The invention relates to glass grinding apparatus, and particularly to apparatus for grinding glass which is carried on tables or carriers beneath a series of grinders in a straight-away or continuous operation, although certain features of the invention are of value in grinding machines in connection with the ordinary rotating tables, so that the invention is not limited to apparatus used in a straight-away operation. It has for its primary objects the provision of grinding apparatus in which, (1) an improved distribution of abrasive is secured beneath the runner bars so that a uniform grinding effect is secured beneath the runner area in contact with the glass, and so that a maximum speed in grinding is secured, (2) a more efficient form of runner block unit is secured, (3) the method of securing the runner bars to the runner frame is cheapened and improved, and (4) the abrasive is applied economically and splashing is eliminated. One embodiment of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is an elevation of the assembled apparatus. Fig. 2 is a transverse section through the runner. Fig. 3 is a plan view of the runner. Fig. 4 is a detail plan view illustrating the method of attaching the runner spindle to the runner. Fig. 5 is a bottom plan view of the runner with most of the runner bars removed. Fig. 6 is an enlarged plan view of two of the runner bars or sections. Fig. 7 is a section on the line VII-VII of Fig. 6. Fig. 8 is an enlarged detail section through the runner bar and runner frame showing the method of attachment. Fig. 9 is a plan view at the center of the runner showing the method of supporting the nozzles for supplying abrasive. Fig. 10 is a partial plan view of a modification. And Fig. 11 is a transverse section through the construction of Fig. 10.

Referring to the general arrangement of Fig. 1 which illustrates the method of supporting and driving the runner, to which the invention particularly relates, and its relation to the car or carrier upon which the glass is mounted, the principal parts of the construction are as follows: 1, 2, 3, 4, 5, 6 and 7 are portions of the framework of the machine, preferably commercial sections; 8 is a bracket carried by the framework; 9 is a bearing member in which the spindle 10, which carries the runner, is journaled; 11 is the electric motor for driving the runner spindle through suitable reducing gearing in the casing 12; 13 is the runner secured to the lower end of the spindle 10; 14 is one of a series of cars or carriers mounted on the track 15 and carrying the sheets of glass which are to be surfaced; 16 is a rack bar on the bottom of the car which is driven from the shaft 17 through the intermediary of the spur gears 18 and 19; 20 is a lever pivotally mounted upon the bracket 8 at 21 and having a pair of hooked shaped ends 22 engaging trunnions projecting laterally from the casing 12; 23 is a connecting rod threaded at its lower end and projecting through a bracket 24 carried by the framework; 25 is a hand wheel which is threaded on the lower end of the rod 23 and bears at its upper side against the spring 26 which is interposed between the hand wheel and the bracket 24; and 27 is an arm pivoted to the bracket 8 at 28 and having a pair of hooked shaped ends 29 engaging trunnions projecting laterally from the member 9. The method of supporting and driving the runner spindle constitutes no part of my present invention, which relates particularly to the runner itself, and is shown and described in greater detail in the application of Albert E. Evans, Serial No. 636,327. It will be understood that the invention is not limited to any particular means for mounting and driving the runner.

The runner 13 consists of the frame or plate shown in Figs. 2 and 3 and the runner bar sections 30 and 31 shown in Figs. 5 and 6, the runner frame consisting preferably of a steel casting having the radial stiffening ribs 32 and the central socket portion 33 in which the lower end of the spindle 10 is secured. The spindle has keyed to its lower end the head 34 secured in position by means of the collar 35, such collar being rigidly clamped to the runner frame by means of the six stud bolts 36. In order to prevent the head turning with respect to the collar 35, the head is
provided with a plurality of teeth or projections 37 as indicated in Fig. 4, fitting into corresponding recesses in the wall of the collar. The lower face 38 of the head 34 is slightly rounded as indicated in Fig. 2 with a slight amount of clearance between such face and the runner frame therebeneath so that the runner can rock slightly with respect to the spindle. This permits the runner to adjust itself to the glass, but at the same time the runner is maintained substantially horizontal when lifted from the glass. If desired, a compression spring 39 may also be employed to assist in maintaining the runner frame with its face in a plane at right angles to the axis of the runner.

The runner bars or sections which are secured to the lower face of the runner frame 29 are preferably of the construction illustrated in Figs. 5 to 8. These sections consist of plates having on one side the upwardly projecting pins 40 and on the other side the blocks 41 separated by the radial grooves 42 and the transverse grooves 43, the blocks being preferably arranged in staggered relation as indicated in Figs. 5 and 6. This arrangement provides on each of the blocks the working or cutting edges 44 and 45 (depending upon the direction in which the runner is rotated) at right angles to the direction of movement of the block with respect to the glass. This arrangement gives a more effective cutting or abrading action when the abrasive is carried beneath the block than if such cutting or working edges were at an angle other than a right angle to the direction of movement of the runner with respect to the glass.

The runner frame is provided with perforations 46 for receiving the pins 40, and when the runner bars or sections are positioned with their pins projecting through these perforations, they are secured in position by means of the fusible alloy 47 as indicated in Fig. 8, such alloy having a low melting point so that it can be easily melted out when it is desired to remove the runner bars and replace them with others. It is preferred that an alloy may be employed having a melting point below 212 degrees F., so that the fusing of the alloy may be accomplished with steam if desired, or such alloy having a melting point of approximately 185 degrees F. is made up of the following compounds:—tin 4 parts, lead 8 parts, bismuth 15 parts, cadmium 4 parts. Before applying the runner bars to the runner frame, each of the sections 30 and 31 has its face smoothed off on a rubbing bed until it is perfectly true and relatively smooth. The bars are then assembled face down upon a plate having a perfectly flat, true surface so that all of the faces of the bars or sections are in alignment.

The runner frame 29 is then positioned on top of the bars, as indicated in Fig. 8 with the pins 40 projecting upwardly through the perforations in the frame and the melted alloy 47 is poured into the spaces surrounding the pins. This alloy not only holds the bars against lateral movement, but by reason of the tapering enlargement 48 in each perforation, also holds the bars in their proper vertical positions so that their faces are maintained in alignment even though their rear faces may not contact fully with the face of the runner frame. This construction provides a runner which is ready for immediate use upon the glass since its entire face lies in one plane and has the desired finish for the particular stage of grinding for which it is designed. For instance, if the runner is to be used in one of the grinding machines for rough grinding, the faces of the runner bars will be finished on the rubbing bed with a degree of roughness such as will give the best results with the coarse abrasive which is used; while if the runner is to be used at the end of the series of grinding machines with fine sand or emery, the surface of the runner bars will be given a relatively fine finish on the rubbing bed.

The central portion of the runner frame is provided with a pair of opposing annular walls 49 and 50 providing between them an annular recess or container which is divided in the present instance into four compartments 51, 52, 53 and 54 by partitions 55, although the number of compartments may vary if desired. On the inner edge of the wall 49 is the annular ring 49. Leacing laterally from each of these compartments are the troughs 56 communicating with the compartments by means of the perforations 57 in the wall 50. Extending through the bottom wall of the trough, which is the runner frame plate, are the series of perforations 58 for conducting the mixture of abrasive and water which is supplied to the troughs downwardly through the runner frame and to the radial grooves 42 between the runner blocks. The mixture of abrasive and water is supplied to the compartments 51, 52, 53 and 54 by means of the pair of nozzles 59 and 60 (Fig. 9) which are connected to conduits leading from a suitable grader. These nozzles are carried by a two part ring 61 which is clamped to the lower end of the stuffing box 62 surrounding the lower end of the runner spindle. The parts of the ring are held together by the bolts 63 and engage the stuffing box 62 with only a slight degree of friction so that when desired, the ring may be adjusted circumferentially to position the nozzles without loosening the bolts 63, the ring being provided with a pair of handles 64 so that it may be turned over easily. The nozzles are placed at an angle to the inclined wall of the ring 49 so that the discharge strikes the wall obliquely, thus eliminating splashing, which is still further guarded against by the use of the inclined
The compartments 51, 52, 53 and 54 are supplied with the proper amount of abrasive as they pass beneath the nozzles 59 and 60, and these nozzles 59 and 60 are preferably positioned so that they discharge to the compartments when they are opposite the center line of the table carrying the glass rather than when they are opposite the sides of the table. This tends to avoid a waste of abrasive since much of the abrasive which is discharged toward the edges of the table flows off at the sides before it is completely utilized due in part to the fact that the runners overhang the side edges of the table, this being necessary in order to secure the necessary uniformity in grinding effect throughout the width of the glass.

The abrasive and water which flows into the compartments 51, 52, 53 and 54 is carried laterally by gravity and by centrifugal force along the troughs 56, from which it flows down other perforations 58 to the lower side of the grinding table. This gives an application of abrasive of the same character to the outer portions of the runner as to the inner portions, such as would not be secured if the abrasive were all supplied at the inner ends of the runner bars or sections and had to work outwardly, as in such case the abrasive would become finer and less sharp as it worked outward so that its cutting effect would be decreased. With the present arrangement, the abrasive supplied to the outer perforations 58 is of the same degree of coarseness as that supplied to the inner perforations so that a uniform grinding effect is secured throughout the length of the runner bars or sections. This arrangement also greatly increases the speed of grinding since the grinding effect of the runner blocks at the periphery of the runner is just as great as those near the center, since each block may be given the amount of abrasive required to secure the most rapid grinding, such as could not be done if the outer blocks were supplied indirectly with abrasive which had worked its way outward along the surface of the glass from the inner edge of the runner.

Figs. 10 and 11 illustrate a modification designed to secure the same function of distributing abrasive of the same character from the inner to the outer side of the runner. In this construction 67 is the runner frame provided with runner bars 68, and 69 is a circular opening at the center of the frame. The head 70 to which the spindle is attached is secured to the runner frame by means of the plate 71, such plate being secured at its inner edge to the head by the bolts 72 and at its outer edge to the runner frame by the bolts 73. The plate 71 is of sheet metal and provides a flexible connection between the spindle and the runner so that the runner can adjust itself to the surface of the glass. A mixture of abrasive and water is supplied from the container 74 carried by the head 70 by means of a plurality of pipes 75 which are turned outwardly at their lower ends. The runner bars are provided with a plurality of grooves 76 preferably of the contour indicated in Fig. 10 and having a curvature such that the mixture of abrasive and water supplied to their inner ends normally follows the curvature of the grooves under the influence of centrifugal force incident to the rotation of the runner. In this manner the abrasive and water is carried throughout the length of the grooves so that the abrasive as it passes under the runners adjacent the outer ends of the grooves is of the same character as that supplied further in toward the center. This arrangement tends to give the same uniformity in abrasive throughout the grinding area of the runner as in the other type of construction, but the other type is preferred because of the greater certainty with which this function is accomplished. It will be understood that the lower face of the runner is preferably provided with runner bars of rectangular form similar to those illustrated in Figs. 5 and 6 and that the grooves 76 cut through these blocks from the inner to the outer edge of the runner. Also that the number of these feed grooves may be increased, if desired.

What I claim is:

1. In combination with a runner frame or plate provided with perforations, of a plurality of runner bars fitting against the face of the plate and having projections fitting loosely in said perforations, and a material having a relatively low fusing point cast in the perforations surrounding the projections for holding the runner bars in position.

2. In combination with a runner frame or plate provided with perforations, enlarged at their inner ends, of a plurality of runner bars fitting against the face of the plate and having projections fitting loosely in said perforations, and a material having a relatively low fusing point cast in the perforations surrounding the projections for holding the runner bars in position.

3. In combination with a runner frame or plate provided with perforations, enlarged at both ends, of a plurality of runner bars fitting against the face of the plate and having projections fitting loosely in said perforations, and a material having a relatively low fusing point cast in the perforations surrounding the projections for holding the runner bars in position.

4. In combination with a runner frame or plate provided with perforations, of a plurality of runner bars fitting against the face of the plate and having their front faces ground and brought into alignment, projec-
tions on the back of the bars fitting loosely in said perforations, and a material having a relatively low fusing point cast in the perforations surrounding the projections for holding the runner bars in position.

5. In combination, a horizontal runner having a lower abrading surface and having a trough on its upper side extending from the inner portion of the runner outward with feed passages at different distances from the center of the runner extending downward from the trough to the lower face of the runner, and means for supplying a mixture of abrasive and water to the trough.

6. In combination, a horizontal runner having a lower abrading surface, and having a plurality of radial troughs on its upper side with feed openings arranged in a radial series extending downwardly therefrom to the lower face of the runner and means for supplying a mixture of abrasive and water to the trough.

7. In combination with a car for carrying a sheet of glass, a driven horizontal runner arranged above the path of movement of the car and having a grinding face, a plurality of compartments moving with the runner and each having communication means leading to a different area of the grinding face of the runner, and means for supplying each compartment with a mixture of abrasive and water during a portion only of the circumferential travel of such compartment.

8. In combination with a car for carrying a sheet of glass, a driven horizontal runner arranged above the path of movement of the car and having a grinding face, a plurality of compartments moving with the runner and each having communication means leading to a different area of the grinding face of the runner, and means for supplying each compartment with a mixture of abrasive and water during a portion only of the circumferential travel of such compartment arranged so that the supply of the mixture to each area from its container is discontinued while such area is above the side portions of the carrier.

In testimony whereof, I have hereunto subscribed my name this 25th day of Oct. 1923.

HALBERT K. HITCHCOCK.