No. 793,604. PATENTED JUNE 27, 1905.

W. E. NICKERSON.

ABRADING MACHINE.

APPLICATION FILED MAR. 18, 1902.

4 SHEETS—SHEET 1.

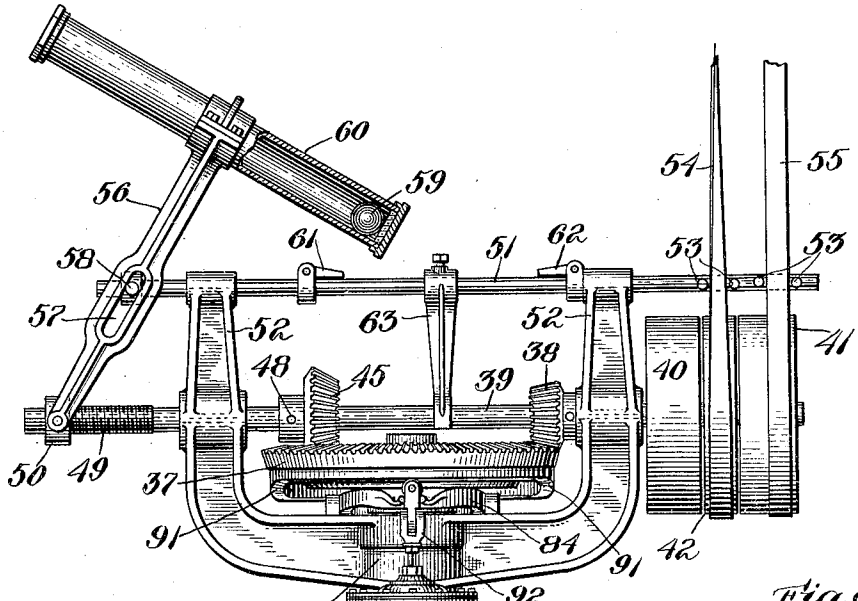


Fig. 1.

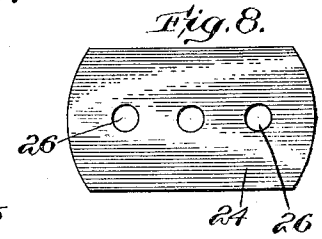


Fig. 8.

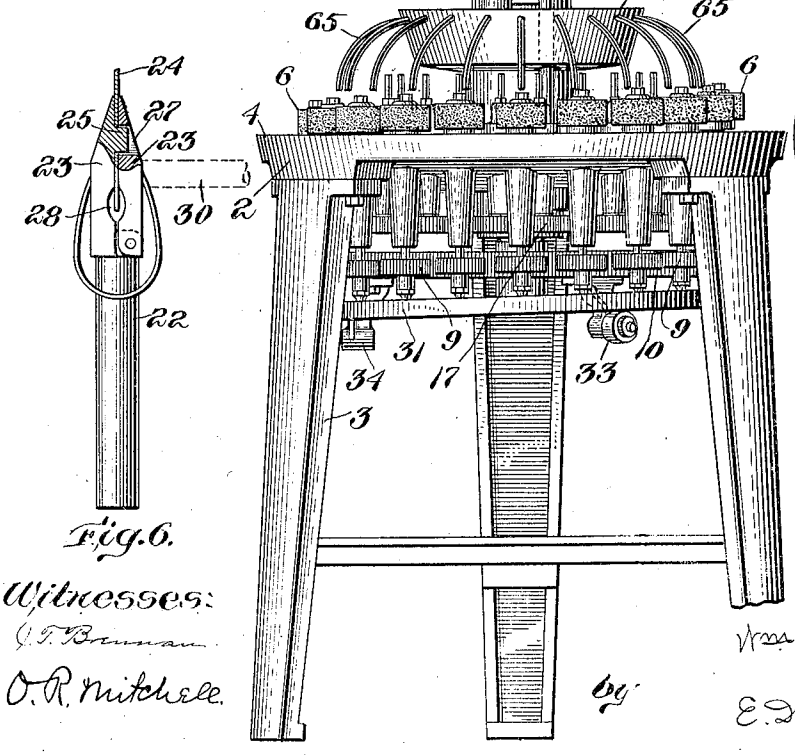


Fig. 6.

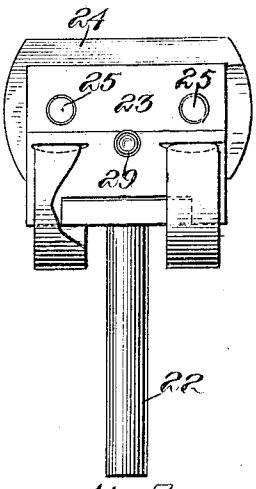


Fig. 7.

Witnesses:
J. T. Brennan
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PHOTO-LITHOGRAPHED BY SACKETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

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4 SHEETS—SHEET 2.

Fig. 2.

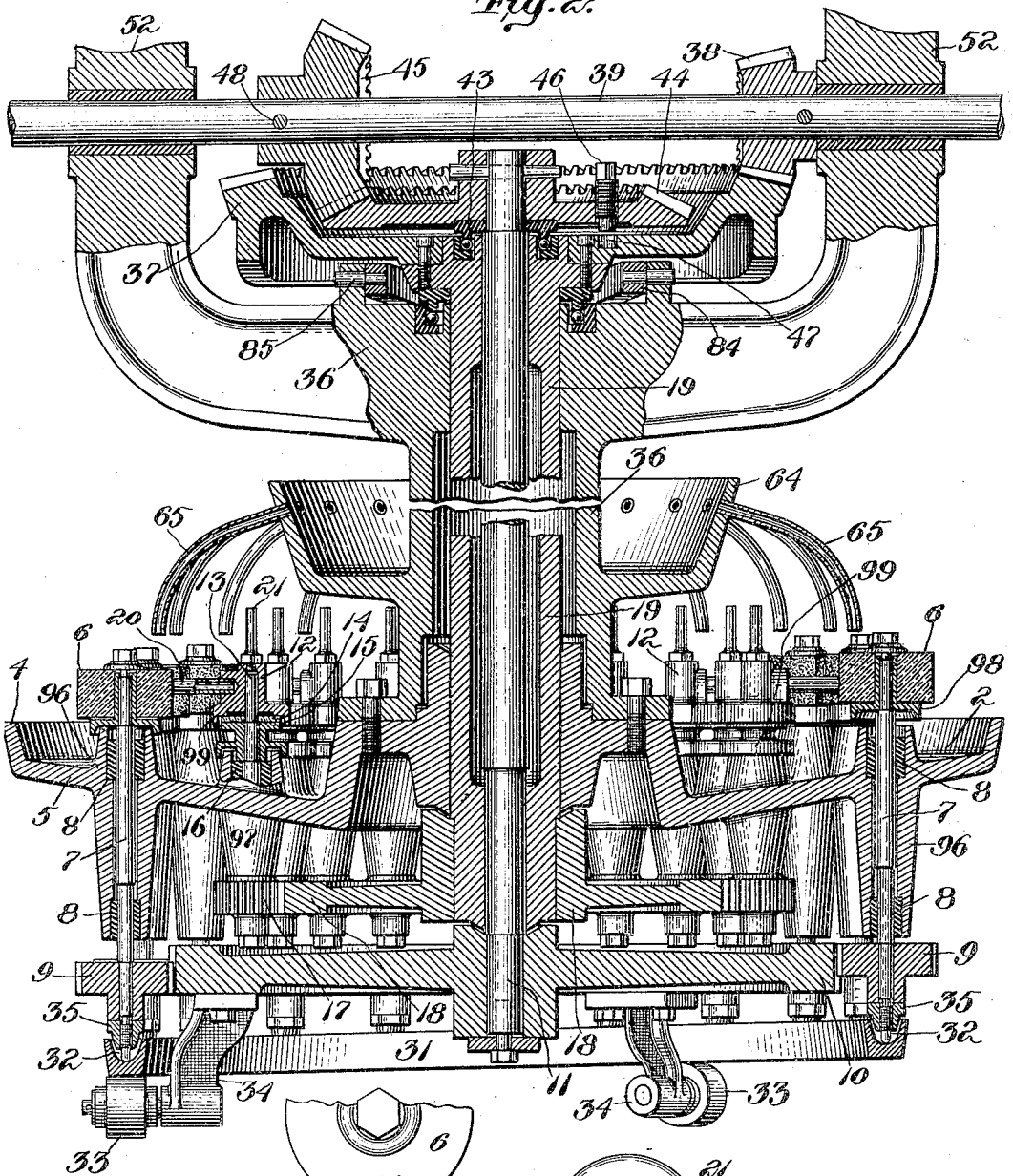


Fig. 5.

Witnesses:

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4 SHEETS—SHEET 3.

Fig. 3.

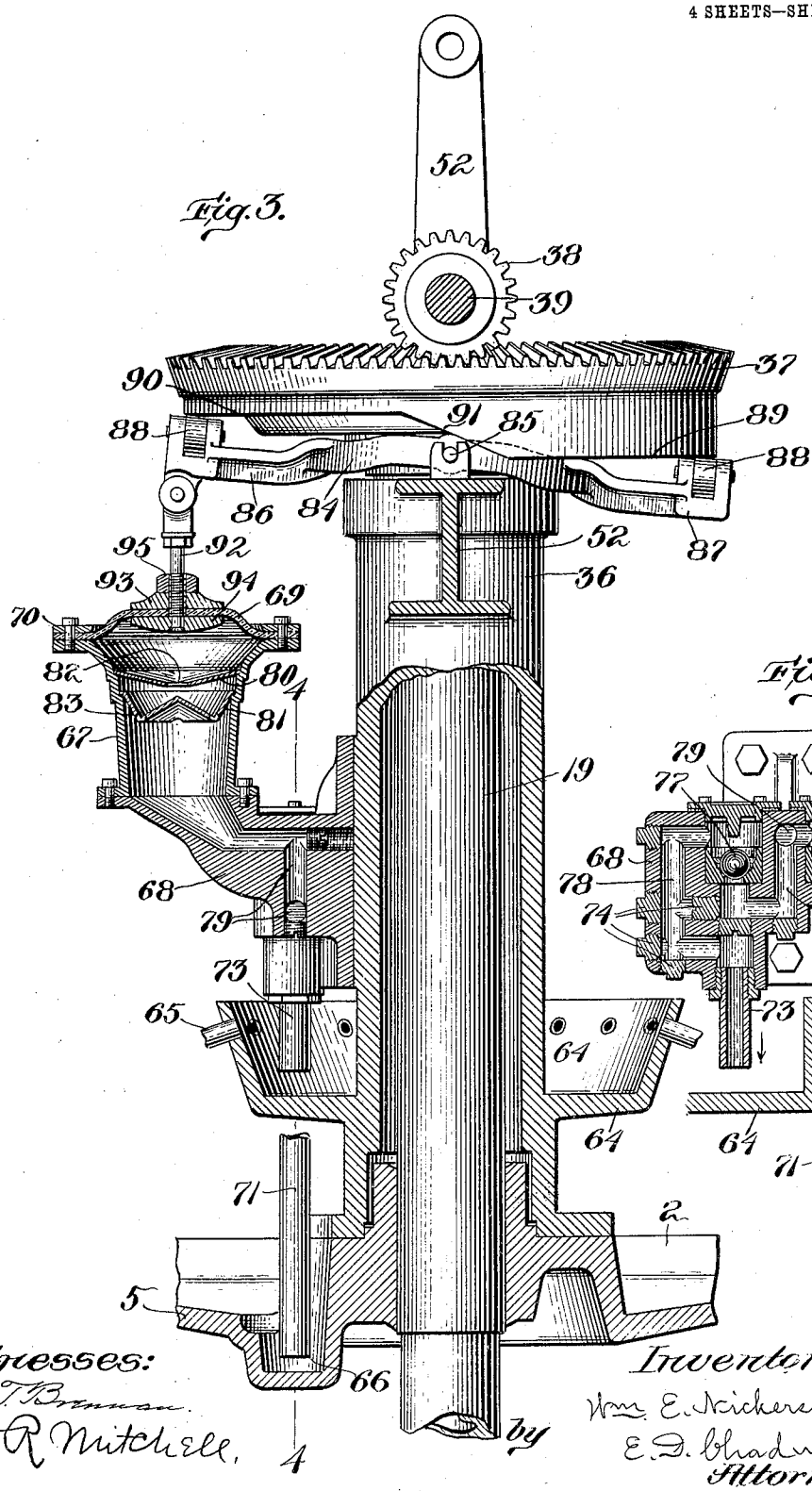


Fig. 4.

Witnesses:

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4 SHEETS—SHEET 4.

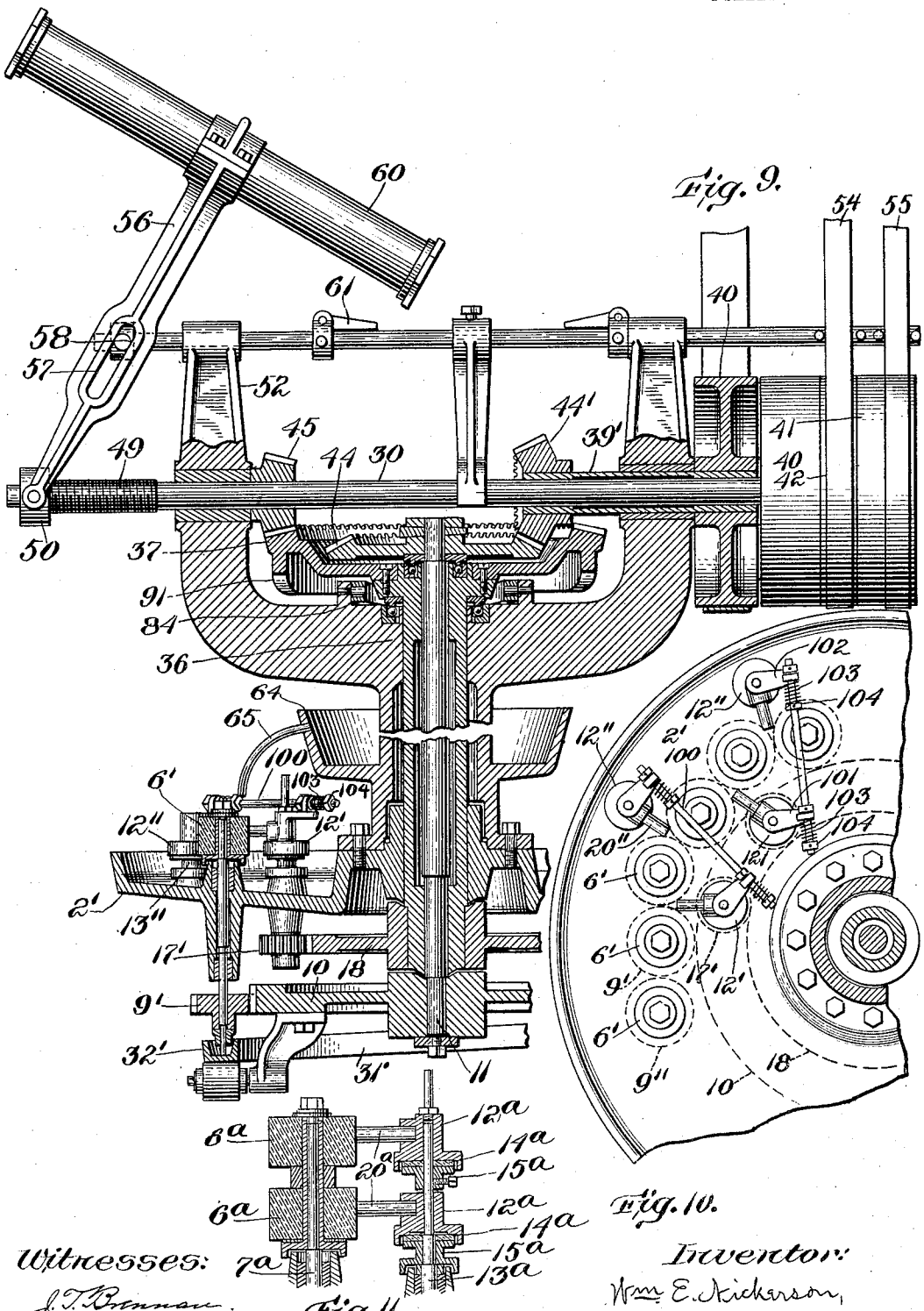


Fig. 9.

Fig. 10.

Fig. 11.

Witnesses:
J. T. Brennan.
O. R. Mitchell.

Inventor:
Wm. E. Nickerson,
by E. G. Chadwick,
Attorney.

No. 793,604. Patented June 27, 1905.

UNITED STATES PATENT OFFICE.

WILLIAM EMERY NICKERSON, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FEDERAL TRUST COMPANY, OF BOSTON, MASSACHUSETTS.

ABRADING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 793,604, dated June 27, 1905.

Application filed March 18, 1902. Serial No. 98,780.

To all whom it may concern:

Be it known that I, WILLIAM EMERY NICKERSON, a citizen of the United States, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Abrading-Machines, of which the following is a specification.

My invention relates to the art of grinding and polishing, my object being to provide a machine by means of which razor-blades may be ground and given a satisfactory cutting edge.

So far as I am aware, it has not been found practicable hitherto to grind razor-blades by automatic machinery, mainly by reason of the difficulty encountered in devising a mechanism which would apply a blade to the abrading-surface with the requisite delicacy and uniformity of pressure and insure the necessary uniformity of the abrading action along the entire length of the blade, as well as on both sides thereof, and an important portion of my invention relates to means whereby this result may be accomplished.

Other features of my invention relate to the organization of a grinding-machine as a whole and to the construction of some of its details hereinafter described.

My invention is particularly intended to provide a machine for grinding thin flat blades, such as used in the safety-razor shown and described in Letters Patent of the United States No. 775,134, granted November 15, 1904, on an application filed by King C. Gillette, and such a machine is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of the complete machine in its preferred form. Fig. 2 is a central vertical section through the body portion of the machine. Fig. 3 is a view, partly in central vertical section and partly in side elevation, of the upper portion of the central axis of the machine and adjacent parts. Fig. 4 is a section taken on the line 4 4 in Fig. 3. Fig. 5 is a plan view showing two adjacent grinding-wheels and a coöperating blade-carrier. Fig. 6 is an end elevation of a blade-holder, hereinafter described, containing an unground blade; and Fig. 7 is a side elevation of the parts shown in Fig. 6. Fig. 8 is a plan view of one of the blades above referred to. Fig. 9 is a view, principally in central vertical section, showing a modified construction of my apparatus; and Fig. 10 is a plan view of a portion of the table shown in Fig. 9. Fig. 11 is a detail view in central vertical section, showing another modification.

My apparatus is preferably so organized as to be capable of grinding a number of blades at once, and to this end I provide a circular table 2, supported on suitable legs 3 and having an upwardly-extending rim 4, thus giving the top of the table the form of a shallow receptacle, the bottom 5 of which preferably slopes downward toward its center for a purpose which will presently appear. Near the rim of the table is located a circular series of rotatable abrading-wheels 6 of a character suitable for the work to be done, each of said wheels 6 being detachably secured to a spindle 7, journaled vertically in suitable bearings 8, carried by the table 2, as shown in Fig. 2. In order that the wheels 6 may be rotated simultaneously, each spindle 7 is provided near its lower end with a gear 9, meshing with a single central gear 10, which is secured to the lower end of a vertical shaft 11, the latter being supported and driven as hereinafter described.

At a suitable distance from each abrading-wheel 6 is located a device for carrying a blade-holder and blade and applying the latter to the abrading-surface. This blade-carrier forms an important feature of my invention and is so constructed and arranged that it will hold a blade against the abrading-surface with a degree of pressure which may be accurately and minutely regulated. To this end my blade-carrier preferably consists of a cap 12, mounted loosely on a vertical spindle 13 and supported on a friction pad or disk 14, of leather or other suitable material, which rests upon a collar 15, rigidly secured to the spindle 13, the latter being journaled in bearings 16, which are carried by the table 2 and

arranged in the same manner as the bearings 8, in which the spindles 7 turn. On the lower end of each spindle 13 is secured a gear 17, and all the spindles 13 are caused to rotate simultaneously by means such as a central gear 18, meshing with the gears 17 and secured to a central shaft 19, which is suitably supported and driven, as hereinafter described. The cap 12 is provided with a tube 20 or equivalent device, adapted to receive a holder to which the blade to be ground is detachably secured, said blade being thereby held in proximity to one of the abrading-wheels at such an angle with respect to the surface thereof as will cause the cutting edge, which is ground, to have the desired bevel. As thus constructed the rotation of the spindles 13 will cause the caps 12 to turn until the blades which they carry are brought against the respective abrading-wheels to which said blades are adjacent, whereupon the further movement of said caps will be arrested and the continued turning of said spindles will cause the blades to bear against the respective wheels 6 with a pressure which will depend upon the amount of friction existing between the caps 12 and the friction-disks 14. The amount of this friction will evidently vary with the pressure of said caps upon the disks 14, so that by varying said pressure, as by slipping weights upon pins 21, secured to the tops of said caps, respectively, the pressure of the blades upon the abrading-surfaces may be given any desired amount and can in no case be increased or made excessive by any irregularity in the action of the apparatus.

My blade-holder as constructed to receive a blade such as is shown in Fig. 8 preferably consists of a rod or stem 22 of such size as to fit the tube 20 easily and provided at its outer end with spring-actuated jaws having opposed flat faces adapted to receive a blade 24 between them, one of said jaws being rigidly secured to the rod 22 and the other jaw being hinged thereto. The blade is properly positioned with respect to these jaws by means such as studs 25, formed on one of said jaws and adapted to pass through perforations 26 in the blade into corresponding holes 27, drilled through the other jaw. The inner faces of the jaws 23 are preferably recessed somewhat near their hinged edges, as shown at 28 in Fig. 6, to the end that when two opposite cutting edges are to be ground on one blade, as is usually the case, the edge first ground will be located within said recess while the other edge is being ground and will thereby be kept from contact with the jaws 23 or anything else which might injure it. In Fig. 7 I have shown the hinged jaw as provided with a recess 29, adapted to receive one end of a rod 30,(shown in dotted lines in Fig. 6,) which is inserted into said recess by the operator and used as a lever to open the jaws 23 when it is desired to remove or insert a blade.

It will be understood that the blade-holder just described is designed particularly for use in connection with blades such as shown in Fig. 8 and that other forms of blade-holder suited to other types of blade may be employed, if desired, without affecting the other features of my invention.

In order that all portions of the edge of each blade may be caused automatically to bear with equal pressure upon the abrading-surface, the rod 22 is secured to the blade-holding jaws 23 at their longitudinal center and is formed to fit the tube 20 with sufficient looseness to permit said rod to turn freely therein, the edge of the blade being thereby rendered self-alining to the abrading-surface, and in order to distribute and equalize the abrading action on the wheels and blades, as well as to combine the rotary movement of said wheels with an axial movement thereof, so as to give a drawing action to the abrading-surface, I prefer to mount the spindles 7 in such manner that they will be capable of sliding vertically in their bearings 8 and to impart to them a periodic vertical reciprocation of such extent that all parts of the abrading-surface will be brought into contact with each blade. The gear 10 is made thick enough to permit the desired reciprocation to be given to the spindles 7 without causing said gear to become disengaged from the gears 9, and for reciprocating said spindles I have devised an arrangement (best illustrated in Fig. 2) according to which a ring 31, preferably provided on its upper face with an annular channel 32, is carried by suitable supports which are not all located in the same horizontal plane and of which at least one is secured to the gear 10 or to some part rotating therewith, the spindles 7 being supported by said ring. In the construction shown the ring 31 is a loose or floating ring and is supported on three rollers 33, carried by hangers 34, which are secured to the gear 10, one of said hangers being longer than the others. The lower end of each of the spindles 7 is caused to project a short distance below the corresponding gear 9, which it carries, and is rounded, so that it will slide easily along the bottom of the channel 32, on which it rests. As thus constructed the ring 31 is at all times uniformly inclined with respect to a horizontal plane; but the line of its greatest inclination is shifted around a central vertical axis as the gear 10 rotates, with the result that each spindle 7 is raised and lowered once during each rotation of said gear through a distance which is determined by the inclination of the ring 31, and said ring being loosely supported is caused to move slowly along the rollers 33 by its slight frictional contact with the lower ends of the spindles 7, all of which rotate in the same direction. The wear on the ring

caused by said spindles is thus distributed uniformly throughout the length of the channel 32 and is prevented from wearing a depression in any one particular spot, and thus varying the position of the corresponding abrading-wheel. Lateral movements of the ring 31 may be prevented by the ends of the spindles 7 or by so forming the nuts 35, which clamp the gears 9 to the spindles 7, that they will enter the channel 32 a short distance, as shown in Fig. 2.

In order that the grinding of the edge of a blade may proceed at substantially the same rate on each bevel, I prefer to provide means whereby the direction of rotation of the spindles 13 is reversed at short periodic intervals, the result of such reversal evidently being to cause each blade to be moved away from the abrading-surface against which it was previously held until the opposite side of the blade is brought into contact with a wheel 6. According to the arrangement shown in Fig. 5, the distance between the adjacent abrading-wheels 6 is such with respect to the position of the spindle 13 that the reversals of said spindle will cause the blade which it carries to oscillate between said two adjacent wheels 6. It will be evident, however, that if that wheel 6 which is shown uppermost in Fig. 5 were located at such a distance from the lower wheel 6 that the blade could pass by said uppermost wheel without coming in contact with it then the reversal of the spindle 13 would result in carrying said blade around said spindle until the blade was brought against the lower side of the lower wheel 6, so that both sides of each blade would in such case be ground on the same wheel, whereas in the arrangement shown they are ground on adjacent wheels. I prefer the arrangement shown, however, on account of its compactness.

For mounting and rotating the shafts 11 and 19 my preferred construction is that shown in Fig. 2, according to which the shaft 19 is supported near its upper end on a ball-bearing located at the top of a hollow column 36, bolted to the top of the table 2, and is provided with a gear 37, meshing with a gear 38, secured to a horizontal shaft 39, the latter being provided with two loose pulleys 40 and 41 and an intermediate fas tpulley 42. Said shaft 19 is journaled in the column 36 and table 2 and is itself made hollow to receive the shaft 11, which is journaled therein and supported on the top thereof on a ball-bearing 43 and is provided with a gear 44, meshing with a gear 45, secured to the shaft 39. The arrangement is preferably such that the shafts 11 and 19 are rotated in opposite directions, since the wheels 6 are thus caused to grind against the edges of the blades, as shown in Fig. 5. When the machine is to be used for polishing and finishing the edges of the blades, the grinding-wheels are replaced by suitable polishing-wheels, and in this case said polishing-wheels should rotate away from the edges of the blades. To this end the gears 37 and 44 may be locked together by means of a threaded bolt 46 passing through the gear 44 and adapted to be screwed downward until its lower end passes into an opening 47 formed in the gear 37. The gear 45 is then disconnected from the shaft 39 by driving out the pin 48, and both the shafts 11 and 19 will then be rotated in the same direction, thus producing the desired relation at the polishing-wheels.

For reversing the shafts 11 and 19 at periodic intervals I have devised the mechanism shown in Fig. 1, in which the shaft 39 is shown as provided with a screw-threaded portion 49, on which a nut 50 is arranged to travel, said nut being connected with means for reversing the direction of rotation of the shaft 39 at the end of the travel of said nut in either direction. Said reversing means may consist of a shipper-rod 51, mounted to slide longitudinally in the upper ends of the arms 52, in which the shaft 39 is journaled, and provided with pins 53, between which driving-belts 54 and 55 pass. These belts travel in opposite directions, and the arrangement is such that when the shipper-rod is in the position shown in Fig. 1 the belt 54 will drive the fast pulley 42, and the belt 55 will drive the loose pulley 41; but when said shipper-rod is moved to the left a suitable distance the belt 55 will pass onto the fast pulley 42 and the belt 54 will pass onto the loose pulley 40, whereupon the direction of rotation of the shaft 39 will evidently be reversed. The shipper-rod 51 is operated by an arm 56, pivoted at is lower end to the nut 50 and provided with a slot 57, which receives a pin 58, rigidly secured to said shipper-rod. The upper end of the arm 56 is weighted, being preferably provided with a traveling weight, such as a heavy ball 59, adapted to roll in a closed tube 60. In operation, assuming that the parts are in the position shown in Fig. 1, the shaft 39 will be rotating in such a direction as to cause the nut 50 to travel toward the center of the machine, which movement of said nut will gradually carry the arm 56 through its vertical position, whereupon the ball 59 will roll to the other end of the tube 60 and instantly exert a force sufficient to tilt said arm outward or away from the driving-belts, and thereby draw the shipper-rod to the left and cause the reversal of the shaft 39, as above described. The nut 50 will thereupon travel in the opposite direction until the shaft 39 is again reversed.

The pivoted latches 61 and 62 (shown in Fig. 1) are for the purpose of stopping the machine when desired, which is accomplished by throwing both of said latches over until they point away from each other, whereupon when the arm 56 is next shifted the shipper-rod 51 will move through one-half its normal travel

only, and hence will bring both the belts 54 and 55 upon the loose pulleys 40 and 41 near the inner edges of the latter, in which position of the belts the shaft 39 will not be driven at all. The collars to which the latches 61 and 62 are pivoted serve as stops to limit the movements of the shipper-rod 51, and said rod is prevented from turning axially by means such as an arm 63, secured to it and provided with a forked lower end loosely embracing the shaft 39.

When my apparatus is in use, it is usually desirable to keep the abrading-wheels 6 supplied with oil or with a mixture of oil and fine grit, and to this end I prefer to provide my apparatus with a tank or basin 64, which may be cast integral with the hollow column 36, as shown in Fig. 3, and is kept filled with the oil or mixture. From this basin leads a series of pipes 65, corresponding in number to the abrading-wheels 6, the lower end of each pipe being located in proper position to deliver oil to one of said wheels. The oil or mixture which flows through these pipes and over the wheels is caught by the inclined bottom 5 of the table 2 as it drips from the wheels and collects in a depression 66, located near the central portion of said table, whence it is pumped back to the basin 64 automatically. I have shown in Fig. 3 the pump which I prefer to employ for this purpose, it being a diaphragm-pump consisting of a short cylinder 67, carried by a supporting-block 68, which contains the valves and is secured to the framework of the machine. Said cylinder is closed at its top by a flexible diaphragm 69, usually made of a sheet of rubber clamped between the top of the cylinder 67 and a ring 70, bolted thereto. From the support 68 a pipe 71, open at its bottom, leads through a tubular aperture 72 in the basin 64 nearly to the bottom of the depression 66 in the table 2, and another pipe 73 is arranged to deliver from said support into the basin 64, said pipes 71 and 73 being connected by suitable valved passages in such manner that oscillation of the diaphragm 69 will result in raising the oil from the table 2 and emptying it into the basin.

The valves and connecting passages (shown in Fig. 4) are contained in the support 68, which is preferably made from a solid block of metal by boring and cross-boring the latter to form the desired passages and closing portions of said passages where necessary by plugs 74. The valves are shown as ball-valves operating by gravity, the inlet-valve 75 being located at the top of the pipe 71. From said valve 75 a passage 76 leads to the outlet-valve 77, and from the latter valve a passage 78 leads to the discharge-pipe 73. A passage 79 leads to the pump-cylinder 67 from the passage 76 between the valves, and thus the oscillations of the pump will result in lifting the oil through the pipe 71 and forcing it out through the pipe 73 in an obvious manner.

In order to prevent the oil pumped up from the table 2 from coming in contact with the diaphragm 69, I prefer to insert two partitions 80 and 81 in the cylinder 67, one of said partitions being perforated at its center and the other near its circumference, as shown at 82 and 83, respectively, so that inasmuch as the perforations are non-registering no oil can splash up through them in sufficient quantities to reach said diaphragm, and said partitions are so shaped that if any oil does pass up through either or both of them it will immediately drain out through said perforations. It will be understood that the pump-cylinder 67 is intentionally left full of air, or substantially so, and the diaphragm 69 when operated acts upon this body of air to expand and contract it, the variations in pressure thus produced in said body of air being sufficient to cause the flow of oil through the valves 75 and 77. Owing to the elasticity of the air-cushion thus provided, the diaphragm 69 need not be oscillated gradually or steadily; but its oscillations may be sudden and violent without detriment to the apparatus. For operating said diaphragm I prefer to provide a ring-shaped lever 84, supported on the top of the column 36 and pivoted at opposite sides thereof, as shown at 85, said ring being provided on each side between its pivots with outwardly-extending arms 86 and 87, carrying rollers 88, which bear against a cam-shaped flange formed on the under side of the gear 37 and consisting of substantially equal horizontal portions 89 and 90, connected by inclined portions 91. Each rotation of the gear 37 in either direction will thus cause the ring 84 to oscillate twice, and said oscillations are imparted to the diaphragm 69 by means such as a rod 92, pivoted to the arm 86 and provided near its lower end with plates 93 and 94, between which said diaphragm is clamped by means of a nut 95.

In order that the bearings 8 and 16 may be kept free from the grit employed in or produced by the grinding of the blades, I prefer to mount said bearings in hollow cylindrical housings 96 and 97, cast integral with the table 2 and extending far enough above and below the same to provide a sufficiently long support for the spindles 7 and 13 and to keep their open upper ends above the level of the oil collected by the table. Said upper ends of the housings 96 and 97, respectively, may be covered by flanged caps 98, which are secured to the spindles 7 and carry the abrading-wheels, and by flanges 99, formed on or secured to the collars 15, as shown in Fig. 2.

The operation of my apparatus will be readily understood without further explanation. The blade-holders can be inserted into and withdrawn from the tubes 20 easily and quickly, and the only attendance necessary is such as is involved in removing each blade-holder as soon as the desired edge has been ground on the corresponding blade, reversing

said blade, or replacing it by another, and then replacing the blade-holder.

In Figs. 9 and 10 I have shown a somewhat modified construction of my apparatus, according to which the alternate abrading-wheels 6′ rotate in opposite directions and are not reversed at all, one of each pair of said wheels being driven, as previously described, by means of a gear 9′, meshing with the central gear 10, and the other abrading-wheel of each pair being driven by supplying its spindle with a gear 9″, meshing with the gear 9′, which drives the adjacent spindle. In this case the spindles which carry the gears 9″ are journaled at a somewhat greater distance from the center of the table 2′ than their companion spindles, as shown in Fig. 10, in order that said gears 9″ may not mesh with the central gear 10, and the channel 32′ in the ring 31′ is made wide enough to receive the lower ends of all of said spindles. The central gear 10 is secured to the vertical shaft 11, constructed and supported as previously described; but the gear 44′, which drives said shaft, is secured to a driving-shaft 39′, which is distinct from the shaft 39 and may be journaled thereon, said shaft 39′ being provided with a fixed driving-pulley 40′, which is continuously rotated in the same direction. With this arrangement of abrading-wheels the blade-carriers are located alternately inside and outside of the circle of abrading-wheels, and the inner series of blade-carriers is driven, as previously described, by means of the central gear 18, meshing with the gears 17′, secured to the respective spindles on which the blade-carrying caps 12′ are mounted, the reversal of these spindles and the resulting oscillation of the blades being accomplished by the same arrangement of shafts, belts, and reversing mechanism as that previously described. For convenience the blade-carriers located outside of the circle of abrading-wheels are oscillated by means of yielding connections between them and the inner series of blade-carriers, so that the blades carried by both the inner and outer carriers will be held against the respective abrading-wheels with a pressure which cannot exceed that produced by the rotation of the respective spindles which actuate the inner carriers. As preferably constructed each outer carrier consists of a cap 12″, journaled on a fixed vertical spindle 13″ and provided with a laterally-extending tube 20″ for receiving a blade-holder. Said cap 12″ is connected with the corresponding cap 12′ by means of a rod 100, passing loosely through the perforated ends of arms 101 and 102, rigidly secured to said caps 12′ and 12″, respectively, the connection between these arms being made yielding by means of springs 103, bearing against said arms 101 and 102 and against nuts 104, secured to said rod 100. These parts should be so proportioned that the blade carried by each cap 12″ will be brought into contact with a wheel 6′ a little before the blade carried by the corresponding cap 12′ is brought into contact with its wheel 6′, so that the last portion of the movement of the latter cap will compress one of the springs 103, and thus provide a force for holding the former blade against the abrading-surface. This force will evidently diminish by its own amount the pressure with which the blade carried by the cap 12′ would otherwise press against its wheel 6′ and may be compensated by suitably weighting said cap 12′, and thus increasing the friction between it and the friction-disk which supports it. As thus constructed all the abrading-wheels will rotate in the same direction with respect to the edges of the respective blades which are applied thereto, and each blade will be periodically oscillated between two adjacent wheels and held against the same with a yielding pressure, which is regulated by the amount of friction between its cap 12′ and the spindle which supports and actuates it. It will be evident that the outer series of blade-carriers may be omitted, if desired, with no other result than the reducing of the capacity of the machine one-half.

In Fig. 11 I have shown a construction by means of which my machine may be adapted to grind twice as many blades at one time as with the constructions above described. According to this modification I provide each spindle 7^a with two abrading-wheels 6^a, located one above the other, and each spindle 13^a carries two blade-carrying caps 12^a, correspondingly located one above the other and independently supported on friction-disks 14^a, resting upon collars 15^a, rigidly secured to said spindle, each of said caps being provided with a laterally-extending tube 20^a, as previously described. With this construction each spindle 13^a will hold each of the blades which it carries against the corresponding abrading-wheel with a pressure which is wholly independent of the pressure applied to the other blade, and both of said blades will be simultaneously oscillated, as will be evident. It will also be evident that more than two abrading-wheels and blade-carriers might be superimposed in this manner, if desired, and that a series of wheels and carriers so constructed may be arranged and operated as shown in Figs. 10 and 11, as well as in the manner shown in other figures of the drawings, and I do not consider my invention to be limited to any specific number or arrangement of abrading-wheels or to any particular mechanism for rotating them, since the apparatus herein shown and described may be greatly varied in these particulars and in its other features of construction without departing from my invention.

I claim as my invention—

1. In a machine of the character described,

the combination with a moving abrading-surface, of a blade-carrier, and means frictionally engaging said carrier for applying the blade to the abrading-surface.

2. In a machine of the character described, the combination with an abrading-wheel and means for driving the same, of a frictionally-actuated blade-carrier located adjacent to said wheel.

3. In a machine of the character described, a blade-carrier comprising a continuously-driven spindle, a cap in frictional engagement therewith, and means for detachably securing a blade to said cap.

4. The combination with an abrading-wheel and means for rotating the same, of a blade-carrier comprising a spindle, a cap supported thereby in frictional engagement therewith, means for detachably securing a blade to said cap, and means for rotating said spindle.

5. The combination with an abrading-wheel and means for rotating the same, of a continuously-driven spindle, a cap frictionally actuated thereby, and a blade-holder pivotally secured to said cap.

6. The combination with an abrading-wheel and means for rotating the same, of a blade-carrier comprising a spindle, means for rotating the same, and a cap loosely supported thereon, and means for periodically reversing said wheel and spindle.

7. The combination with an abrading-wheel and means for rotating the same, of a rotating spindle, a cap loosely supported thereon, a blade-holder pivotally secured to said cap, and means for simultaneously reversing said wheel and spindle.

8. The combination with a pair of abrading-wheels and means for rotating the same, of a blade-carrier adapted to present a blade to either of said wheels, and means for periodically oscillating said blade-carrier.

9. The combination with a pair of abrading-wheels and means for rotating the same, of a rotatable spindle and means for driving the same, a cap loosely supported on said spindle and provided with means for detachably receiving a blade, and means for periodically reversing said spindle.

10. The combination with a pair of abrading-wheels and means for simultaneously rotating the same in the same direction, of a spindle, means for rotating the same, a cap loosely supported on said spindle and provided with means for detachably receiving a blade, and means for simultaneously reversing said spindle and abrading-wheels at periodic intervals.

11. The combination with an abrading-wheel of a blade-carrier arranged to hold a blade against the same, means for rotating said wheel, and means for simultaneously reciprocating said wheel axially.

12. The combination of a table, a series of abrading-wheels journaled thereon, means for rotating said wheels simultaneously, means for holding a corresponding series of blades against said wheels respectively, and means for simultaneously reversing said wheels and shifting the respective blades therefrom to the adjacent wheels.

13. The combination of a series of spindles journaled in vertical bearings and arranged to slide therein, an abrading-wheel secured to each of said spindles, means for rotating said spindles, an inclined ring arranged to support the lower ends of said spindles, and means for rotating the inclination of said ring around a central axis.

14. The combination of a series of spindles journaled in vertical bearings and arranged to slide therein, an abrading-wheel secured to each of said spindles, a gear secured to each of said spindles, a central gear meshing with said spindle-gears, and an inclined floating ring carried by said central gear and supporting the lower ends of said spindles.

15. The combination with a series of spindles journaled in vertical bearings and arranged to slide therein, an abrading-wheel secured to each of said spindles, a gear secured to each of said spindles, a central gear meshing with said spindle-gears, hangers secured to said central gear and provided respectively with rollers, and an inclined channeled ring supported loosely on said rollers and supporting the lower ends of said spindles within its channel.

16. The combination of a table having an inclined bottom, a series of abrading devices carried by said table, a basin provided with a series of pipes leading to said abrading devices respectively and adapted to supply oil thereto, and means for pumping oil received by said table into said basin.

17. In a machine of the character described, a table having an inclined bottom and provided with a series of hollow housings projecting above and below said table, for the purpose set forth.

18. In a machine of the character described, a blade-holder comprising clamping-jaws arranged to receive a blade between them, and a stem secured to said jaws and projecting therefrom in the plane of the blade.

19. In a machine of the character described, a blade-holder comprising clamping-jaws arranged to receive a blade between them, and a stem secured to said jaws and extending laterally from the center thereof.

20. In a machine of the character described, a blade-holder comprising a stem and blade-clamping jaws secured thereto, one of said jaws being provided with studs 25, and the other jaw being provided with recesses 27 adapted to receive said studs.

21. In a machine of the character described, a blade-holder comprising a stem and blade-clamping jaws secured thereto, said jaws being recessed as at 28 and provided with means

for positioning the blade with respect to said recess.

22. In a machine of the character described, the combination with a frictionally-actuated blade-carrier, of a blade-holder comprising blade-clamping jaws, and a central stem secured thereto and adapted to be pivotally attached to said blade-carrier.

23. In a machine of the character described, the combination with an abrading-wheel and means for rotating the same, of a rotatable spindle, a cap loosely supported thereby and provided with a laterally-extending socket, and a blade-holder comprising a stem adapted to fit said socket loosely and blade-clamping jaws secured to said stem.

24. The combination of a table, a circular series of spindles vertically journaled therein, each of said spindles being provided with an abrading-wheel and a gear, a concentric series of spindles vertically journaled in said table and provided respectively with a gear, a cap loosely mounted on each of the latter spindles and provided with means for detachably carrying a blade and applying it to an abrading-wheel, concentric vertical shafts supported by said table and provided with gears meshing respectively with the gears on said series of spindles, a horizontal shaft geared to said vertical shafts respectively, and means for rotating said horizontal shaft.

25. The combination of a table, a circular series of spindles journaled therein, each of said spindles being provided with an abrading-wheel and a gear, a concentric series of spindles vertically journaled in said table and provided respectively with a gear, a cap loosely mounted on each of the latter spindles and provided with means for detachably carrying a blade and applying it to an abrading-wheel, concentric vertical shafts supported by said table and provided with gears meshing respectively with the gears on said series of spindles, a horizontal shaft geared to said vertical shafts respectively, means for rotating said horizontal shaft, and means for periodically reversing the same.

26. In a machine of the character described, the combination of a series of abrading-wheels, a series of blade-carriers, a shaft provided with a screw-threaded portion, means for driving said shaft, driving connections between said shaft and said abrading-wheels and blade-carriers, and means for reversing said shaft at periodic intervals, comprising a nut arranged to travel on the screw-threaded portion of said shaft, an arm pivoted at its lower end to said nut and provided with a weighted head, a shipper-rod pivotally connected with said arm between the nut and head, and means carried by said shipper-rod for actuating the shaft-reversing mechanism.

27. In a machine of the character described, the combination of a table carrying a series of abrading-wheels and a corresponding series of blade-carriers, a basin and pipes leading therefrom to said abrading-wheels respectively, a pump arranged to transfer oil from said table to said basin and comprising a cylinder closed at its top by a flexible diaphragm and containing perforated partitions 80 and 81, and means for oscillating said diaphragm.

28. In a machine of the character described, the combination of a table carrying a series of abrading-wheels and a corresponding series of blade-carriers, a central shaft and driving connections between the same and said abrading-wheels, means for driving said shaft, a basin and a series of pipes leading therefrom to said abrading-wheels respectively, a pump for transferring oil from said table to said basin, and means for operating said pump comprising a pivotally-supported lever provided with oppositely-extending arms, connections between one of said arms and the pump, and a cam-shaped ring secured to said central shaft and arranged to bear against said arms, substantially as described.

29. In a machine of the character described, the combination with an abrading-wheel and means for rotating the same, of a blade-carrier, means for oscillating the same, and means for simultaneously reversing the rotation of said abrading-wheel.

30. In a machine of the character described, the combination with a pair of abrading-wheels and means for rotating the same in the same direction, of a blade-carrier adapted to present a blade to either of said wheels, means for shifting the blade from one wheel to the other, and means for simultaneously reversing the rotation of said wheels.

31. In a machine of the character described, the combination of an abrading-wheel, means for rotating the same, means for simultaneously reciprocating said wheel axially, a self-alining blade-holder, and means for moving the same toward said wheel.

32. In a machine of the character described, the combination of an abrading-wheel and means for rotating the same, a blade-carrier, a self-alining blade-holder carried by said carrier, and means for actuating the carrier to apply a blade to the wheel.

33. In a machine of the character described, the combination of a pair of abrading-wheels and means for rotating the same, a blade-carrier and means for oscillating the same, and a self-alining blade-holder carried by said carrier and adapted to present a blade to either of said wheels.

34. In a machine of the character described, the combination of a series of abrading-wheels and means for rotating the same in the same direction, a series of blade-carriers each provided with a self-alining blade-holder, and means for oscillating said carriers and simultaneously reversing the rotation of said wheels.

35. In a machine of the character described, the combination of a series of abrading-wheels

and means for rotating the same, a series of blade-carriers, and means for actuating the latter to apply the respective blades carried thereby to adjacent abrading-wheels in alternation.

36. In a machine of the character described, the combination of a series of abrading-wheels and means for rotating the same, a series of blade-carriers each provided with a detachable, self-alining blade-holder, and means for actuating said carriers to apply each blade to adjacent abrading-wheels in alternation.

37. In a machine of the character described, a table provided with a series of housings projecting above its top surface, a series of spindles journaled respectively in said housings, a cap carried by each spindle and covering the top of the corresponding housing, and an abrading-wheel carried by each spindle above its cap.

38. In a machine of the class described, the combination of a series of abrading-wheels and means for rotating the same, a series of blade-carriers provided respectively with detachable blade-holders, and means for actuating said carriers to apply the blades to the wheels.

39. In a machine of the character described, the combination of a circular series of abrading-wheels mounted on vertical axes and means for rotating the same, a concentric series of blade-carriers, and means for actuating said carriers to apply the blades to the wheels.

40. In a machine of the character described, the combination of a circular series of abrading-wheels and means for rotating the same, means for simultaneously reciprocating said wheels axially, a concentric series of blade-carriers and means for actuating said carriers to apply the blades to the wheels.

In testimony whereof I have hereunto subscribed my name this 13th day of March, 1902.

WILLIAM EMERY NICKERSON.

Witnesses:
R. M. DE VIGNIER,
E. D. CHADWICK.