distance not materially less than one-half the diameter of the head, the polishing unit being of such diameter that it simultaneously operates upon a portion of the glass adjacent to the edge thereof, and a portion adjacent to the longitudinal center line.

4. The method of polishing sheet glass, which comprises advancing a sheet of glass beneath a polishing unit composed of a rotatable head upon which a series of polishing pads are disposed concentrically to the axis of the head, and traveling said head transversely of the path of movement of the glass a distance not materially less than one-half the diameter of the head, the polishing units being of such diameter that they simultaneously operate upon a portion of the glass adjacent to the edge thereof, and a portion adjacent to the longitudinal center line, at one end of its path of reciprocatory movement, and operating upon the opposite edge of the glass and the said mid portion thereof at the opposite end of its path of movement.

5. The combination with means for imparting traveling movement to a sheet of glass, of polishing apparatus, comprising a head, means for rotating said head, a series of freely rotatable polishing pads on said head disposed circumferentially of the axis thereof, and a cam for reciprocating said head transversely of the path of the glass, the cam being of such size that the head will be moved a distance not materially less than one-half of its diameter.

6. The combination with means for imparting traveling movement to a sheet of glass, in one direction only, in a straight path, of a polishing head, means for rotating said head, a series of freely rotatable polishing pads on said head disposed circumferentially of the axis thereof, and a cam for reciprocating said head transversely of the path of movement of the glass, the cam being of such size that the head will be moved a distance not materially less than one-half of its diameter.

Signed at Hartford, Conn., this 30th day of November, 1926.

GEORGE E. HOWARD.