Feb. 21, 1933. H. K. HITCHCOCK 1,898,012

GLASS GRINDING MACHINE

Filed Feb. 11, 1930 4 Sheets-Sheet 1

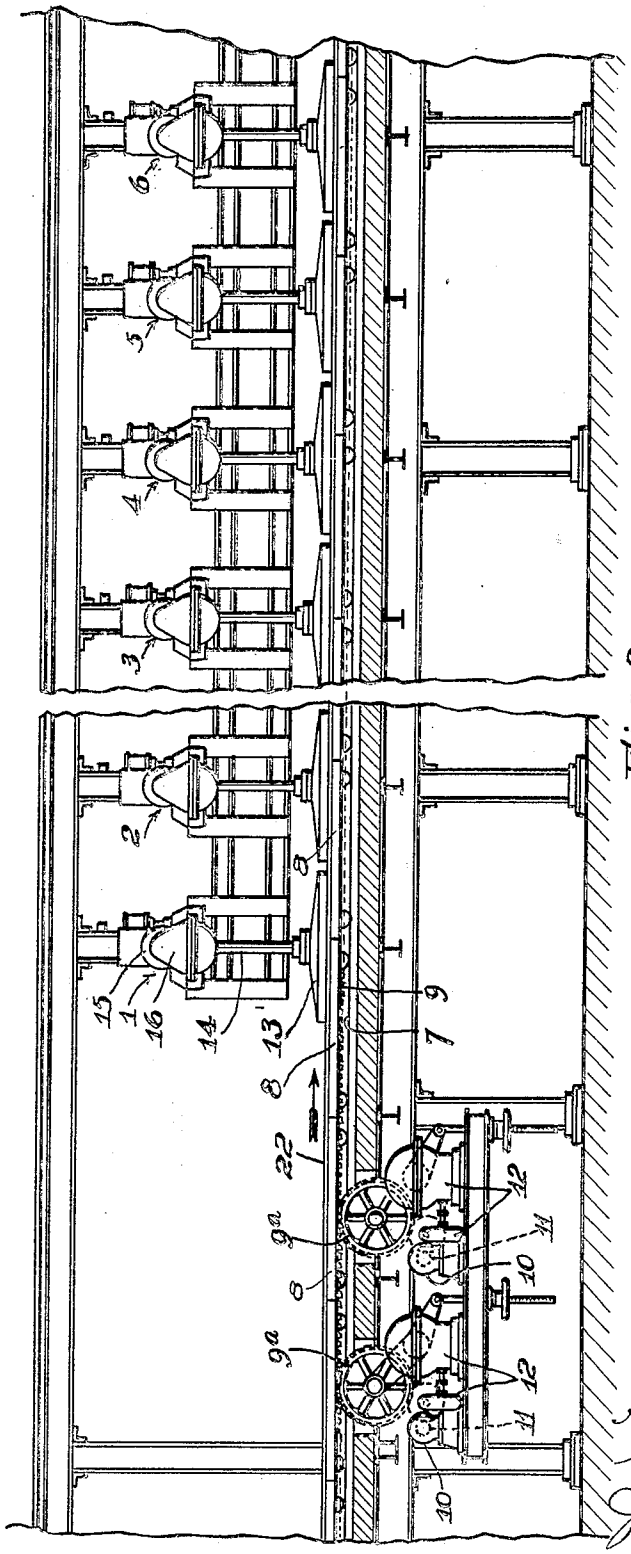


Fig. 1.

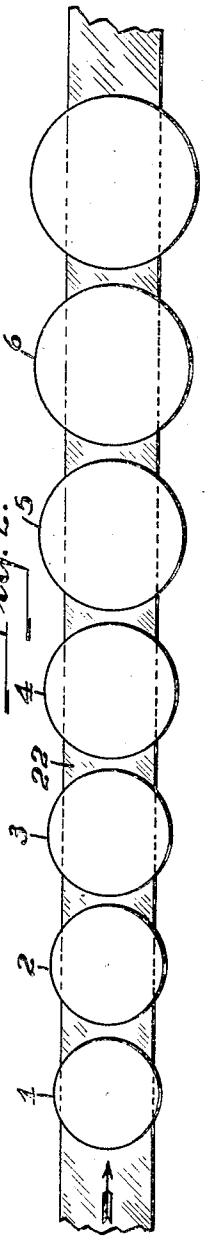


Fig. 2.

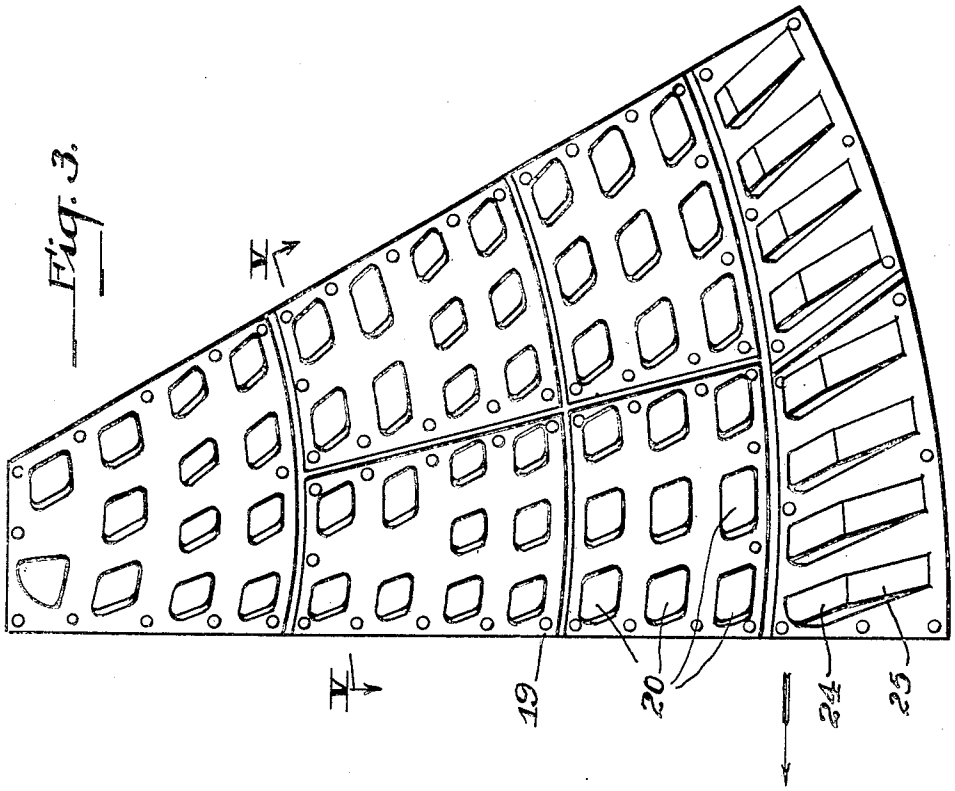
INVENTOR
H. K. Hitchcock
by
J. C. Bradley
Atty

Feb. 21, 1933. H. K. HITCHCOCK 1,898,012

GLASS GRINDING MACHINE

Filed Feb. 11, 1930 4 Sheets-Sheet 2

Fig. 3.



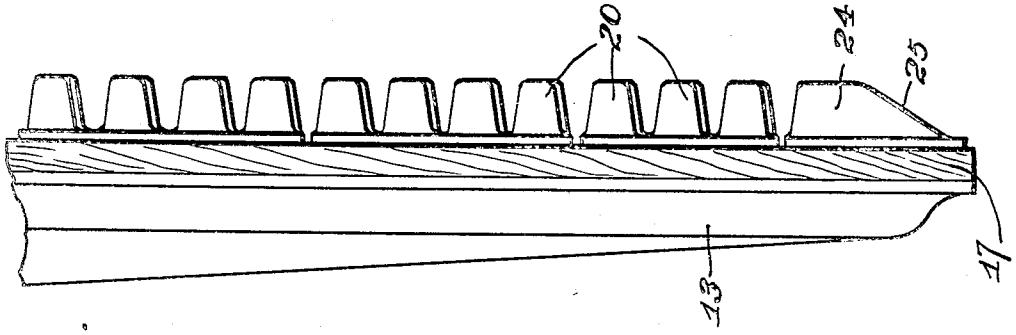


Fig. 4.

INVENTOR
H. K. Hitchcock
by
James C. Bradley
Atty

Feb. 21, 1933. H. K. HITCHCOCK 1,898,012

GLASS GRINDING MACHINE

Filed Feb. 11, 1930 4 Sheets-Sheet 3

Fig. 5.

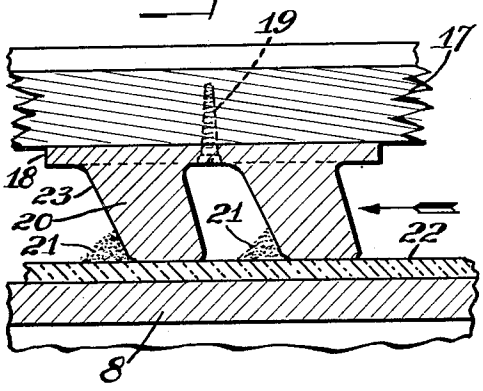


Fig. 6.

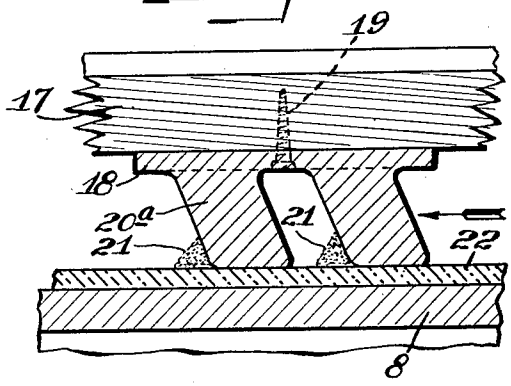


Fig. 9.

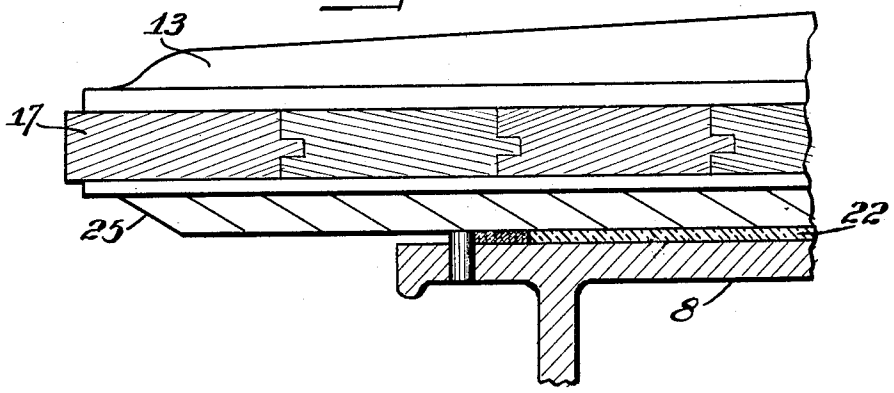
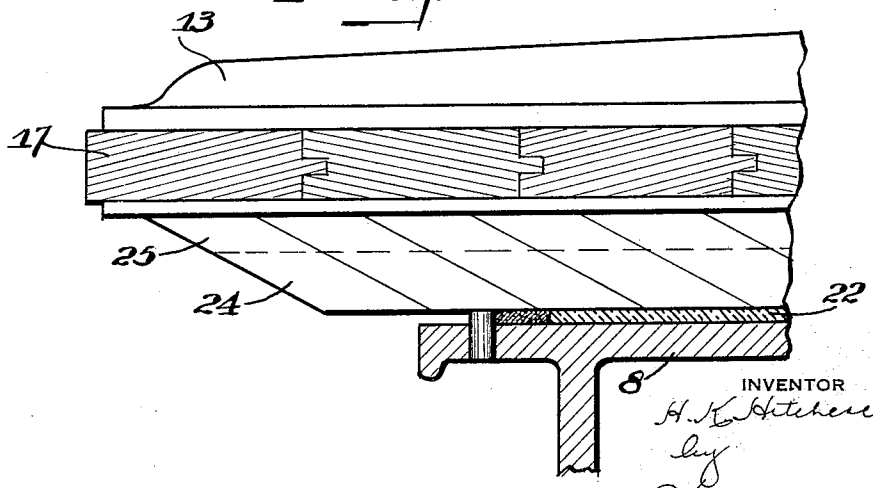


Fig. 8.



INVENTOR

H. K. Hitchcock

by

James G. Bradley

Atty

Feb. 21, 1933. H. K. HITCHCOCK 1,898,012

GLASS GRINDING MACHINE

Filed Feb. 11, 1930 4 Sheets-Sheet 4

Fig. 7.

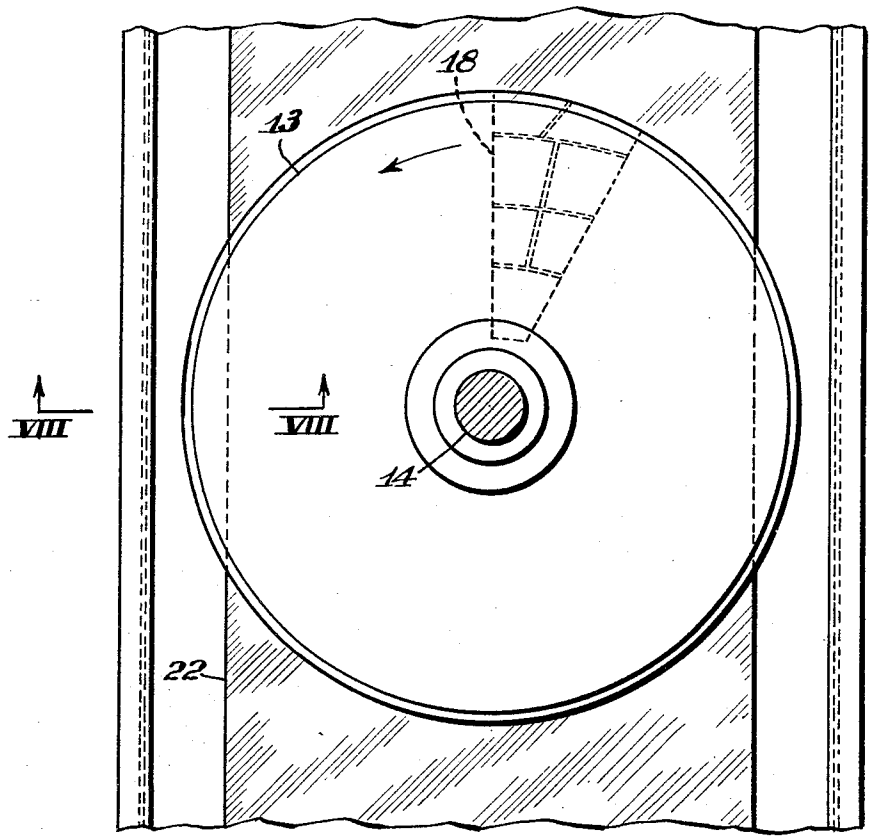
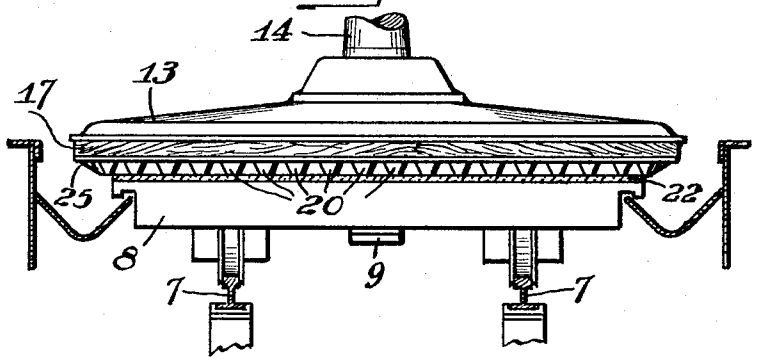


Fig. 10.



INVENTOR
H. K. Hitchcock
by
James C. Bradley
atty

Patented Feb. 21, 1933 1,898,012

UNITED STATES PATENT OFFICE

HALBERT K. HITCHCOCK, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO PITTSBURGH PLATE GLASS COMPANY, A CORPORATION OF PENNSYLVANIA

GLASS GRINDING MACHINE

Application filed February 11, 1930. Serial No. 427,583.

The invention relates to glass grinding machines and particularly to those used in the so-called "straight away" surfacing apparatus in which the sheets of glass to be surfaced are placed upon the top of a series of tables or cars and passed beneath the runners of a series of grinding and polishing machines. The invention is not limited in use, however, as to all its features to such straight away surfacing operation. It has for one of its objects the provision of grinding apparatus of the type specified and employing single runner machines in which a better "smooth" is secured along the side edges of the glass sheets than has heretofore been secured and substantially free from runner scratches along such edges. A further object of the invention is the provision of a runner in the use of which the chipping of the glass sheets along their edges is reduced to a minimum. A still further object is the provision of an improved runner, the grinding blocks of which are so shaped as to increase the tendency of the abrasive to work therebeneath during the grinding operation and one in which the area of the runner blocks exposed to grinding contact with the glass is increased as the blocks wear away, thus decreasing the pressure between the glass and the runner blocks per unit of area of the blocks. This is a desirable condition in a system in which the runners are shifted progressively as they wear down from the forward end of the system toward the rear end of the system, as rapid rough grinding is insured, due to relatively high pressure per unit area of grinding contact at the beginning of the operation, combined with freedom from scratches further along in the grinding operation, due to reduced pressure per unit area of grinding contact in such further grinding operation. Certain embodiments of the invention are illustrated in the accompanying drawings, wherein:

Figure 1 is a side elevation showing a part of a grinding system embodying the invention. Fig. 2 is a diagrammatic plan view. Fig. 3 is a partial bottom view of one of the grinding runners constructed in accordance with the invention. Fig. 4 is a side elevation of the construction of Fig. 3. Fig. 5 is a section on the line V—V of Fig. 3. Fig. 6 is a section similar to that of Fig. 5 through a modification. Fig. 7 is a diagrammatic plan view. Fig. 8 is a section on the line VIII—VIII of Fig. 7. Fig. 9 is a section similar to that of Fig. 8 after the grinding face of the runner has been worn down. And Fig. 10 is an end elevation partially in section of the construction of Fig. 7.

Referring first to the general arrangement as shown in Fig. 1, 1, 2, 3, 4, 5, 6, etc. are a plurality of grinding machines arranged in series above the track 7. Mounted on the track 7 are a series of tables 8, 8, 8, etc. placed end to end in abutting relation and provided on their lower sides with racks 9 by means of which the tables are fed continuously forward from left to right, tables being supplied at the left hand end of the system as they are removed from the right hand end thereof. The glass sheets to be surfaced are embedded in plaster on the tops of the tables, so that the series of cars constitute in effect a continuous grinding table. The racks are driven by two spur wheels 9*a*, 9*a* at the left hand end of the track, such gears being in turn operated from the motors 10, 10 through the spur gears 11, 11 and suitable reduction gearing in the casings 12, 12. The two motors are used merely to take care of an emergency which might arise due to the failure of a single drive motor. The grinding machines each comprise a runner frame 13 driven from a spindle in the tubular casing 14, such spindle being in turn driven from a motor 15 through suitable reduction gearing in the casing 16. The runner and drive mechanism constitutes a removable unit suitably counterbalanced and preferably constructed as to detail in accordance with the machine of the Evans Patent No. 1,577,457. The details of the driving mechanism for the runner constitute no part of the present invention, the primary requirement as to this construction being that it may be readily removed from its support so that the units

may be shifted from one position in the system to another for the purpose as hereinafter more fully set forth.

The construction of the runner will be seen by reference to Figs. 3 to 7. It comprises a metal frame 13 to the under side of which is secured a wood platform 17 which in turn supports the runner bars 18 secured to the platform 17 by means of the screws 19. The runner bars 18 are of varying shape, as will be seen by reference to Fig. 3, which shows $\frac{1}{12}$th of the entire runner bar construction, but each comprises a metal plate carrying from four to thirteen downwardly projecting blocks 20 which are approximately all of the same shape. These blocks are approximately trapesoidal in horizontal cross section and are inclined as indicated in Fig. 5. They also preferably increase in horizontal cross section from their lower to their upper ends, as indicated in Fig. 5. In operation sand or other abrasive is supplied near the center of the runner and is distributed outwardly by centrifugal force through the passageways provided between the runner blocks. The runner is driven in the direction of the arrows shown in Figs. 3 and 5 so that the sand 21 (Fig. 3) is directed into the angular spaces between the surface of the glass sheet 22 and the inclined faces 23 of the blocks. Under these conditions, the sand works under the grinding faces of the runner blocks much more effectively than is the case where the side faces of the runner blocks are at right angles to the surface of the glass sheet as is the case in the ordinary runner block construction.

The runner blocks 20 are preferably increased in horizontal cross section from their lower to their upper ends, as indicated in Fig. 5, so that as the blocks wear down in service, a larger and larger area of metal is brought into contact with the glass sheet. This reduces the pressure between the blocks and the glass per unit of area of the block in contact with the glass. In operating the system, the runners as they become worn are shifted from their positions near the forward end of the grinding system to positions farther along the grinding system. The abrasive used in the system is supplied in accordance with well-established practice, the coarsest at the forward end of the system and becoming gradually finer along the series of tables as the grinding progresses. At the beginning of the operation, it is desirable to smooth off the surface of the glass as rapidly as possible and this is best accomplished with the coarsest abrasive upon which a maximum pressure is applied by the grinding blocks per unit of area of such blocks. Therefore, at the beginning of the operation, runners are employed whose blocks 20 have not been worn down so that the block area in contact with the glass is a minimum. Further along in the grinding operation, it is desirable to smooth the glass without scoring it too deeply by the abrasive and this is better accomplished with the worn runners whose grinding areas have been increased by the wearing down of blocks such as those shown in Fig. 5, wherein the cross sectional area increases from the lower to the upper ends of the blocks. The runner blocks shown in Fig. 5 are, therefore, desirable in carrying out an operation in which the runners are shifted after a period of use from the front end of the grinding system to a position farther along the series. If the runners are not to be shifted, blocks may be employed like those shown at 20*a* in Fig. 6 in which the cross sectional area of the blocks from their lower to their upper ends remains constant. In both cases, however, the blocks are inclined as shown so as to provide angular recesses between the forward faces of the blocks and the surface of the glass, thus promoting a movement of the abrasive between the faces of the blocks and the glass.

The peripheral row of grinding blocks 24 (Figs. 3 and 8) have their outer edges beveled away, as indicated at 25, thus differing from prior constructions in which the edges of these blocks were formed at right angles to the surface of the glass sheet being ground. I have found that the beveling of the blocks in this manner reduces breakage and chipping at the edges of the glass sheets. This chipping is apt to occur both at the side edges of the sheet and at the end edges due to the impact of the vertical edges of the peripheral blocks. This is particularly liable to occur at the end edges of the sheets where the edge of one sheet may lie slightly above the edge of the succeeding sheet. Under these conditions, the glass is liable to be chipped when the edge of the runner first strikes the high edge of glass. I have found that by beveling off the edges of the blocks, as indicated at 25, this chipping action is reduced to a minimum, since the blow which is struck the edges of the glass is a glancing or slanting one instead of the more positive blow which is struck by the edge of a runner which is perpendicular to the surface of the glass.

The beveling of the edges of the runner blocks also has another advantage incident to the system of shifting the runners along the line of grinding from the front, or rough grinding end, to the rear, or smoothing end, as heretofore referred to. With runners such as those shown in Fig. 7 which extend out past the edges of the glass sheet 22, the grinding effect of the runner is greater along the side edges of the glass sheets than it is along the portions of the sheets intermediate

such edges. As a result, during the rough grinding, the side edges of the sheets are ground down to a slightly lower level than the central portions of the sheets. The glass during this rough grinding operation is, of course, scored in accordance with the roughness of the abrasive and it is necessary in the subsequent grinding operation and in the final facing of the glass with emery preliminary to polishing to remove the scoring incident to the rough grinding. Since, as above pointed out, the edges of the sheets are ground down somewhat below the level of the center portions of the sheets in the rough grinding operation, in the subsequent smoothing operations with finer and finer abrasive, the runners do not have the same opportunity to act upon the edge portions of the glass as upon the center portions, so that when the glass is finally smoothed with the emery, it is found that the edge portions of the sheets do not have the same degree of "smooth" as the center portions. As a result, in the subsequent polishing operation, great difficulty is experienced in getting the edges properly polished, a defect being present known as "runner scratches", which runner scratches are the traces of the grinding operation which are not removed by the polishing machines. The beveling off of the edges of the grinders assists materially in eliminating the condition above described, since such beveling reduces the diameter of the grinding face of the runner so that in the coarse grinding operation, the edges are not given the additional grinding as above described which brings their level below the level of the center portions of the glass. As the grinding continues, the runners are, of course, worn away and are thus decreased in diameter due to the beveled edges, this condition being indicated in Fig. 9 which shows one of the runners after it has been worn down to a considerable extent. By arranging the runners along the line of grinding so that the runner bars gradually decrease in thickness from the front end of the series to the rear end, a condition is secured in which the diameters of the grinding faces of the runners gradually increase from the rough grinding end of the series to the fine grinding or facing end of the series.

This is illustrated diagrammatically in Fig. 2, the difference in diameter of the runners being exaggerated in order to illustrate the condition described. The runners are originally all of the same thickness and diameter, but in the course of service they become worn down so that it is possible after the grinding is once well under way to secure the desired gradation in thickness and diameter by progressively shifting the runners forward in the series of grinders as the operation continues. In other words, at certain intervals whose length can be determined by trial, all of the runners 1, 2, 3, 4, 5, 6, etc. are shifted ahead one step in the series and a new runner is added to take the place of the runner 1. Over-grinding of the edges of the sheets is thus avoided in the first portion of the series and later in the series the edges are given an increased amount of grinding and facing so that any scratches due to the rough grinding are eliminated along the edges of the sheets during the concluding portion of the grinding operation and the smooth secured along the edges of the sheets is made equal to that at their center portions. A comparison of Figs. 8 and 9 which show sections at the edges of the first and last runner respectively indicates clearly the change in diameter of the runners incident to the thinning of the runners by the grinding operation.

What I claim is:

1. A grinding apparatus for plate glass comprising a series of tables mounted for right line movement in a continuous train and adapted to carry the glass sheets to be surfaced upon their upper sides, and a plurality of grinding machines arranged in series above the tables and each provided with a horizontal driven disc runner whose periphery projects out past the side edges of the glass sheets, said runners having the diameter of their faces which contact with the glass progressively larger and larger from the front end of the series onward.

2. A grinding apparatus for plate glass comprising a series of tables mounted for right line movement in a continuous train and adapted to carry the glass sheets to be surfaced upon their upper sides, and a plurality of grinding machines arranged in series above the tables and each provided with a horizontal driven disc runner whose periphery projects out past the side edges of the glass sheets, said runners all being of the same diameter, but having their corners at the peripheries of their grinding faces bevelled away, and being of progressively decreasing thickness from the front end of the series on, so that the diameters of the faces of the runners contacting with the glass are progressively larger and larger from the forward end of the series onward.

In testimony whereof, I have hereunto subscribed my name this 29th day of January, 1930.

H. K. HITCHCOCK.