W. E. NICKERSON.

GRINDING MACHINE.

APPLICATION FILED NOV. 26, 1907.

971,861.

Patented Oct. 4, 1910.

5 SHEETS—SHEET 1.

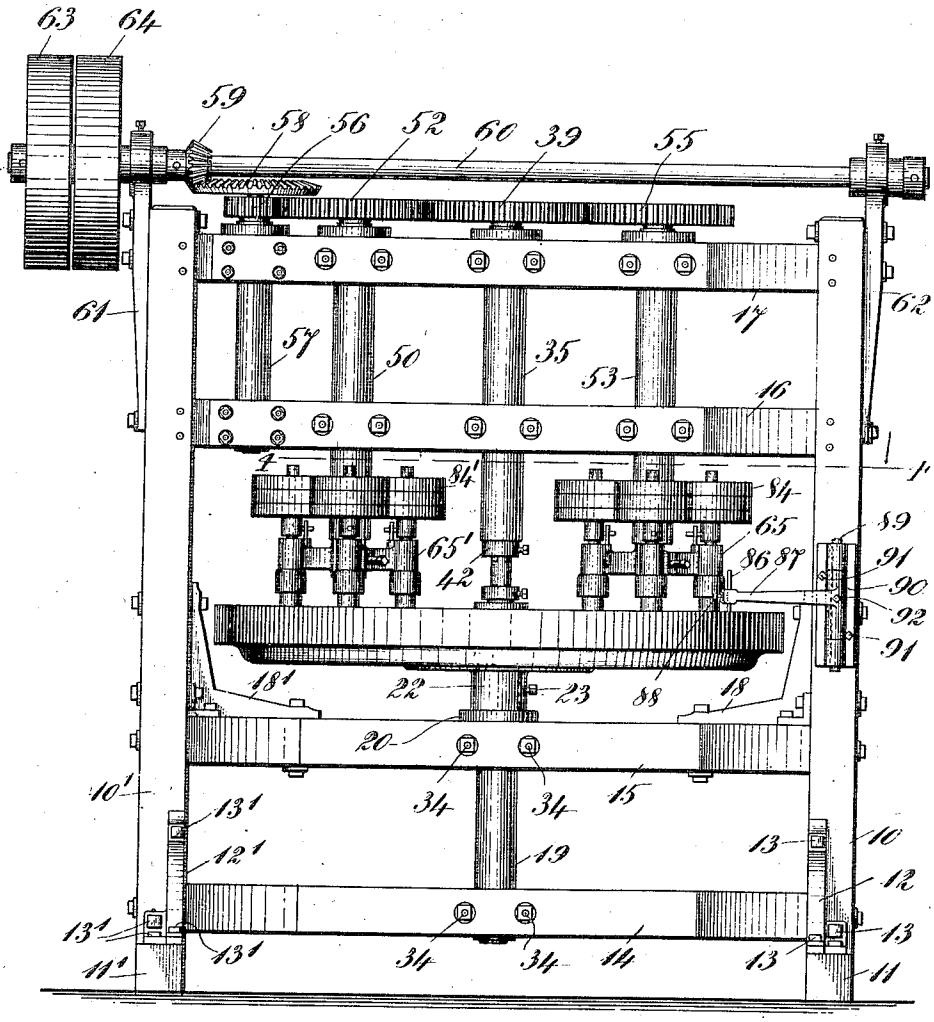

Fig. 1.

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5 SHEETS—SHEET 2

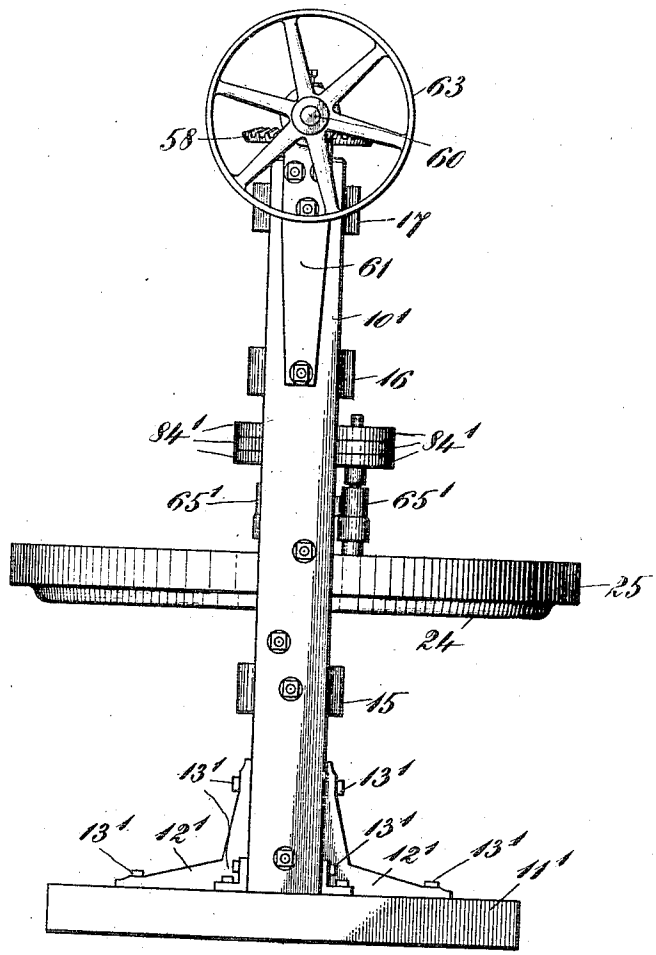

Fig. 2.

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5 SHEETS—SHEET 3.

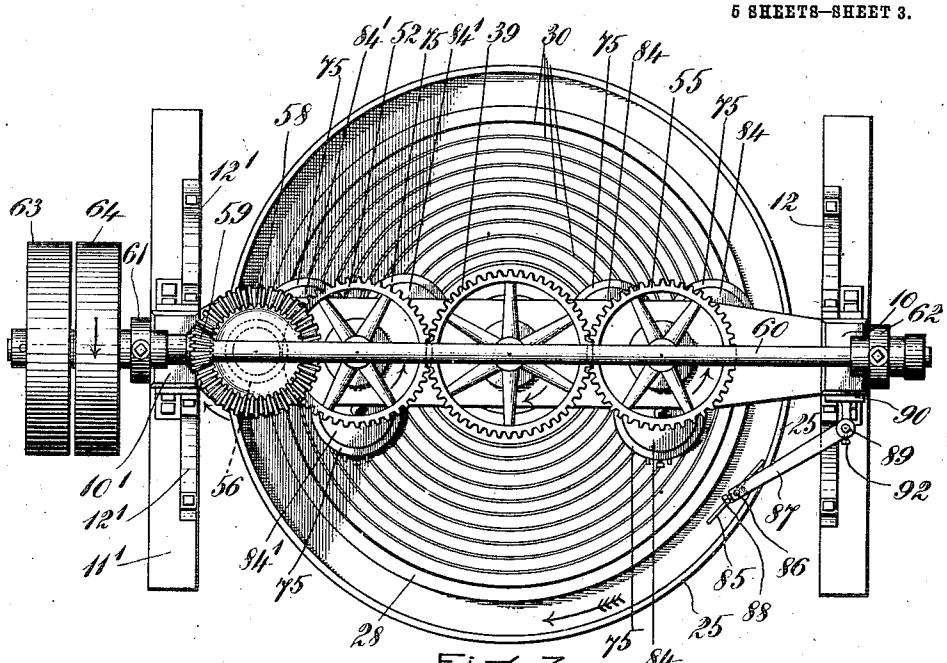

Fig. 3.

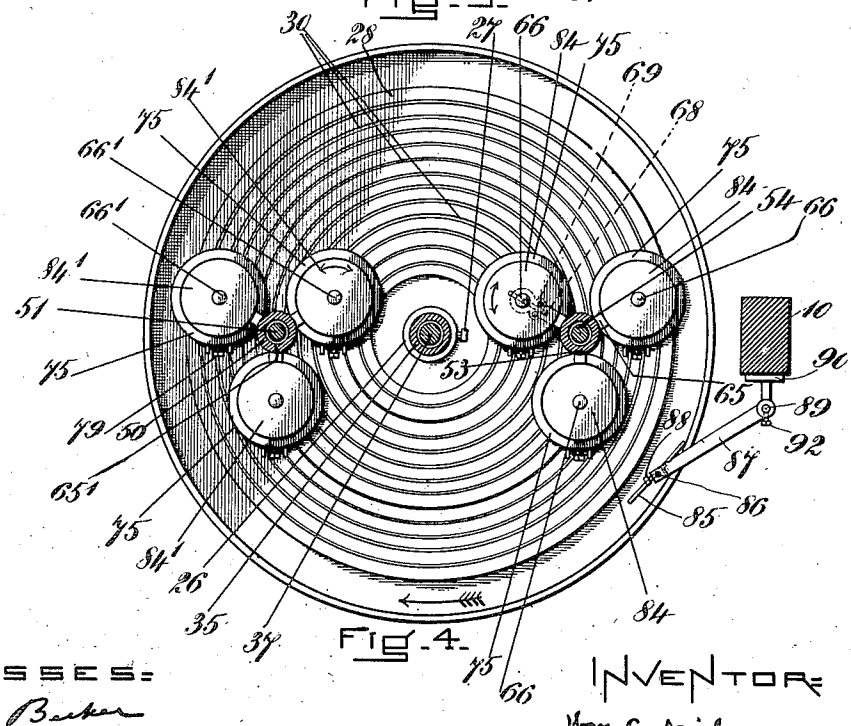

Fig. 4.

WITNESSES:

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5 SHEETS—SHEET 4.

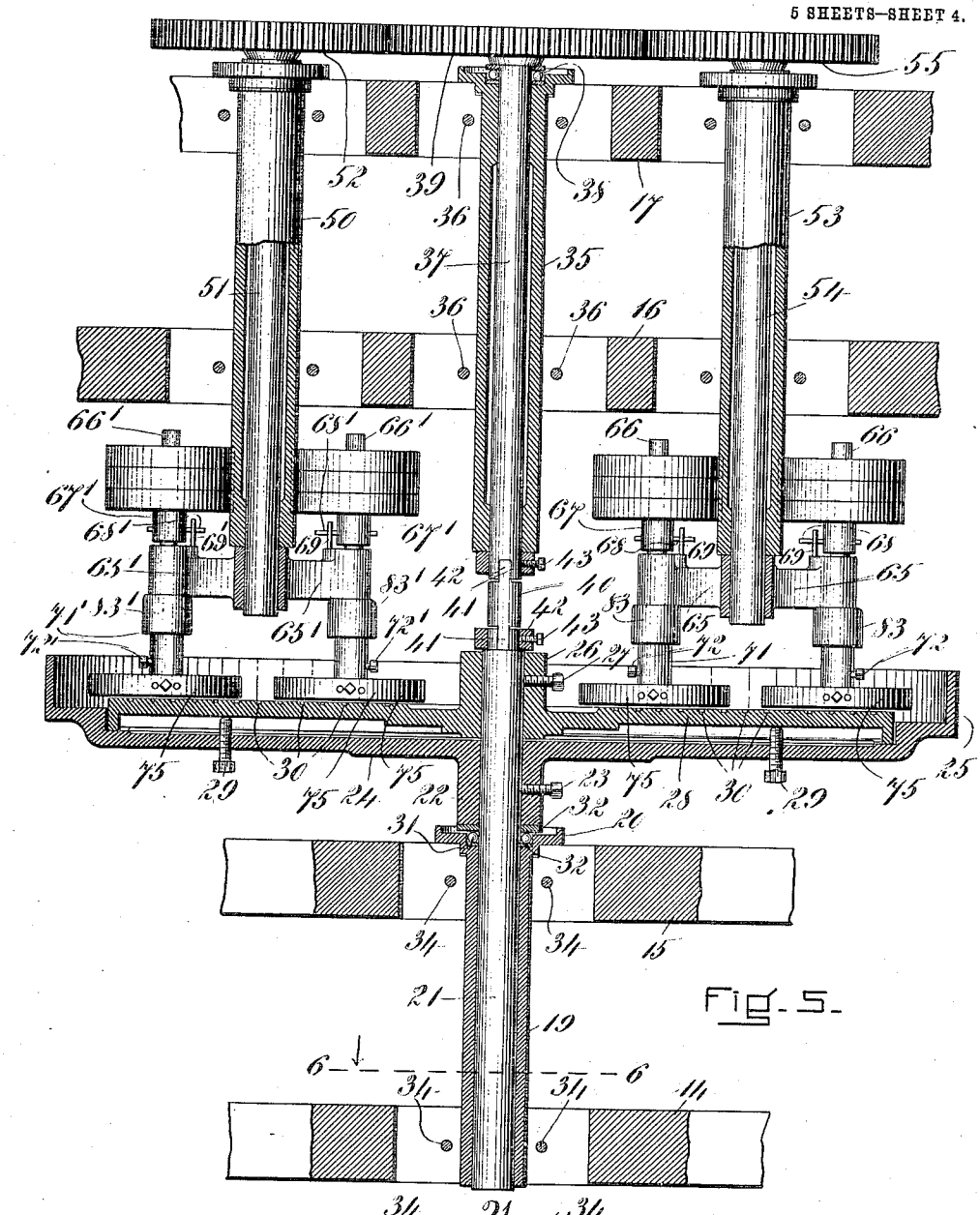

Fig. 5.

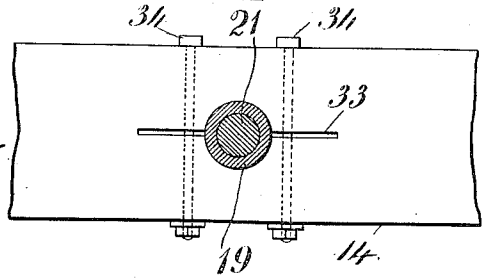

Fig. 6.

WITNESSES:

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5 SHEETS—SHEET 5.

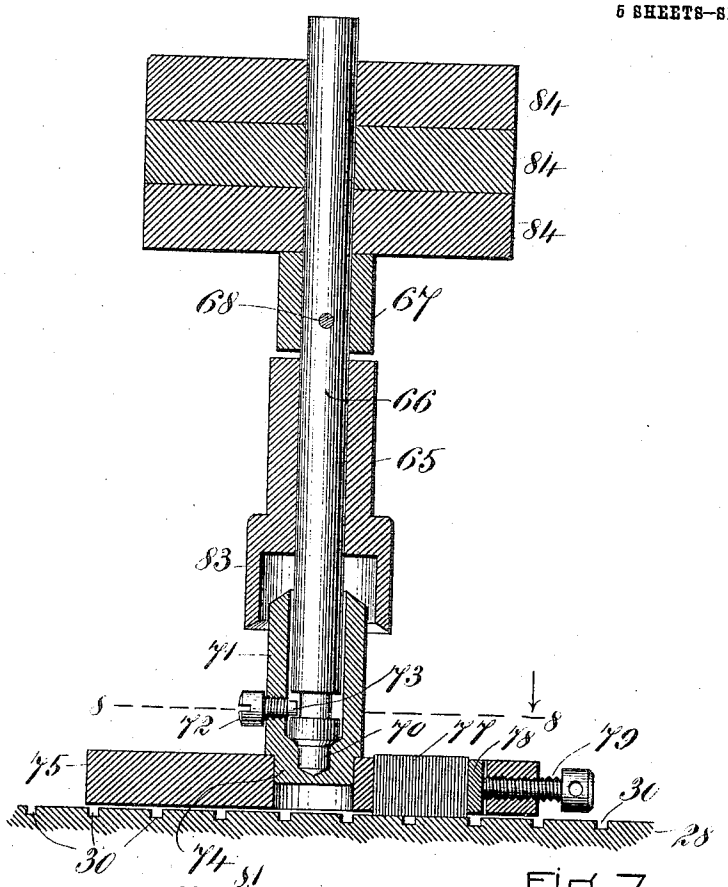

Fig. 7.

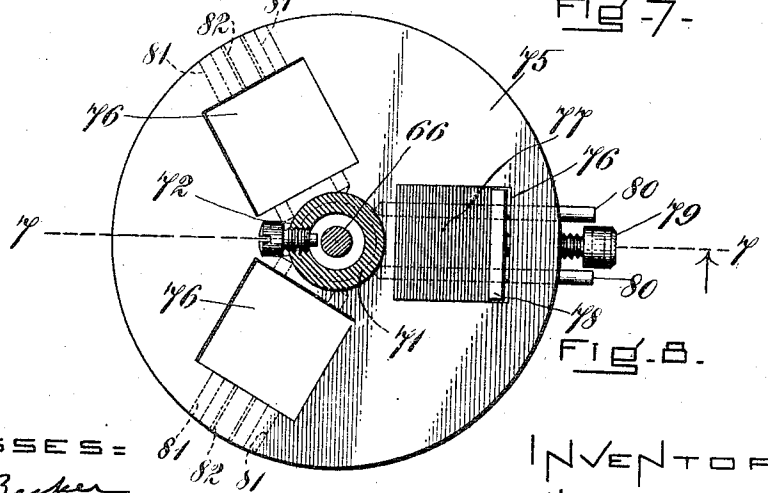

Fig. 8.

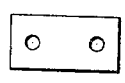

Fig. 9.

WITNESSES:

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UNITED STATES PATENT OFFICE.

WILLIAM E. NICKERSON, OF CAMBRIDGE, MASSACHUSETTS.

GRINDING-MACHINE.

971,861. Specification of Letters Patent. Patented Oct. 4, 1910.

Application filed November 26, 1907. Serial No. 403,852.

To all whom it may concern:

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

The present invention relates to grinding machines of the type in which the surface to be ground is rubbed in contact with a much more extensive abrasive plane, and the main object of the invention is to provide means for simultaneously handling a large number of the articles to be ground, in such manner as to insure that the grinding shall be both rapid and accurate.

By the present invention a number, preferably three, of the articles to be ground, or a corresponding number of stacks of such articles, are mounted in a common block, in a certain relative position to such block, at a distance from each other, and in such manner that they will act as well separated legs to firmly support the said block on and in definite relation to the grinding surface. The grinding plane is thus determined by three point bearing and the accuracy of the grinding action is dependent upon the fact that the individual articles to be ground have first been formed, roughly, to the proper size and are clamped in a certain proper relation to the block or work holder so that the effective dimensions of the stack and therefore the position of the grinding plane, are determined with considerable precision.

The invention further consists in making the block or work holder of such dimensions that the work may project through opposite faces of the block to permit of grinding directly opposite faces of the work in exact parallelism by simply reversing the block or work holder on the grinding surface. As this block or work holder and any flat abrading surface might be rubbed together by hand, the work holder alone constitutes an important feature of the invention. The relative motion of the two however, is best produced by mechanical means and my invention further comprises a special and novel means of producing the desirable degree of erratic motion necessary to secure an even wear of the work as well as to prevent tracking or grooving of the grinding surface. This means consists in relatively moving the grinding surface and the work holder about three non-coincident parallel axes, two of the rotations being positive and one free. The object of the free rotation is to permit automatic variations in the direction and velocity of rotation corresponding to variations that occur in the frictional forces acting between the grinding face and the work; and the object of the positive rotations is to cause the axis of free rotation to describe on the grinding face a species of wavy curve or roulette which shall make a great number of turns about the central axis of the grinding face before closing in upon itself.

The invention further consists in making the work holders easily removable from the machine and in providing a sufficient number of them to permit of loading and unloading them in any suitable part of the factory by unskilled hands while the machine is run and kept in constant operation by a more intelligent operator. Moreover, to secure an even and balanced pressure on the grinding wheel, a plurality of properly distributed heads is used, each provided with a plurality of work holders, and each of those work holders as above stated preferably carries and is supported by three stacks of articles to be ground.

The invention also comprises other features more or less incidental to the above.

In the preferred form of my invention described below, the grinding face is made horizontal and constitutes the bottom of the pan which is adapted to hold the abrasive mixture in fluid or semi fluid form. This pan is caused to rotate positively about its central vertical axis, which is the main axis of the machine. A positively driven vertical shaft, mounted in fixed bearings to one side of the said main axis, carries a spider or other head on which are mounted the blocks or work holders, preferably three in number, equally distant from each other and from the second axis, that is to say, circularly arranged on the head. Each work holder is mounted so that it may rotate freely on its own axis and it is held pressed against the grinding surface by its own weight and by its spindle which is loaded with removable weights, the number of which can be varied to secure corresponding variations in the grinding action.

Figure 1 is a front elevation of the machine in one of its preferred forms; Fig. 2

is an elevation of the left hand side of the machine; Fig. 3 is a plan; Fig. 4 is a horizontal section taken on the line 4—4 Fig. 1; Fig. 5 is a vertical section in the plane determined by the principal shafts of the machine; Fig. 6 is a section on the line 6—6 Fig. 5; Fig. 7 is a section on the line 7—7 Fig. 8; Fig. 8 is a section on the line 8—8 Fig. 7; and Fig. 9 is a face view of the blade stack clamping plate.

The frame of the machine comprises uprights 10 and 10′, Fig. 1, provided with feet 11, 11′ which are firmly connected at right angles to the uprights by compound brackets 12, 12′ held in place by lag screws 13, 13′. These two uprights 10, 10′ are connected by four horizontal beams 14, 15, 16 and 17. The beam 15, Fig. 1, is provided with brackets 18, 18′ (similar to the brackets 12, 12′ before described) for the purpose of stiffening the frame in a lateral direction. In the lower beams 14, 15, is mounted a tubular bearing 19 the head of which is expanded to form a ball bearing cup and retaining flange 20. In the tube bearing 19 is revolubly mounted a shaft 21 to which a hub 22 is firmly secured by means of a set screw 23. This hub 22 carries a disk 24 the extreme edge 25 of which is turned up to form a pan 24, 25, adapted to hold the abrading material. On this same shaft 21 is also fixed a hub 26, by means of a set screw 27, and this hub 26 carries the grinding wheel proper 28 which is leveled by means of screws 29 passing through the web 24. The surface of this grinding wheel is provided with concentric grooves 30 which are adapted to hold and retain the abrasive particles. When the grinding wheel 28 has been accurately adjusted and the different screws 23 and 27 have been tightened the pan 24, 25, and the grinding surface proper, 28, may be considered as an integral grinding wheel having rigidly connected therewith a shaft 21. To reduce the friction to a minimum, the weight of this heavy mass is supported on balls 31 rolling on removable bearing surfaces 32. A very practical method of mounting and holding the tubular bearing 19 consists in simply slotting the beams 14, 15, as shown at 33, Fig. 6, so that the walls of the bore may be squeezed together by bolts 34, to firmly clamp the tubular bearing.

In direct alinement with the tubular bearing 19 I provide a similar tubular bearing 35 similarly mounted and clamped in the cross beams 16, 17, the clamping means in this case being the bolts 36. In this tubular bearing 35 is mounted the shaft 37 carrying at its upper end the gear wheel 39 and supported with its gear wheel, on the roller bearing 38 the latter being substantially the same as the roller bearing 31, 32, before described. The shafts 37, 21 are thus virtually independent but they are more or less loosely connected by means of a coupling 40, the ends of which are reduced to form tenons 41 which engage in corresponding recesses or grooves formed in the facing ends of shafts 21, 37 respectively. To hold this coupling in place, collars 42 are provided, having set screws 43. By loosening the said set screws these collars can be slipped along onto the coupling 40 and removed with it. The collars are inserted with the coupling 40 and they are then slipped back into the positions illustrated in Fig. 5. In the cross beams 16, 17, is also mounted a tubular bearing 50, carrying shaft 51 and gear wheel 52 meshing with the gear 39 of the central shaft. At the same distance on the opposite side of the central shaft is mounted a similar and symmetrically arranged tubular bearing 53 with shaft 54 and gear wheel 55 also meshing with the central gear 39. These gear wheels 52, 39 and 55 are rotated by means of a pinion 56 (Fig. 1) mounted in the vertical tubular bearing 57. The pinion 56 revolves with the beveled gear wheel 58 which is actuated by the beveled pinion 59 and this turns with the shaft 60, which rotates in bearings 61, 62 bolted to the uprights 10′ 10 respectively. On the left end of the shaft 60 (Fig. 1) are mounted a loose pulley 63 and a fixed pulley 64. The right hand shaft 54 (Fig. 5) carries fixed at its lower end a spider 65 having at least 3 radial arms as shown and each of these arms is provided at its outer end with a vertical bore in which is carried a spindle 66, Fig. 7, which spindle is provided with a collar 67 held in place by pin 68, the latter being made long enough to project inwardly as seen in Figs. 4 and 5, between two vertical pins 69 fixed to the spider 65. This arrangement permits the spindle to rise and fall in the spider without turning. The only object of preventing the rotation of the spider is to avoid needless wear in the bearing of the spider, otherwise there would be no reason why the spindle should not be left free to rotate. The lower end of the spindle 66 is shaped as seen at 70 (Fig. 7) and rests in a cup 71 which is provided with a retaining screw 72, the reduced end 73 of which is loosely engaged in an annular groove in the lower end of the spindle 66. The underside of the cup 71 is reduced to form a cylindrical tenon 74 adapted to fit snugly, but removably, in the central cylindrical bore of a disk 75. This disk is provided with a number of openings 76 (see plan view Fig. 8) preferably not less than three for reasons which will appear later and in which the stacks of razor blades or other articles to be ground are firmly clamped. One stack of blades is shown at 77, Fig. 8, held clamped by a plate 78 against which acts the screw 79 which is threaded into the disk 75. It is obvious that the stack of blades may project more or less

below the lower edge of the disk 75 but in order that each blade shall be properly ground the exact position of the blade should be determined before the screw 79 is tightened. In the principal use to which the invention is especially adapted, to wit, grinding of the Gillette razor blades this adjustment is preferably secured by means of pins 80 which are adapted to pass through the extreme openings that are formed in the blade. These pins 80 are lodged in recesses or bores 81 seen dotted at the left in Fig. 8. 82 between the two bores 81 represents the threaded opening adapted to receive the screw 29. The holes 81 are very accurately bored midway between the opposite faces of the disk so that when the razor blades have been clamped in place these opposite faces of the disk will be equidistant from the central median plane of the stacks of blades, that is to say, from the plane determined by the longitudinal axis of symmetry of the blades.

Each arm of the spider 65 is provided with an inverted cup 83, Fig. 7, the object of which is to prevent dirt from falling into the cup 71.

The spindle 66 has two principal functions, first, to keep the vertical axis of the disk or head 75 at an invariable distance from the central axis of the spider 65, also to apply a constant pressure on the head 65, and to this end the upper part of the spindle 66 is made to project through the collar 67 far enough to hold any desirable number of removable disk shaped weights 84. The shaft 51 at the left, Fig. 5, carries a spider 65′ with parts 66′ to 84′ in all respects similar to the correspondingly numbered parts 66 to 84 described above.

During the grinding operation, the abrasive material is apt to collect at the periphery of the pan. In order to push it back on to the grinding surface, I provide a normally stationary blade 85 (Figs. 1, 3 and 4) carried by a vertical rod 86 which is adapted to slide and turn in the end of the arm 87 and be clamped in fixed relation to said arm by the set screw 88. The arm itself is adapted to turn on the fixed pin 89 which is mounted in the casting 90, secured to the upright 10 by lag screws 91. The arm 87 can be fixed in any of its angular positions on the pin 89 by the set screw 92, the blade 85 may therefore be set at any desired depth in the pan and may be held inclined at any desired angle to the rim 25.

The use of the machine will depend somewhat on individual preference and circumstances but the operation may substantially be described as follows: Work holders 75 are provided in sufficient number to permit the keeping of unskilled attendants busy stacking and unstacking blades as fast as the machine can grind them. The work holders 75 having been charged in any preferable part of the factory are brought to the operator of the machine who removes the work holders that may be in the machine, by raising the spindles 66 and 66′, and he inserts the new set of work holders after which he allows the spindles to fall so that the tenons 74 shall lodge in the central bore of the work holders. In order to permit this vertical motion of the spindles 66 and 66′ the bearing cup 83 is deeply recessed as seen in Fig. 7. The different revolving parts may rotate as indicated in Figs. 3 and 4, that is to say, the grinding wheel 28 and parts connected therewith may be rotated in clock-wise direction. Heads 65 and 65′ are then positively rotated in counter clock-wise direction and the work holders 75 carried by the spiders 65 and 65′ rotate freely on their spindles 66 and 66′ in either direction, according to the varying position which they happen to occupy with relation to the shafts 37 and 54, for the right hand set of heads, and to shafts 37 and 51 of the left hand set of heads; the direction of the rotation and its rate being entirely dependent upon the direction and intensity of the frictional forces which vary with these relative positions. The motion of any particular head is therefore extremely irregular but certain and the general wearing effect of all the heads is uniform not only on the work but also on the grinding surface. After the work holders have been inserted for grinding, and before the machine is started the pan 25 is filled with the abrading material or particles held in suspension in any suitable liquid, and the belt (not shown) is shifted to the live pulley 64 to drive the machine. The particles of abrading material are prevented from shifting too freely over the grinding surface 28 by the grooves 30 which also serve to carry the abrasive material in under the surfaces to be ground. The abrading material being in rotary motion naturally tends to move outwardly toward the rim 25 but the plate 85 (see Figs. 3 and 4) pushes it back onto the grinding surface and into the path of the adjacent revolving work holders to be carried in toward the center of the grinding surface. After the power shaft has turned a sufficient number of times to complete the first grinding operation it is stopped, and the work holders 75 are reversed. The machine is again started to grind the opposite edge of the blades and then stopped again for removal of the work holders which are then taken to a proper place for unstacking.

It is understood that the average width of the blades before grinding, that is to say, the distance between the edges thereof to be ground is the same although the exact width of any one blade might be hard to ascertain because of the irregularity of its edges. The

accuracy of the grinding operation is therefore entirely dependent, first, upon the fact that the blades in great number and properly stacked may be considered as having a certain exact average dimension. Secondly, upon the fact that three spaced stacks of blades accurately determine a grinding plane. The evenness of the grinding action on all the stacks is dependent upon the fact that they all pass through the same phases of motion with relation to the grinding wheel, and the evenness of the grinding action at the different points of any one stack is due to the fact that the stack surface being ground, is a relatively small element when considered with relation to the general dimensions of the curves described by the stack on, or with relation to, the grinding surface. The evenness of the wear on the grinding surface is insured by using gear wheels 39 and 55 having numbers of teeth that are prime to each other so that each wheel shall have to make as many revolutions as the other wheel has teeth before a cycle of different relative positions has been completed, and as this number of revolutions is relatively large all danger of tracking or grooving the grinding surface is avoided. The other gear wheel 52 may have the same number of teeth as wheel 55. After the second surface has been ground, the work holders 75 are removed to another part of the factory for unstacking of the blades and for refilling and are replaced by a new set of charged holders. The operation for the first lot of blades is repeated for the second, the third and all following lots, as fast as the machine can dispose of them.

The main characteristic feature of the machine is therefore seen to be that the accuracy of the grinding action is made to depend upon the average dimensions of the blades properly arranged in a block or work holder and does not depend in any way upon adjustments or on the accuracy of construction in other parts of the machine, such other parts having no other purpose but to hold the stacks against the grinding surface with a certain yielding pressure and to displace them thereon in a peculiar manner adapted to secure the required irregularity of relative displacement repeated uniformly for all points to be ground.

What I claim and desire to secure by Letters Patent is:—

1. A grinding machine comprising a grinding surface, a work holder mounted to move freely under the resistance developed by the grinding action between the work and the grinding surface and adapted to hold the work in contact with said grinding surface, and means for positively imparting bodily movements to the work holder over the grinding surface.

2. A grinding machine comprising an upwardly facing grinding surface, a vertically movable work holder mounted to rotate freely on a vertical axis and provided with means for securing the work thereto at a distance from said axis, and means for positively imparting bodily movements to the work holder over the grinding surface.

3. A grinding machine comprising a grinding disk and means for rotating the same, a frame mounted to rotate on an axis parallel with and to one side of the axis of the grinding disk, means for rotating said frame, and a work holder journaled in said frame and mounted to turn freely on an axis parallel with and to one side of the axis of the frame, said work holder being provided with means for securing the work thereto at a distance from its own axis and in position to bear against the grinding surface of the disk.

4. A grinding machine comprising a substantially horizontal pan mounted to rotate on a vertical axis, a grinding disk contained in said pan and mounted to rotate therewith, means for leveling the grinding surface of the disk with respect to the pan, and a work holder located above the disk and adapted to hold the work against the grinding surface thereof.

5. A grinding machine comprising a substantially horizontal grinding disk and means for rotating the same on a vertical axis, the upper surface of said disk being provided with grooves located beneath the surface of the work to be ground and adapted to receive abrasive material, means for supplying the abrasive material to the top of said disk, and a work holder located above the disk and adapted to hold the work against the grinding surface thereof.

6. A grinding machine comprising a pan adapted to hold a liquid containing abrasive material in suspension, a horizontal grinding disk located in said pan and means for rotating the same on a vertical axis, the upper surface of said disk being provided with grooves located beneath the surface of the work to be ground and adapted to receive abrasive material, and a work holder located above the disk and adapted to hold the work against the grinding surface thereof.

7. A grinding machine comprising a horizontal grinding disk and means for rotating the same on a vertical axis, a frame mounted to rotate on an axis parallel with and to one side of the axis of the disk, said frame being provided with a plurality of laterally-extending arms, means for rotating said frame, and work holders carried one by each of the arms of said frame and mounted to turn freely on a vertical axis, each work holder being provided with means for securing separated articles or stacks of articles thereto at a distance from its own axis.

8. In a grinding machine the combination

with a plane grinding surface and means for causing said surface to rotate about a central axis perpendicular thereto; of a work holder carrying a plurality of circularly disposed work holding clamps and means adapted to engage said work holder at a point on the axis of said circular series of work holding clamps so as to leave said work holder free to swivel and rotate about the said point of engagement; said work holder engaging means being adapted to cause said central point of engagement to revolve about a fixed axis substantially parallel to and at a distance from the axis of rotation of the said grinding surface.

9. In a grinding machine the combination with a plane grinding surface mounted horizontally to face upwardly, and means for causing said surface to rotate about a central axis perpendicular thereto; of a work holder carrying a plurality of circularly disposed work holding clamps and a spindle adapted to engage said work holder at a point on the axis of said circular series of work holding clamps so as to leave said work holder free to swivel and rotate about said point of engagement; said spindle being adapted to yieldingly press said work holder against said grinding surface; and means for carrying the said spindle positively around in a circle about a fixed axis substantially parallel to and at a distance from the axis of rotation of the said grinding surface.

10. In a grinding machine the combination with a plane grinding surface mounted horizontally to face upwardly and means for causing said surface to rotate about a central axis perpendicular thereto; of a work holder carrying a plurality of circularly disposed work holding clamps and a spindle adapted to engage said work holder at a point on the axis of said circular series of work holding clamps so as to leave said work holder free to swivel and rotate about said point of engagement; said spindle being weighted and adapted to yieldingly press said work holder against said grinding surface; and means for carrying the said spindle positively around in a circle about a fixed axis substantially parallel to and at a distance from the axis of rotation of the said grinding surface.

11. A grinding machine comprising a horizontal grinding surface and a spindle movable vertically toward and from the same, a work-holder secured to said spindle and adapted to be supported in proper relation to said surface by the work carried by said holder, the latter being provided with means for holding a plurality of separated articles or stacks of articles, and means for positively imparting bodily movements to the work-holder over said grinding surface.

12. In a grinding machine the combination with a plane grinding surface and a work holder carrying a plurality of circularly disposed work holding clamps, of means adapted to engage said work holder at a point on the axis of said circular series of work holding clamps so as to leave said work holder free to swivel and rotate freely about the said point of engagement under the control of the said grinding face; and mechanism connecting said grinding surface to said work holder engaging means, said mechanism comprising means for imparting to the work holder and the grinding surface relative displacements compounded of two positive rotations about two substantially parallel axes.

13. The combination with a plane grinding surface, means for causing said surface to rotate about a central axis perpendicular thereto; of a work holder carrying a plurality of circularly disposed work holding clamps and a spindle adapted to engage said work holder at a point on the axis of said circular series of work holding clamps so as to leave said work holder free to swivel and rotate about said point of engagement and mechanism connecting said spindle and said grinding surface, said mechanism comprising means for imparting to the work holder engaging spindle two positive rotations about two substantially parallel axes.

14. The combination with a plane grinding surface and a work holder adapted to be supported in proper relation to said surface by the work carried in said holder, said holder being provided with at least three separated work holding clamps arranged out of alinement.

15. The combination of a plane grinding surface and a work holder adapted to be supported in proper relation to said surface by the work carried in said holder, said holder being provided with at least three separated work holding clamps arranged out of alinement, and having means for gaging the proper relative position of the work to the holder in a direction perpendicular to the imaginary plane of the grinding action.

16. The combination with a plane grinding surface and a work holder adapted to be supported in proper relation to said surface by the work held in said holder, said holder being provided with at least three separated work holding clamps arranged out of alinement and having means for gaging the proper relative position of the work to the work holder in a direction perpendicular to an imaginary plane of the grinding action, also means for clamping the work in a direction parallel to such an imaginary plane of the grinding action.

17. The combination with a plane grinding surface and a work holder adapted to be supported in proper relation to said surface by the work held in said holder, said holder

being provided with at least three circularly arranged work holding clamps; and means for engaging said work holder at a central point and adapted to cause said central point of the holder to describe with relation to the grinding surface the species of curves known as roulettes.

18. The combination with a plane grinding surface and a work holder adapted to be supported in proper relation to said surface by the work held in said holder, said holder being provided with at least three circularly arranged work holding clamps; and having means for engaging said work holder at a central point, said means being adapted to press against the holder at the said point to yieldingly force the work against the grinding surface, and also being adapted to cause said central point of the holder to describe with relation to the grinding surface curves of the class known as roulettes.

19. In a grinding machine the combination with a plane grinding surface and means for causing said surface to rotate about a central axis perpendicular thereto, of a work holder carrying a plurality of circularly disposed work holding clamps and means adapted to engage said work holder at a point on the axis of said circular series of work holding clamps so as to leave said clamps free to swivel and rotate about said point of engagement, said work holder engaging means being adapted to cause said central point of engagement to revolve positively about a fixed axis substantially parallel to and at a distance from the axis of rotation of the said grinding surface.

20. In a grinding machine the combination with a plane grinding surface and means for causing said grinding surface to rotate about a central axis perpendicular thereto, of a work holder carrying a plurality of circularly disposed work holding clamps; and means adapted to engage the said work holder at a point on the axis of said circular series of work holding clamps so as to leave said clamps free to swivel and rotate about said point of engagement, said work holder engaging means being adapted to press said work holder against the said grinding surface and cause said central point of engagement to revolve positively about a fixed axis substantially parallel to and at a distance from the axis of rotation of the said grinding surface.

21. A grinding machine comprising a grinding surface and a work holder adapted to be supported in proper relation to said surface by the work held in said holder, and comprising three circularly arranged work holding means adapted to hold three articles or stacks of articles, with their surfaces to be ground lying substantially in the same plane.

22. In a grinding machine, a work holder and means for detachably connecting the same to the rest of the machine, said work holder being provided with means for holding a plurality of separated articles or stacks of articles with their surfaces to be ground projecting on the same side of the work holder.

23. In a grinding machine, a detachable and reversible work holder, and means for securing the work thereto with opposite faces of the work projecting simultaneously beyond opposite faces of the work holder.

24. In a grinding machine, a detachable and reversible work holder provided with means for securing a plurality of articles or stacks of articles thereto at separated points, with opposite faces of said articles or stacks of articles projecting simultaneously beyond opposite faces of the work holder.

25. In a grinding machine, a work holder comprising a parallel-sided disk provided with a central opening adapted to detachably receive a spindle, and provided with three work-holding recesses symmetrically disposed about the central recess and each adapted to hold an article or stack of articles to be ground, and means for positioning and securing said articles on said work holding recesses with the opposite faces thereof projecting simultaneously beyond opposite faces of the disk.

In testimony whereof, I have hereunto subscribed my name this twenty-third day of November, 1907.

WILLIAM E. NICKERSON.

Witnesses:
E. D. CHADWICK,
JOSEPH T. BRENNAN.