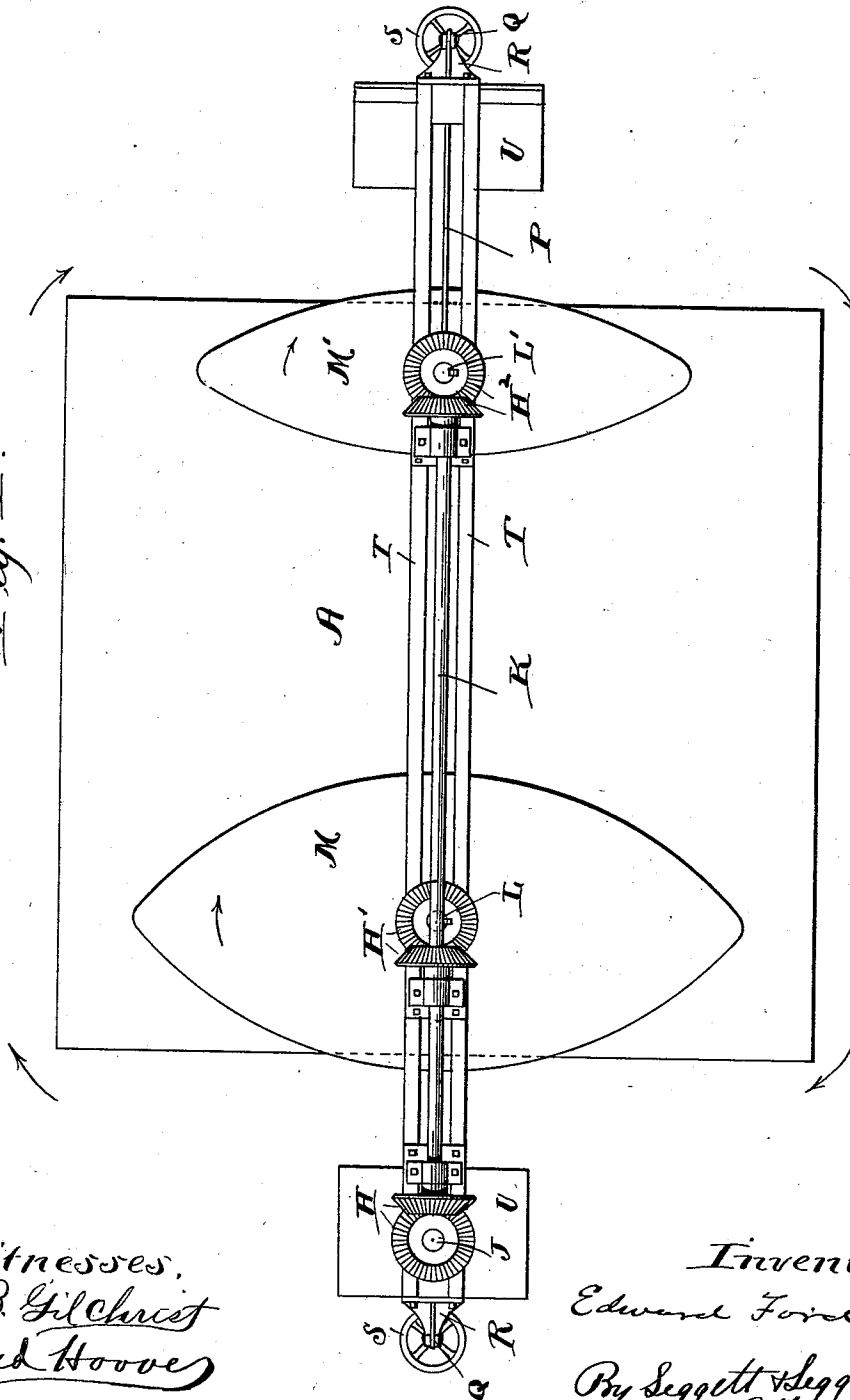


E. FORD.
GRINDING AND POLISHING MACHINERY.

No. 521,953.

Patented June 26, 1894.

Fig. 1.



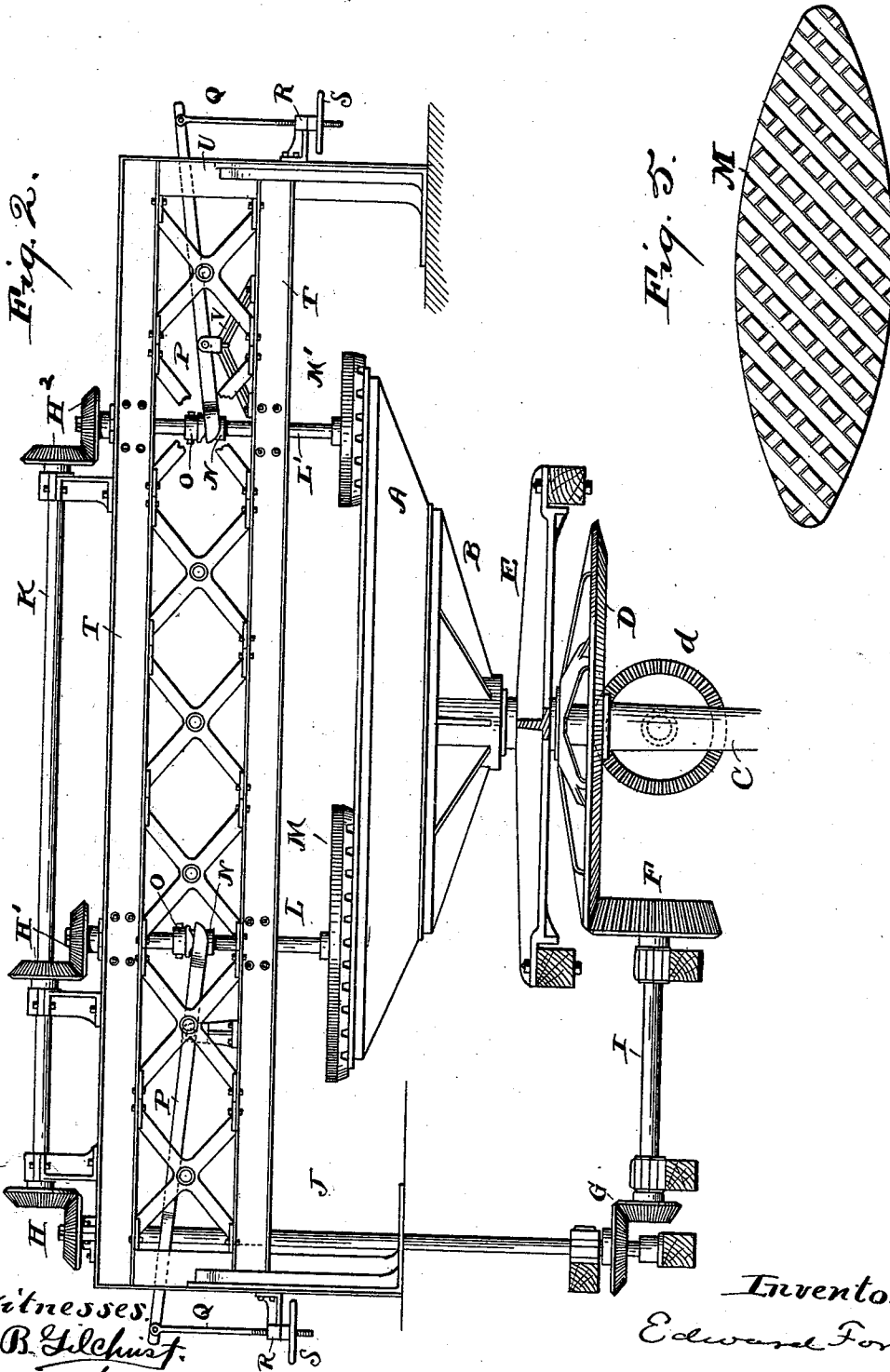
Witnesses,
E. B. Gilchrist
Ward Hoove

Inventor,
Edward Ford,
By Segett & Segett
Attorneys.

E. FORD.
GRINDING AND POLISHING MACHINERY.

No. 521,953.

Patented June 26, 1894.



Witnesses:
E. B. Gilchrist.
Ward Hoover

Inventor:
Edward Ford
By Seppett & Seppett
Attorneys

E. FORD.
GRINDING AND POLISHING MACHINERY.

No. 521,953.

Patented June 26, 1894.

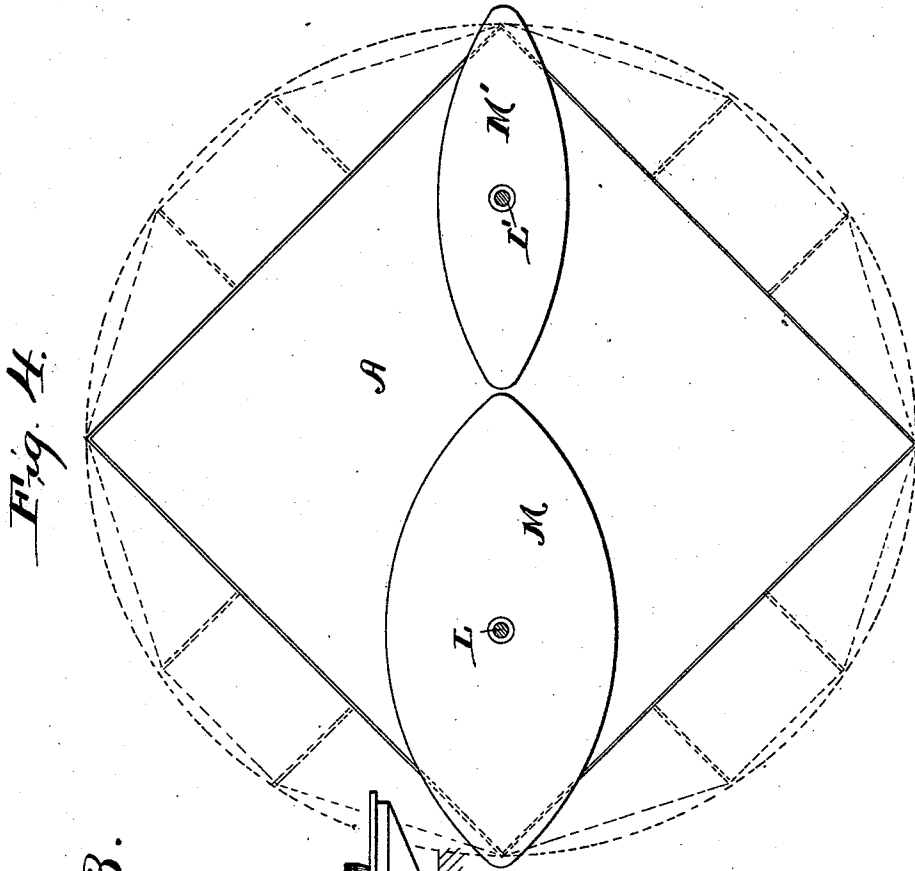


Fig. 4.

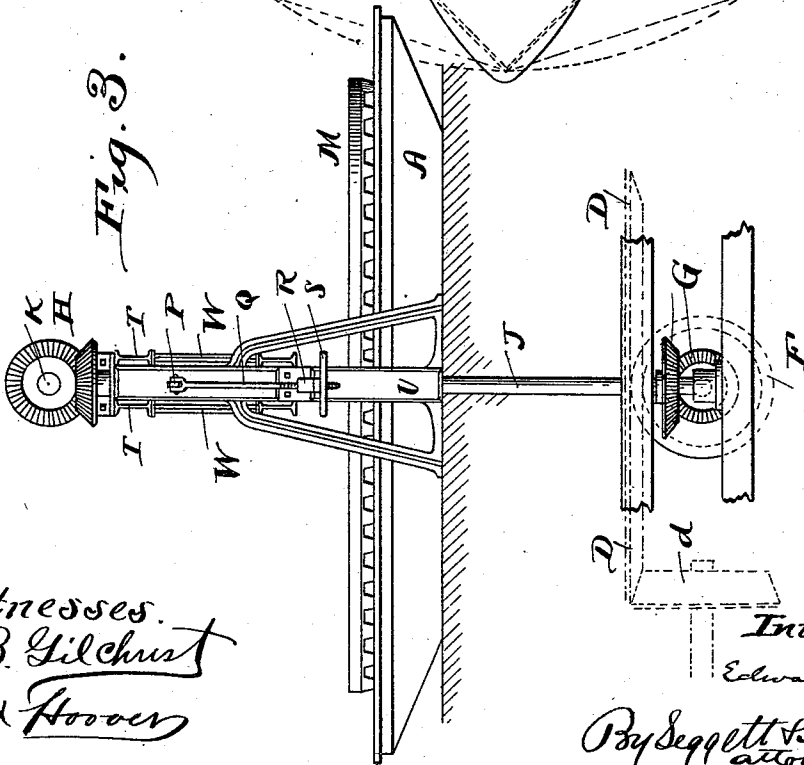


Fig. 3.

Witnesses.
E. B. Gilchrist
Ward Hoover

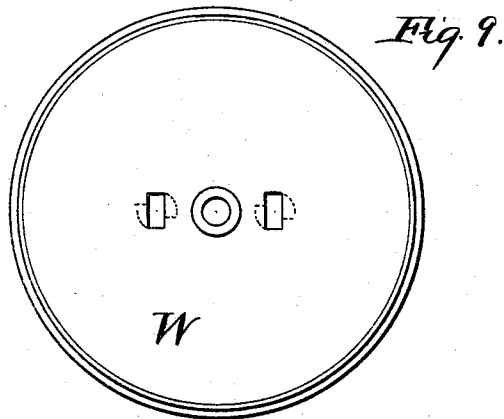
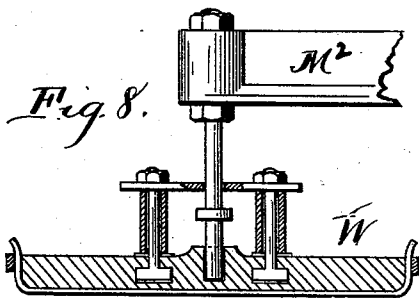
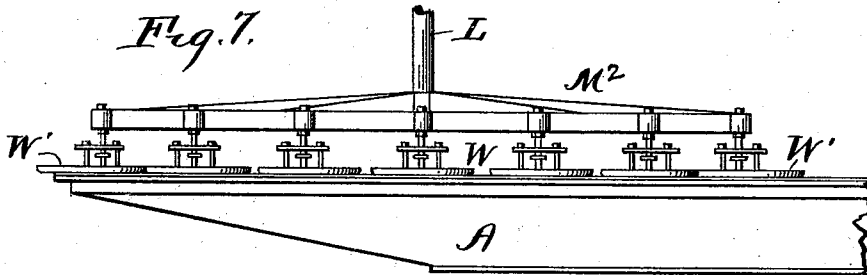
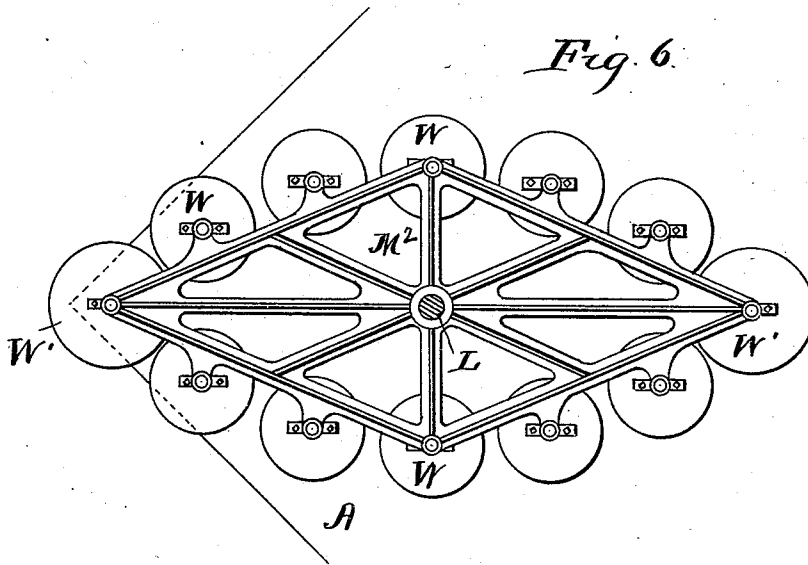
Inventor,
Edward Ford
By Seppett, Seppett
attorneys.

E. FORD.

GRINDING AND POLISHING MACHINERY.

No. 521,953.

Patented June 26, 1894.



Witnesses.
E. B. Gilchrist
Ward Hoovey

Inventor,
Edward Ford
By Leggett & Leggett
 Attorneys.

UNITED STATES PATENT OFFICE.

EDWARD FORD, OF CREIGHTON, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO THE PITTSBURG PLATE GLASS COMPANY, OF SAME PLACE.

GRINDING AND POLISHING MACHINERY.

SPECIFICATION forming part of Letters Patent No. 521,953, dated June 26, 1894.

Application filed October 16, 1893. Serial No. 488,251. (No model.)

To all whom it may concern:

Be it known that I, EDWARD FORD, of Creighton, in the county of Allegheny and State of Pennsylvania, have invented certain
5 new and useful Improvements in Grinding and Polishing Machinery; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as
10 will enable others skilled in the art to which it pertains to make and use the same.

My invention relates to a machine for grinding or polishing, or grinding and polishing, such substances as plate-glass, stone, or other materials that are to be dressed down to a
15 surface and afterward polished, or not, as may be desirable or necessary.

I shall describe my invention as adapted to grind, or polish, plate-glass; although it will be understood that I do not limit this application narrowly to such use, as it is manifest
20 that, without any material variation, and without any departure from the true spirit and substance of my invention, it is well suited for grinding or polishing other materials than
25 plate-glass.

Heretofore, in grinding or polishing machines employing revolving round or octagonal tables and revolving runners, it has been necessary to bed the table with "small glass" outside of and encircling the large square area on which the "large glass" is bedded. This has been necessary owing to the fact that the runners heretofore employed, whether operated by their frictional contact with the material acted upon, or by suitable gearing, have always been allowed a range of movement extending outside of such square area; and unless afforded a support throughout their entire range of movement, such runners would
40 break off the edges of the large glass and would seriously injure the machine.

Among the objections attending the bedding of the table with small glass to insure an extended support for runners operating as above set forth are the following:—Unduly large, heavy and expensive machines are needed, requiring corresponding power to drive them, owing to the extra and practically waste material thereon to be treated. Further, it involves the manufacture of "small glass," which all plate glass manufacturers

desire to avoid as far as possible. Further, the bedding of this "small glass" involves a great outlay of time, labor and material for bedding, smoothing and polishing, wherein
55 plaster, rouge and emery are respectively employed, the table requiring a complete bedding for the treatment of each surface of the large glass. Further a serious loss is incurred by reason of the fact that all of the time required for handling this small glass is so much
60 time lost and wasted in the use of the machine, and the service of the employés.

I am aware that English Patent No. 18,151, of 1889, discloses a grinding machine and also
65 a separate and materially different machine for polishing glass or other material. The grinding machine consists of a rotary square table and a grinding runner located at one side of the axial center of the square table,
70 and adapted to be rotated only by its frictional contact with the material on which it acts. The runner is rectangular, and projects outwardly from the edge of the square table a varying distance according as its position may change with relation to the table
75 at any given time. Owing to the fact that the runner is rotated by frictional contact, only, no fixed ratio of speed is maintained between it and the table, and hence it will
80 project one quarter of its length outside of the table.

It is evident that this machine is wholly impracticable as a polishing machine, because its polishing blocks, if of ordinary construction, or of such construction as is shown
85 in the English patent in question, would be carried off from the edge of the square plate and thus render the machine useless. In fact, in the said patent, a separate and distinct machine for polishing is shown and described, which consists of several series of
90 longitudinally reciprocating polishing blocks beneath which a rectangular table slowly reciprocates in a transverse direction.

My invention consists in the combination with a revolving table and revolving runners, one or more, of gearing for imparting a positive and differing speed to the table and runners, the runners being of such form and
100 bearing such relation to the table that, in the operation of the machine, they will act upon,

and be practically confined in their action to a square surface on the table.

My invention further consists in certain other features of improvement, hereinafter described and pointed out in the claims.

The grinding and polishing of plate-glass require large, heavy and expensive machines; and the fact is too manifest to need explanation that the grinding, smoothing and polishing of plate glass must be accomplished in the most complete and perfect manner. Both surfaces must be perfectly flat and smooth, before polishing; and the polishing must be effected without any scratching of the glass, such as would surely result by the presence of the smallest particle of sand, or the like. Every portion of the glass bedded upon the revolving table must receive equal treatment with every other portion, else the plate will not be uniformly and properly made, and is, therefore, ruined.

Heretofore no experiments ever made with a square revolving table have ever given any promise of accomplishing these, and other, essential performances; and it has, therefore, been thought by those who have ever given any attention to the construction or operation of glass grinding and polishing apparatus, that a revolving square table, desirable as it would be if it could be made to work, was something beyond the reach of practical and useful accomplishment; and, up to the time of this my present invention, grinders and polishers of the moving-table or platform type have employed tables either round or octagonal, and entirely covered with glass, and made to revolve, having revolving or reciprocating carriers or spiders for the grinders or polishers proper, or else the table has been square or rectangular, but not provided or associated with runners confined in their action to a square surface on a revolving table. But in no prior device of which I am aware has there ever been a revolving square table, with the runners or spiders above it for carrying the grinders or polishers-proper given also a revolving motion and positively geared and driven in such a way that the runner or runners shall perform two complete revolutions to one revolution of the table, the runner or runners being of such form, and so associated with the table, as to be confined, substantially, in their operation, to a square shaped area on such table.

Having, in this general way, indicated the broad and leading features of my invention, I will now proceed to a more detailed description of one among many forms in which it may be embodied;—and, as already said, I will describe it as I have constructed and used it, and found it to be most completely and admirably suited to the grinding, smoothing and polishing of plate-glass.

In the accompanying drawings, Figure 1 is a plan view showing a square revoluble table, with two runners or spiders above it, and some of the associated gearing and connec-

tions. In this figure, as in the other drawings accompanying this specification, the size, location, and position of the runners in relation to the table are endeavored to be shown with approximate exactness. Fig. 2 is a view, in side elevation, showing the table, its general character of construction, its gear-connection with the driving power, two runners or spiders for carrying the grinders or polishers proper, the frame for supporting the runners above the table, and the gear-connections whereby the runners are revolved;—also a lever-contrivance whereby the runners and their contained or attached grinders or polishers can be bodily lifted from the surface of the table. Fig. 3 is a view, in end elevation, showing the table, one of the runners resting upon it, and the immediately-associated gearing and connections. Fig. 4 is a plan view, showing, in solid lines, my square table with two runners. The dotted lines in this drawing indicate a round table, with the spaces outside the central square portion, (which would be bedded with "large-glass,") bedded with "small glass." This drawing, as will later appear, is provided to assist in explaining some of the faults and objections that inherently attach to all round, or octagonal, tables, completely covered or bedded with glass, as has been the universal custom heretofore; and also to explain how a round or octagonal-shaped table, having only a square shaped area upon its surface bedded with glass, will constitute, and will be, to all effects and purposes, a "square table," and entirely within the scope and intent of my invention, when employed in association with independently revolving runners or spiders, substantially such as I shall hereinafter describe. Fig. 5 is a detached view, showing the under face of one form and construction of spider or runner, used for grinding and smoothing. Fig. 6 is a plan view, showing a corner of the square table, and one form of spider or runner carrying polishing-plates. Fig. 7 is a view, in side elevation, of that which is illustrated in Fig. 6. Fig. 8 is a view, partly in side elevation, and part in vertical section, of one polishing plate, and its manner of attachment to the runner or spider. Fig. 9 is a plan view showing the upper surface of the polishing-plate illustrated in Fig. 8.

A is the square table upon which the glass, or other material to be ground, or faced, or polished, is suitably bedded or fixed. In the case of plate glass, the ordinary way of bedding is to place the glass in a thin layer of plaster of paris, which, upon "setting," holds the glass to the table with sufficient firmness. To prevent any lateral disturbance or displacement of the glass, wooden pegs are driven at the outside edges, holes in the table being provided for these pegs. The table A must be made staunch and strong, sufficiently so to prevent any liability to breakage, or distortion, or unsteady working under the heavy strain to which it must be constantly sub-

jected. In short, to save further reference to this feature, the entire apparatus, from end to end of the machine, must be constructed in a solid, strong and substantial manner, and the whole provided with a good foundation, preferably of masonry. This necessity will be recognized when it is stated that such machines as I use have a table from eighteen to twenty feet square, and require about one hundred horsepower, each; to run them.

B represents an iron or steel sub-table beneath the table proper, having webs or braces as shown extending from a central hub, to add strength and stiffness to the structure.

C is the main upright shaft which supports the table, and upon which the table revolves. The table is rigidly attached to the upper end of shaft C, while the lower end of said shaft rests and revolves in any suitable step or bearing.

D is a miter-gear-wheel which engages with the gear-wheel d , driven directly, or indirectly, by an engine.

E is a metallic frame spanning the pit beneath the table, in the center of which frame is a journal-bearing for the shaft C, to support its upper end.

F is a miter-gear-wheel engaging with the gear-wheel D; and, through shaft I, the wheel F transmits its motion to the miter-gear G, and thence, through the vertical shaft J, and gears H H' H², revolving motion is imparted to the runners or spiders M M'. The gear-connection just pointed out between the wheel D and the runners M M' is such that, for every revolution of the wheel D, (and the table A upon the same shaft C,) two revolutions shall be given to the runners M M'.

The operative face of the grinding runners consists of square, rectangular, or other-shaped, sections secured to the under face of the runner. However, as this method of shoeing a runner is not new, it having been resorted to by others, and is so well understood by persons skilled in this art, it will be unnecessary to illustrate it in the drawings. It is sufficient to say that the grinding-surface illustrated in Fig. 5 is not made up of a single casting, but of sections suitably shaped and proportioned, so that when attached to the runner, they shall match with each other and cover the lower face of the runner. These sections are rough sand castings, and are consequently more or less uneven when first applied and used, but soon become worn to a uniform plane. It is manifest that if a freshly shod grinding runner was allowed to extend its grinding blocks beyond the outer edges of the bedded glass, any block or section so escaping that was longer than its fellows would strike the edge of the glass when attempting to come upon the table with the certain result of breaking the glass, stripping it from the table, or damaging the machine.

As the drawings clearly indicate, the shafts L L' of the runners M M', and their associated mechanism, are supported by, and op-

erate in, the iron frame T, which frame spans the table and extends centrally over it.

In order to lift the runners M M' and their contained or attached grinders or polishers bodily from the table A, the lever arrangement N, O, P, Q, R, S, is provided the lever P being fulcrumed on a suitable support V; and this apparatus is operated by turning the crank or hand-wheel S in one direction or the other, as it is desired to lift or lower the runners. The turning of the wheel S, whose hub is internally screw-threaded, allows the link-rod Q to rise or fall, thus raising or lowering the long arm of the lever P, which lever is fulcrumed in the frame T. The short arm of this lever is forked, and arrangements, shown with sufficient clearness in the drawings to make detailed explanation unnecessary, are provided whereby this fork terminating the short arm of the lever can carry up or down, or maintain in any lifted position, the runners M or M'.

I will here incidentally explain that, in the particular machine illustrated in the drawings, the table A is constructed to be lifted off from its sub-table B, and taken from the general machine to be bedded with glass; that when it is thus bedded it is set into position in such a structure as shown in Fig. 2 of the drawings, and there kept until the grinding process is completed, and the smoothing process likewise if desirable; that it, and its contained glass, is then removed from that structure, and carried to another machine of the same kind, and there placed upon another sub-table B, where it is kept during the polishing process, and until one side of the bedded glass is entirely finished and polished; that this table A is then again removed from the polishing machine, and its glass removed, turned over and rebedded in fresh plaster, and then put upon the sub-table of the grinding machine until that machine has finished its work; that the table A is then removed from the grinding machine and put into the polishing machine, and there kept until the glass is polished and finished. By this means it will be seen that the glass is removed from the table and rebedded thereon but once during the entire process of grinding, smoothing and polishing both of its faces. But all this has no material bearing whatever upon my invention; and I have only made the foregoing explanation in order more completely to show why the runners are not required to be lifted from the table A any higher than would appear possible from the construction illustrated in the drawings. But, so far as concerns coming within my invention, it matters not in what particular manner the glass is bedded upon its table, whether by plaster, or otherwise, or how it is taken through the steps necessary to finish it for the market, so long as the table upon which it is ground or smoothed, or polished, is square and revolving, and the runner or runners carrying the grinders or polishers

proper are also revoluble, in the manner and to the effect described.

In order that the runners M or M' may move up or down, so as to always rest with their full weight upon the table during operation, as well as to be lifted from the table by the lever P, the vertical shaft L or L' has a sliding feather-and-groove fitting within the hubs of their respective gears H' or H².

U represents the upright end-supports of the frame T.

I have shown in the drawings two forms of runners or spiders;—one at Fig. 5, adapted for grinding, and another at Fig. 6 for polishing.

The rubbing surfaces of the grinding-runner consist of iron blocks which are detachably attached to the runner-frame, either singly, or in groups, (preferably in groups.) In use, these blocks are substantially worn out in about six weeks' constant running, and are then to be replaced by new ones.

In the case of the polishing-runner, I have shown what has been found to be a very effective construction of a polishing-plate therefor; and Figs. 6, 7, 8 and 9 illustrate a polishing runner provided with said plates, and also illustrate the manner in which the plates are constructed and attached to the runner-frame. The loose and wabbling attachment between the polishing-plate and its runner-frame enables the plate, of its own gravity, and irrespective of any other parts of the apparatus, to automatically adjust itself in even and entire contact with the glass being polished, without any danger of sudden and undue pressure or strain, either upon the glass or upon the machinery. I do not lay claim to the inventorship of this particular construction and character of polishing-plate; but have chosen to show it as one of the best devices for its use that I know of. It is fully shown and described in United States Patent No. 496,731, granted May 2, 1893, to John B. Ford;—and for a better understanding of this special device, if such be necessary, reference is hereby made to the above-named patent.

Referring, now, to the runners or spiders, while I prefer to provide two of them, as shown in the drawings, the larger one, alone, might be made to suffice; although it is apparent that the work of the machine could not be done so fast with one, as it will be done with two, runners, because a smaller number of grinding or polishing-plates will be in operation. This is my principal reason for providing two runners. Another reason for preferring two runners, instead of one, is that when two are used, as I have shown, upon opposite sides of the table A, their pressures balance the table better, and will probably tend to prevent any uneven or undue wear upon one side between the shaft C and its bearings, which, if it occurred, would result in more or less tilting of the table, thus disturbing its uniform plane of ro-

tation, and deranging the operation of the machine.

I prefer to construct the runners or spiders so that, in plan view, they shall have a general oval, diamond, lozenge, kite, or equivalently-elongated shape, as this form insures against any of the attached grinding or polishing blocks or plates running unduly off from the glass. I do not, however, narrowly limit my invention to any particular shape or outline for a runner, as they may be made of any form that will prevent their attached grinding or polishing-plates from unduly running off from the glass, while, at the same time, said plates shall be made to effectually operate upon the entire surface of said glass when the machine is in operation. The larger runner M is made of a sufficient length, and is so located, that it shall extend beyond the axial center of the table A, while the smaller runner M', as sufficiently indicated in Figs. 1 and 4 of the drawings, is so proportioned and located that, on the one hand, it shall properly clear the larger runner M, and, on the other hand, not extend, at its ends, so far over the table A, during the operation of the machine, as that its grinding or polishing plates shall run unduly off from the glass.

In assembling my machine, it is important that the runners shall be properly placed in relation to the table A; and this relation is shown in Figs. 1 and 4 of the drawings, where it will be seen that, when the table A has two of its sides parallel with the line of the frame T above it, the longest diameter of the runners is at right angles to the line of said frame, (see Fig. 1.) or, when two corners of the table A are centrally beneath the frame T, then the longest diameter of the runners is parallel with the line of said frame. In whichever direction, whether from right to left, or left to right, the table A revolves, the runners should be made to turn in the same direction. It is entirely immaterial, however, in which direction the table and runners revolve, for, in either, the operation and results are the same, it only being important, as already said, that the runners and table should turn in the same direction, and that the runners revolve twice for every revolution of the table. When this is done, no matter at what point the table may be during its movement, the revolving runners above it will be in such positions in relation to the table that none of the grinding or polishing-plates can escape, or unduly run off from the glass, while, at the same time, every portion of the glass bedded upon the table receives sufficient and uniform treatment.

In the drawings, (Fig. 6,) it will be seen that I have shown the two polishing plates W', which are located at the ends of the runner, as somewhat larger and heavier than the other polishing-plates, W, upon said runner. While these heavier polishing-plates may not be necessary, and while they certainly do not

constitute any essential part of my invention, still they may be found desirable by way of hastening the operation of the machine by effecting a more vigorous polishing action at the corners of the table, at which part, owing to the fact that a smaller number of plates can operate, the polishing process might proceed more slowly than at the more central part, where a greater number of plates are acting.

I wish, in treating of the square-table element of my invention, to explain that what is meant by the "square table" in this specification is not, of necessity, merely a table having a square top, but a table upon which the bedded glass or other material to be operated upon is laid upon the table so as to fill a square surface thereon, the center of said square substantially coinciding with the axial center of the revolving table. For instance, let us suppose the case of a circular-top table, say, of twenty-two feet diameter. On such a table I can map out a fifteen-foot square. I bed only this square with glass, leaving the rest of the table empty. Now, if I properly locate over this occupied square the runners $M M'$, properly proportioned, and operate the machine thus constructed and arranged, it is, so far as every function and result is concerned, a square table, and nothing else, according to the essence and intent of my invention, and the meaning of this specification. The unoccupied parts of the circular table, just supposed, are entirely unnecessary, useless and superfluous, and, in fact, are not acting or serving any of the purposes or functions of a table, for it is only the square-shaped area upon which the glass is bedded as described, and upon which the runners operate, that is acting as the table, or that can be considered the table proper. I would, therefore, have it understood that my invention would not be at all evaded, but, on the contrary, would be completely practiced, by the use of a round-top, or octagonal-top table, having the glass to be worked bedded on such table so as to cover only a square area thereon, the center of which square should substantially coincide with the axial center of the table, in combination with one, or more, runners located above the table, as described, and arranged so that said runners shall have two revolutions to one revolution of the table, or shall be of such form and so associated with the table and so operated as to be confined substantially in their action to a square shaped area on said table. Such an arrangement as I have just supposed, is shown in Fig. 4 of the drawings, if I imagine the "small glass" removed (which is there indicated in triangles and rectangles by dotted lines outside the square),—the circular edge of the round table being also shown by dotted lines. The principal object, however, of providing Fig. 4 of the drawings, is to show some of the material advantages and benefits of the square table, as compared with a round or oc-

tagonal table completely covered with glass, as such tables have always heretofore been used. The rectangular spaces defined by the dotted lines in Fig. 4 indicate plates of "small glass;"—likewise the triangular spaces. The triangular glass is practically worthless, and the small rectangular plates of very low value compared with large plates. Yet, in bedding these round tables, as they have always been used, they must be entirely covered with glass; and it not unfrequently happens that larger plates, of greater value, have to be cut to provide these smaller pieces to cover the table. The material waste here involved is too apparent to need further explanation; and what I have said in criticism of round tables completely bedded with glass equally applies to octagonal tables.

Besides the objections already pointed out, the items of plaster for bedding this "small glass," the time and labor required for bedding and handling it, the material consumed in grinding and polishing it, the extra size of the table itself, its cost of construction, the additional power required to run it;—all this, and more, unnecessary to here enumerate, is entirely avoided by my invention herein described.

In describing the general construction and operation of my machine, I have referred to its runners as "the runners M and M' " and these are shown as grinding runners. However, instead of these grinding runners $M M'$, polishing runners M^2 , as shown in Figs. 6, 7 and 8 may be employed in the same manner as the grinding runners $M M'$.

What I claim is—

1. A grinding or polishing machine, where- in revolving runners, one or more, are confined in their action to a square surface on a revolving table, substantially as and for the purpose set forth.

2. In a grinding or polishing machine, the combination with a revolving table and an elongated runner, of gearing for positively actuating, and maintaining a constant ratio of speed between them, the runner and table associated, substantially as set forth, whereby the runner will act upon, and be practically confined in its action to, a square surface on the table.

3. In a grinding or polishing machine, the combination with a revolving table and an elongated runner of sufficient length to extend over and beyond the axial center of the table, of gearing for positively actuating and maintaining a constant ratio of speed between them, the runner being of such form, and bearing such relation to the table; that, in the operation of the machine, it will act upon, and be confined or practically confined in its action to, a square surface on the table, substantially as and for the purpose shown.

4. In a grinding or polishing machine, the combination with a revolving table, of elongated runners, one of which is of sufficient length to extend over and beyond the axial

center of the table, of gearing for positively actuating and maintaining a constant ratio of speed between the table and runners, the latter being of such form, and relatively arranged with respect to the table, that, in the operation of the machine, they will act upon, and be confined or practically confined in their action to, a square surface on the table, substantially as and for the purpose set forth.

5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
350
355
360
365
370
375
380
385
390
395
400
405
410
415
420
425
430
435
440
445
450
455
460
465
470
475
480
485
490
495
500
505
510
515
520
525
530
535
540
545
550
555
560
565
570
575
580
585
590
595
600
605
610
615
620
625
630
635
640
645
650
655
660
665
670
675
680
685
690
695
700
705
710
715
720
725
730
735
740
745
750
755
760
765
770
775
780
785
790
795
800
805
810
815
820
825
830
835
840
845
850
855
860
865
870
875
880
885
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
965
970
975
980
985
990
995

5. In a grinding or polishing machine, the combination with a revolving square table and an elongated runner, of gearing for positively imparting two revolutions to the run-

ner to each revolution of the table, said runner being of such form, and bearing such relation to the table, that, in the operation of the machine, it will act upon, and be practically confined in its action to, the square surface of the table, substantially as set forth.

In testimony whereof I sign this specification, in the presence of two witnesses, this 6th day of October, 1893.

EDWARD FORD.

Witnesses:

L. L. LEGGETT,
J. B. FORD, Jr.