June 12, 1923.

1,458,528

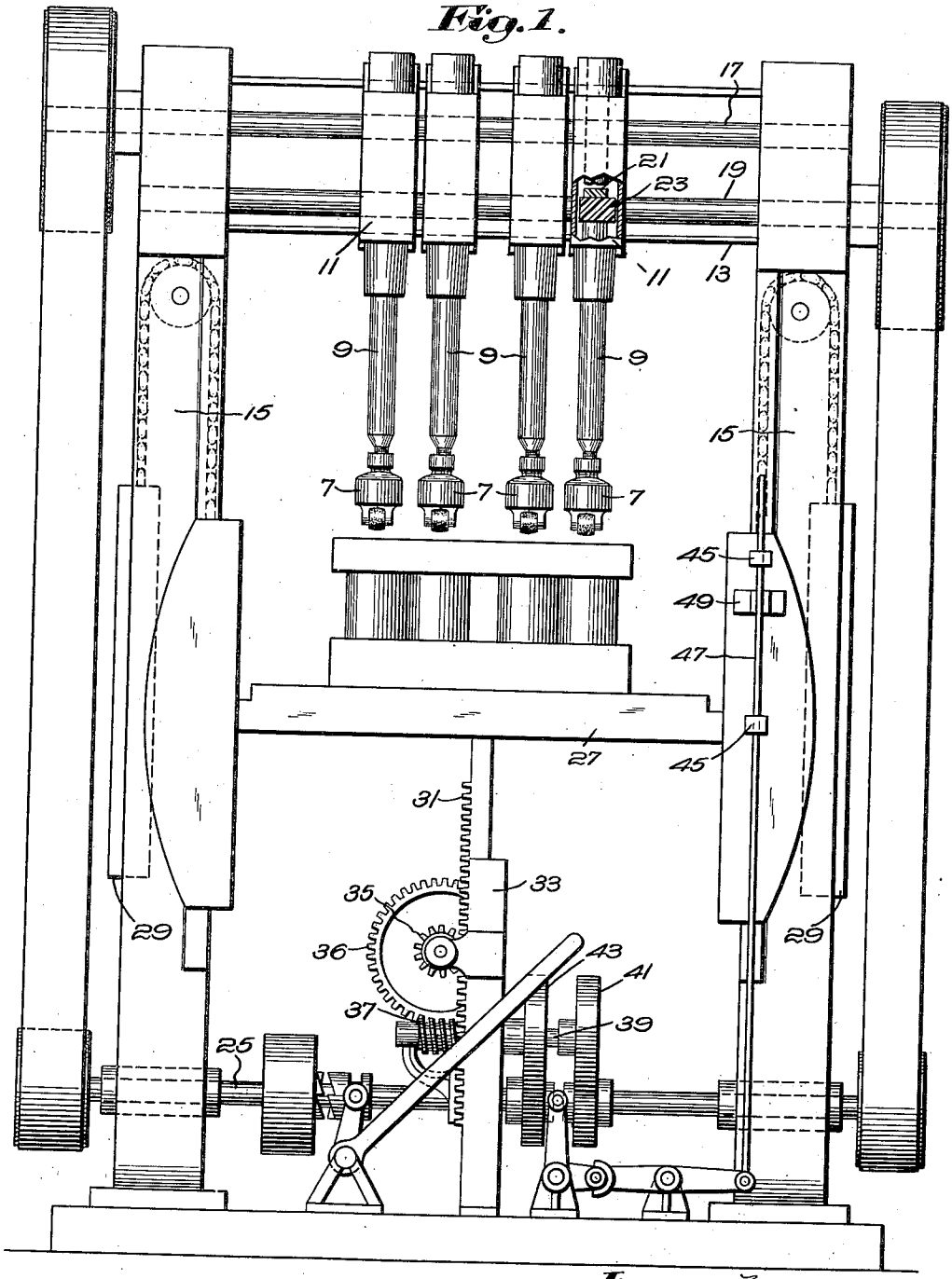
V. J. EMERY

GRINDING MACHINE

Filed Jan. 14, 1922

2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

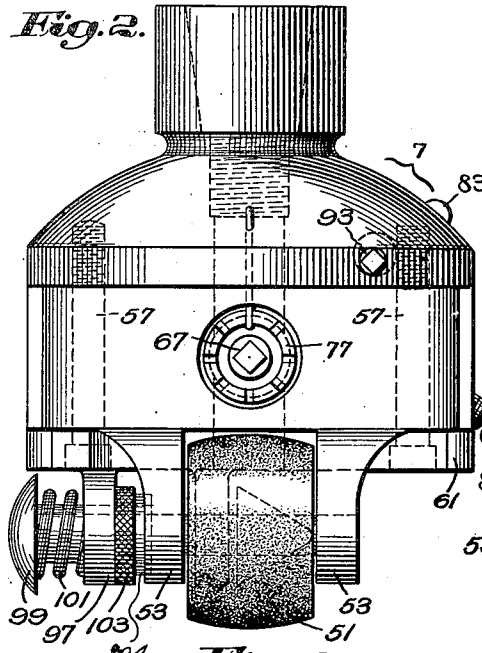


Fig. 3.

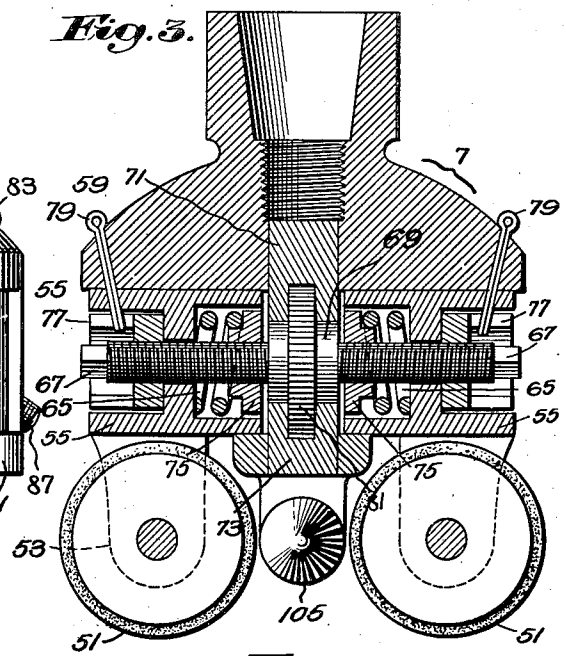


Fig. 4.

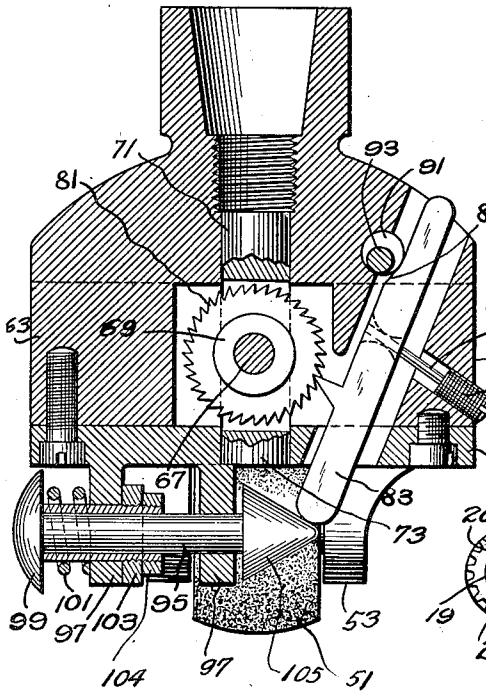
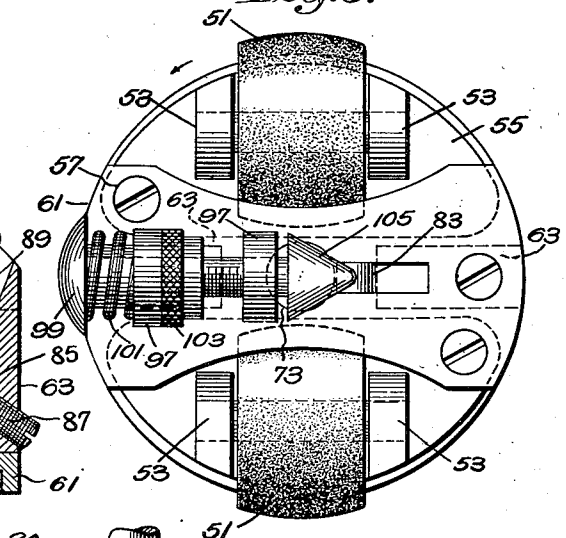


Fig. 5.



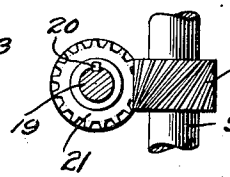


Fig. 6.

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Patented June 12, 1923. 1,458,528

UNITED STATES PATENT OFFICE.

VICTOR J. EMERY, OF WOLLASTON, MASSACHUSETTS.

GRINDING MACHINE.

Application filed January 14, 1922. Serial No. 529,375.

To all whom it may concern:

Be it known that I, VICTOR J. EMERY, a citizen of the United States, and a resident of Wollaston, county of Norfolk, and State of Massachusetts, have invented an Improvement in Grinding Machines, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to grinding and lapping machines and more particularly to one adapted for the internal grinding of cylindrical surfaces. Such a grinder, while not limited thereto, finds a large field of application in the grinding of engine cylinders.

My invention will best be understood by reference to the following description of the illustrative embodiment thereof shown by way of example in the accompanying drawings, wherein:

Fig. 1 is a front elevation of an organized machine illustrative of my invention;

Fig. 2 is an elevation on a larger scale of the grinding head utilized on the machine;

Fig. 3 is a central vertical section through Fig. 2;

Fig. 4 is a similar section through Fig. 3;

Fig. 5 is an end view or bottom plan of the head; and

Fig. 6 is a broken sectional detail of the gearing of the grinding head spindle.

Novel mechanical constructions claimed in the present application are, in the form of the invention illustrated, embodied in a rotary head which for various purposes might be attached to any suitably rotated shaft. In Fig. 1 I have shown for purposes of illustration an organized machine of peculiar construction having certain advantages for operating with heads of the kind referred to. This machine is a vertical machine, that is, the heads rotate about vertical axes, this giving greater facility for the mounting and positioning of the work and is also in this instance a gang machine having a plurality of spindles adapted to operate at once. For example, the engine blocks of internal combustion engines embodying a plurality of cylinders may be finished by simultaneous grinding of the several cylinders.

Referring to Fig. 1 of the drawings, suitable grinding heads 7 which may be and preferably are of the type shown in Figs. 2 to 5 are mounted on vertical spindles 9 which may be journalled in closed casings 11 which are slidably adjustable on the cross-bar 13 extending between the two upright standards 15 of the machine. The sliding adjustment referred to permits the heads to be adjusted to various distances in accordance with the type of work operated upon and to permit a closely grouped arrangement of the heads. The spindles 9 are preferably driven from two power shafts, alternate spindles being driven from the upper shaft 17 and alternate ones from the lower shaft 19. Enclosed by the walls of each casing 11 (see Fig. 6) and sliding on a feather 20 on the driving shaft is a spiral gear 21 driving a spiral gear 23 on the spindle 9. The shafts 17 and 19 may be belt driven from the main shaft 25 which extends adjacent the bottom of the machine.

To cause the grinding head to grind a cylindrical surface a relative translative motion axially of the spindle 9 is effected between the work and the head and in the particular machine shown this is effected by raising and lowering the work while the heads rotate. For this purpose the work may be clamped upon the table 27 guided on the standards 15 and counterbalanced by the weights 29. A rack 31 connected to the table slides in post 33 and meshes with a pinion 35 fast with a worm wheel 36 driven by a worm 37 on a countershaft 39 and countershaft 39 may be driven from main shaft 25 by either an open belt on pulleys 41 or a crossed belt on pulleys 43 and a suitable clutch mechanism provides for connecting the countershaft to the power shaft alternately through these pulleys, thus providing for a regular reversal of the direction of rotation of the shaft 39 and the reciprocating movement of the table 27. The movement is conveniently effected by an automatic reversing mechanism operating on the drive pulleys on the main shaft 25 which may be of any convenient or suitable type and is conveniently operated by means of tappets 45 adjustable on the rod 47 and adapted to be engaged in the movement of the table by a stop 49 carried thereby.

I will now describe more in detail the preferred construction of the head 7 as illustrated in detail in Figs. 2 and 3. The head may be resemble in certain respects the head shown in my Patent No. 1,193,884

and embodies in its construction one or more separate abrading blocks 51 peripherally presented at the side of the head. In other words, each one is eccentrically mounted as regards the axis of the shaft 9 and is swept around in a circular path by the rotation of the head. In the form of the invention shown the blocks 51 are rollers in the form of truncated double conoids mounted to rotate on axes which are chords of the circle being ground and thus presenting to the work an arcuate face which will correspond substantially to the contour thereof and adapted to roll in the relative reciprocating movement of work and head so as constantly to present a new face to the work.

The rollers 51 are mounted in ears 53 on swinging arms 55 pivoted adjacent one end at 57 (see Fig. 5) on the head, the pivot pins 57 herein passing through the body 59 of the head and an overhanging portion of a plate 61 secured to posts 63 rising from the body 59. These posts 63 appear in dotted lines in Fig. 5 and are centrally cut by the sectioning plane in Fig. 4. In the form of the invention shown two abrading elements are utilized which is an instance of a centric group of such elements adapted to be symmetrically operated in the manner hereinafter described. In other words, considering the plurality of elements as a group, they are symmetrically arranged about a common center, the axis of rotation and lie equal distances from that center. Each element, however, considered alone is distant from that center and thus is properly described as eccentrically mounted.

The arms 55 are supported against inward movement by suitable springs 65 and positively but adjustably held against outward movement as in my prior patent referred to. The head carrying the pivots 57 is rotated in the direction shown by the arrow in Fig. 5 and the abrading elements are dragged around trailing rearwardly from their pivots and are yieldably held to their work without possibility of sticking or chattering. In the present instance two arms are shown and they may be adjusted to position the blocks 51 by means of a right and left hand screw 67 (see Fig. 3) having a hub 69 (see Fig. 4) supported by pins 71 and 73 swivelled in the central web body 59 and top plate 61 of the head respectively. The springs 65 (see Fig. 3) may be housed in recesses in the arms 55 and find a support on nuts 75 threaded on to the screw. Castle nuts 77, which may be recessed as shown into the outer faces of the arms 55, may be set up on the screws to swing the arms inwardly against the influence of the springs 65 and thus adjust the position of the abrading rollers 51. Preferably the nuts 75 and 77 are square and positioned in square recesses and the adjustment is effected by rotating the screw 67 by a suitably squared end thereof and after the adjustment has been effected and the orbit or eccentricity of the rollers 51 determined as by means of a pair of calipers, the castle nuts 77 may be locked in position by means of a pin 79. Obviously the two nuts 75 and 77 are always the same distance apart and thus the pressure on the spring 65 is the same for all positions of adjustment of arm 55.

When the parts are adjusted as described and the head is rotated and the work reciprocated relatively to the rotating head, the latter will grind out a cylinder to a maximum size determined by the setting. On account of the conoidal form of the rollers they will enter a cylinder of a diameter smaller than the dimension desired, the arms yielding inwardly against the action of the springs 65, and the abrading rollers will then be pressed out by these springs with a yielding pressure against the sides of the cylinder until it is ground to proper size.

My invention includes means whereby the eccentricity of the grinding block or blocks may be intermittently increased during the operation of the heads. Thus, for example, in one reciprocation or traverse of the grinding head through the cylinder one thousandth of an inch of metal might be removed. It would be desirable then to relax the means which holds the block supporting arms 55 against the force of the springs 65 and to permit the grinding blocks to move outwardly so that their outer peripheries would lie on the circumference of a circle of a diameter one thousandth of an inch greater. The construction which I will presently describe permits such action.

For this purpose (see Fig. 4) the screw 67 is provided with a ratchet wheel 81 which is adapted to be operated by a pawl or tooth on a reciprocating lever 83 which moves, roughly speaking, in a plane tangent thereto. The lever 83 is normally pressed inwardly towards the wheel and downwardly as by means of the piano wire spring 85 mounted in plug 87 and having an end received in the lever 83 as shown. To vary the effective stroke of the lever to turn the ratchet wheel through one or more teeth the former is provided with a shoulder 89 adapted to cooperate with a cam or eccentric 91 mounted on a shaft 93 which may be adjusted from the exterior of the head. The shoulder 89 moving over the cam 91 moves the lever to the right viewing Fig. 4 and disengages the tooth of the lever from the ratchet wheel and limits the active stroke of the lever. It will be readily understood that for each incremental rotation of the ratchet wheel 65 the screw 67 is rotated and the nuts

77 and 75 driven outwardly thereon permitting the springs 65 to support the arms 55 further outward and consequently to position the rollers 51 on the circumference of a circle of greater radius.

Preferably the relative reciprocating movement which takes place between the work and the head in the operation of the machine and which in the illustrative embodiment thereof is effected by a motion of the work while the head remains in fixed vertical position is taken advantage of to effect this adjusting movement of the parts and conveniently the eccentricity of the blocks is regularly increased on each reciprocating movement. The construction herein disclosed also provides for imposing a limit on such movement. Thus, the parts may be set in a certain initial position of adjustment and arranged to expand a certain definite amount so as to grind out the work to a predetermined size. The machine could then, if desired, be left without supervision and after the work has reached this predetermined size the expanding movement would cease and further work of the grinding head would be idle. By such an arrangement a single workman would be permitted to care for many machines and production work embodying the production of many elements of the same size is greatly facilitated.

In the example shown the expanding movement is governed by the work itself so that after the work reaches a given size the grinding elements will be automatically shifted to take a larger cut until the desired limit is reached. By this arrangement the removal of a certain amount of stock is effected before further adjustment of the parts for further removal. Referring particularly to Fig. 4 of the drawings, movement of the pawl lever 83 may be effected by means of an adjustable plunger 95 sliding in the ears 97 and having a mushroom shaped head 99 adapted to project at the side of the grinding head 7 as a whole and normally supported by the spring 101. A nut 103 and lock nut 104 permit the plunger to be adjusted against the force of the spring 101 so that the head 99 projects more or less at the side of the head as desired. At the inner end of the plunger 95 is a cone-shaped camming surface 105 adapted to cooperate with the end of the pawl lever 83. Referring to Fig. 4, it will be readily understood that if the plunger 95 is moved to the right the lever 83 will ride along the surface of the cam 105 and will be given an upward stroke, the amount of which will be limited by the cooperation of cam 91 with shoulder 89, and that the ratchet wheel will thereby be turned a predetermined amount. In the operation of the device the edge of the head 99 will enter the cylinder which is being ground and the plunger will be pressed inwardly thereby and the adjusting screw 67 will thus be given an incremental movement. On the next reciprocation of the parts, therefore, the grinding elements 51 will be permitted to sweep through a circle of greater diameter. The movement will continue until the cylinder being ground has reached such a size that it is no longer effective to press inwardly the plunger 95 and then the head will no longer expand and no more stock will be removed from the work. By a suitable initial adjustment of the plunger 95, therefore, the work may be brought to a desired maximum size and the operation of the grinding head will then automatically cease even if the machine continues running.

While I have described in detail the form of machine shown in Fig. 1 and this form of machine has great advantages for use with such a type of head as I have described, it will be understood that the head might be utilized in other mechanisms. For example, under certain circumstances it might be mounted on a lathe.

I have described in detail the particular embodiment of my invention shown by way of example in the accompanying drawings with all the mechanical details and refinements there illustrated, not because all these are essential although they are desirable, but in order that the construction illustrated might be more readily understood.

What I claim as new and desire to secure by Letters Patent I shall express in the following claims:

1. A grinding head comprising a centric group of abrading elements and incrementally movable means for expanding the group comprising a feeler governed by the portion of the work acted on by the abrading elements.

2. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft comprising a centric group of abrading elements coaxially arranged therewith and means governed by said reciprocating movement incrementally to expand the group.

3. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft comprising a centric group of abrading elements coaxially arranged therewith and means governed by said reciprocating movement incrementally to expand the group, said means being adjustable to cause it to cease its expanding action after the group has reached a predetermined maximum.

4. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the

shaft comprising a centric group of abrading elements coaxially arranged therewith and adjustably positionable means adapted to make contact with the work in such reciprocating movement and by such contact effecting an incremental expansion of the group.

5. A grinder comprising a rotatable head, an abrading element eccentrically mounted thereon, resilient means to resist inward movement thereof, cooperating means to limit outward movement thereof and a reciprocating element adapted on actuation to effect a determined adjustment of said cooperating means.

6. A grinder comprising a rotatable head, an abrading element eccentrically mounted thereon, resilient means to resist inward movement thereof, cooperating means to limit outward movement thereof and a reciprocating element projecting adjacent the path of the abrading element for actuation by contact with the work and adapted on actuation to effect a determined adjustment of said cooperating means.

7. A grinding head comprising a plurality of swinging arms carrying abrading elements, springs tending to swing the arms outwardly, means to impose an outward limit on the swinging movement and means for incrementally adjusting said limiting means.

8. A rotatable grinding head having a carrier eccentrically mounted thereon and supporting an abrading element, an adjusting screw having threaded engagement with the carrier and a trip adapted incrementally to rotate the screw.

9. A rotatable grinding head comprising a carrier adapted to support an abrading element eccentrically of the head, an adjusting screw engaging the carrier, a ratchet on the screw, a pawl cooperating therewith and a reciprocable member projecting laterally of the head to actuate the pawl.

10. A rotatable grinding head comprising a carrier adapted to support an abrading element eccentrically of the head, an adjusting screw engaging the carrier, a ratchet on the screw, a pawl cooperating therewith and a reciprocable member projecting laterally of the head to actuate the pawl, said member being adjustable to vary the amount it projects.

11. A rotatable grinding head having a swinging arm pivoted thereon, an abrading element carried by the arm, a spring for supporting the arm, an adjusting screw engaging the arm and a trip adapted incrementally to rotate the screw.

12. A rotatable grinding head having a swinging arm pivoted thereon, an abrading element carried by the arm, a spring for supporting the arm, an adjusting screw engaging the arm, a ratchet on the screw, a pawl cooperating therewith and a reciprocable member projecting laterally of the head to actuate the pawl.

13. A rotatable grinding head having a swinging arm pivoted thereon, an abrading element carried by the arm, a spring for supporting the arm, an adjusting screw engaging the arm, a ratchet on the screw, a pawl cooperating therewith and a reciprocable member projecting laterally of the head to actuate the pawl, said member being adjustable to vary the amount it projects.

14. A rotatable grinding head having a peripherally presented abrading surface and means for altering the effective diameter thereof comprising a ratchet, a pawl having a shoulder, an adjustable member which contacts with said shoulder to disengage the pawl from the ratchet and a trip to reciprocate the pawl.

15. A rotatable grinding head having a peripherally presented abrading surface and means for altering the effective diameter thereof comprising a ratchet, a pawl having a shoulder, an adjustable member which contacts with said shoulder to disengage the pawl from the ratchet and a trip to reciprocate the pawl having an end portion adjustable to extend in variable amount from the head.

16. A grinder comprising a pair of swinging arms carrying abrading elements, a right and left screw connecting the arms and means adapted to be actuated by the work for incrementally rotating the screw.

17. A grinder comprising a pair of swinging arms carrying abrading elements, springs tending to swing the arms outwardly and providing a resilient support for the abrading elements, a right and left screw holding the arms against the springs and means adapted to be actuated by the work for incrementally rotating the screw.

18. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft, an arm pivoted to said head to swing in a plane transverse to said shaft, an abrading element thereon, a spring inwardly supporting the arm, means determining the outward movement of the arm and means actuated in the said reciprocating movement for adjusting said movement determining means.

19. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft carrying an eccentrically located abrading element, and a radially adjustable trip adapted to be thrown in said reciprocating movement and effective to increase the eccentricity.

20. A grinding machine comprising a ro-

tatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft, an arm pivoted to said head to swing in a plane transverse to said shaft, an abrading element thereon, a spring inwardly supporting the arm, means determining the outward movement of the arm, a radially adjustable trip adapted to be thrown in the said reciprocating movement and means actuated thereby to adjust said movement determining means.

21. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft carrying an eccentrically located abrading element, means for incrementally increasing the eccentricity and an adjustable device adapted to actuate said means and operable in said reciprocating movement, the adjustment providing for a cessation of such increase after a determined maximum.

22. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft, an arm pivoted to said head to swing in a plane transverse to said shaft, an abrading element thereon, a spring inwardly supporting the arm, means determining the outward movement of the arm, means for incrementally shifting said movement determining means and an adjustable device adapted to actuate said shifting means and operable in said reciprocating movement, the adjustment providing for a cessation of such shifting after a determined maximum.

23. A grinding machine comprising a rotatable shaft and a work support, means to effect relative axial reciprocating movement between said parts, a grinding head on the shaft, a grinding element on the head adapted to move in and out from the center thereof and means adapted for actuation in said reciprocating movement for incrementally moving said element outwardly through an adjustably predetermined range having a variable outer limit.

24. An internal grinder comprising a rotatable head carrying a centric group of abrading elements and means comprising a yieldable trip projecting outwardly beyond the group for contact with the work for actuation thereby and means whereby such actuation serves incrementally to increase the effective diameter of the group.

25. A rotatable grinding head having a peripherally presented abrading surface and means for shifting the radial position of the surface including a trip radially adjustable to project in variable amount beyond such surface.

26. A grinding head comprising a swinging arm carrying an abrading element, a spring tending to swing said arms outwardly, means to impose an outward limit on the swinging movement and means for incrementally shifting said limiting means, said latter means being adjustable to vary the amount of the increment.

27. A grinding head having an eccentrically disposed abrading block, a spring supporting the same against inward movement, a support for the spring and means for equally moving block and support whereby adjustment is effected while maintaining uniform tension of the spring.

28. A grinding head comprising a swinging arm, an abrading block carried thereby, an adjusting screw passing through the arm, non-rotatable nuts carried by the screw on opposite sides of the arm and a spring interposed between the arm and one of the nuts.

29. A grinding head having an eccentrically mounted abrading block, means for holding it against outward movement, a spring for supporting it against inward movement, and means for adjusting the position of the block serving to maintain a constant tension on the spring.

30. An internal cylinder grinder comprising a work support, a rotatable head having an abrading element eccentrically mounted thereon, means to effect relative reciprocating movement of said support and head and means to vary the eccentricity of said element comprising a trip to make contact with the work, said element in a determined position of adjustment serving to mask said trip.

31. An internal cylinder grinder comprising a work support, a rotatable head having eccentrically located thereon an abrading element yieldably mounted to give inwardly, said element presenting at the end of the head an inwardly directed surface whereby it may enter axially a cylinder to be ground and means to vary the eccentricity of said element comprising a trip to make contact with the work, said element in a determined position of adjustment serving to mask said trip.

In testimony whereof, I have signed my name to this specification.

VICTOR J. EMERY.