Dec. 15, 1931. A. H. LYON ET AL 1,836,482

GRINDING MACHINE

Filed May 20, 1929 4 Sheets-Sheet 1

FIG. 1

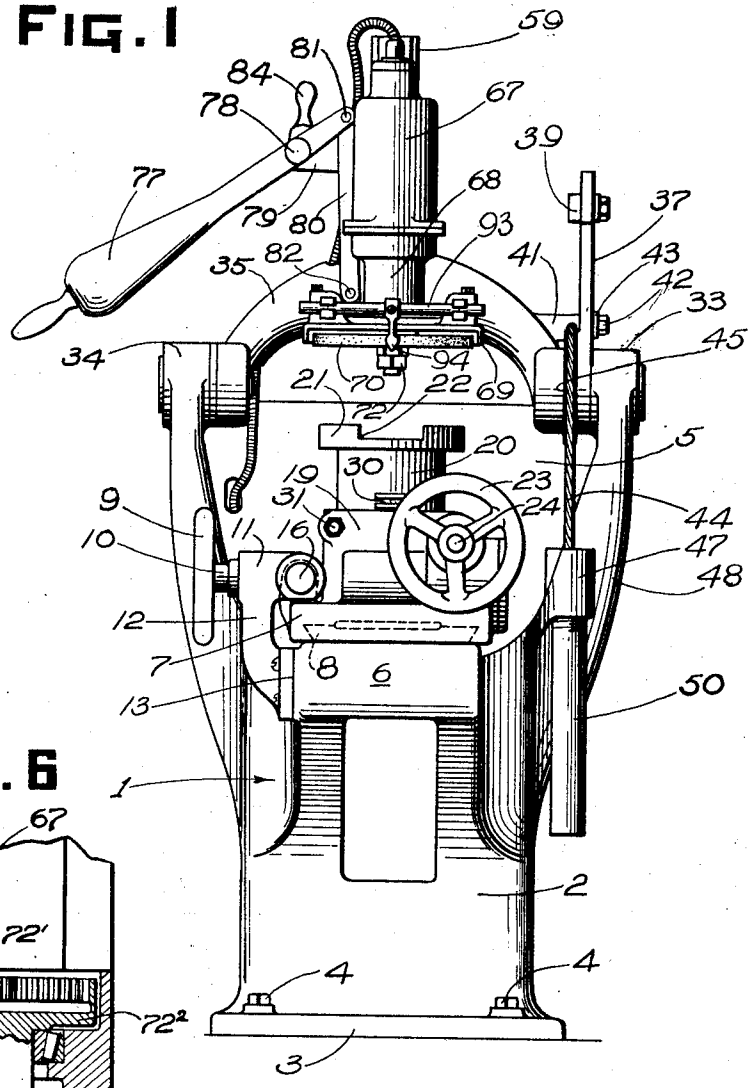
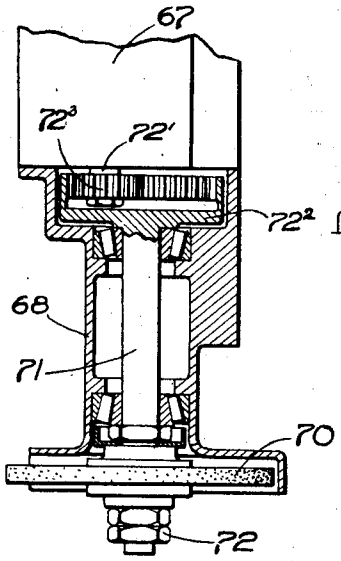


FIG. 6



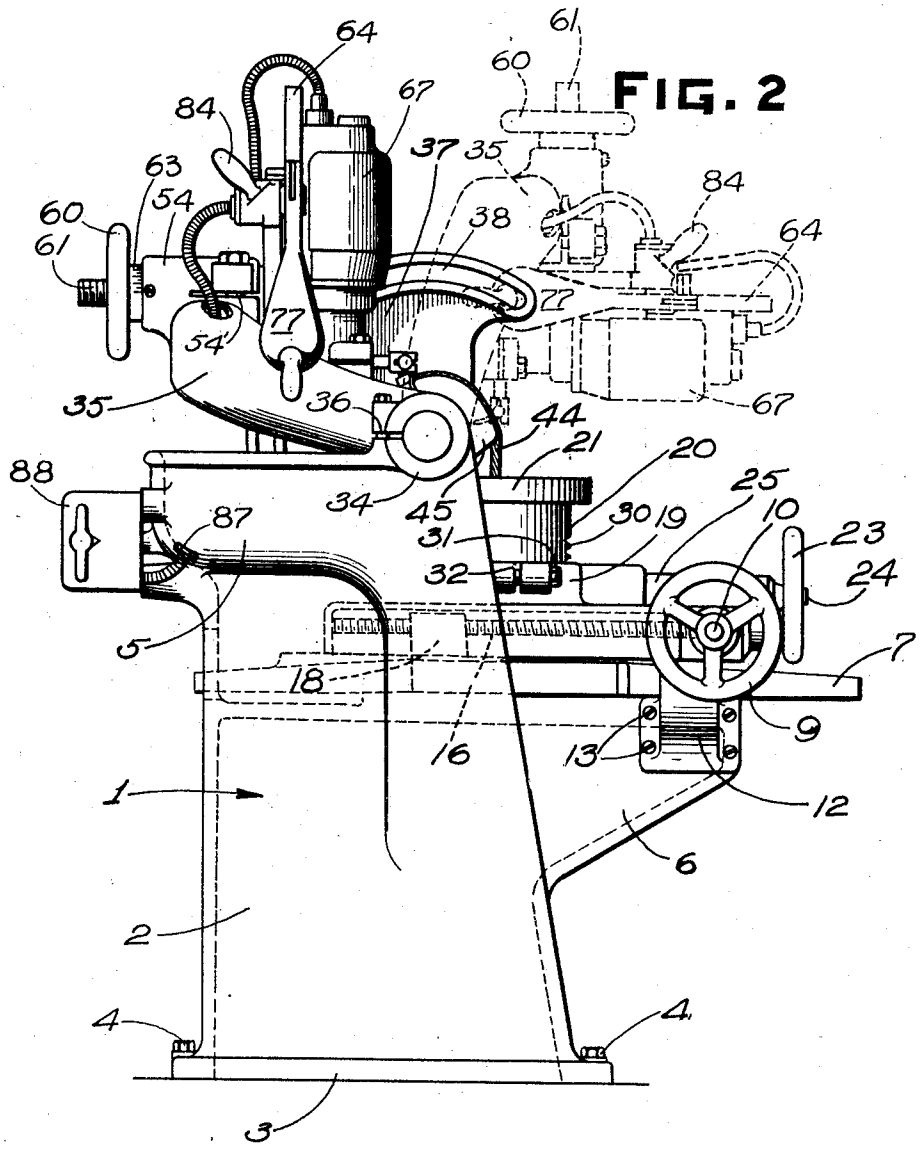
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GRINDING MACHINE

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FIG. 2



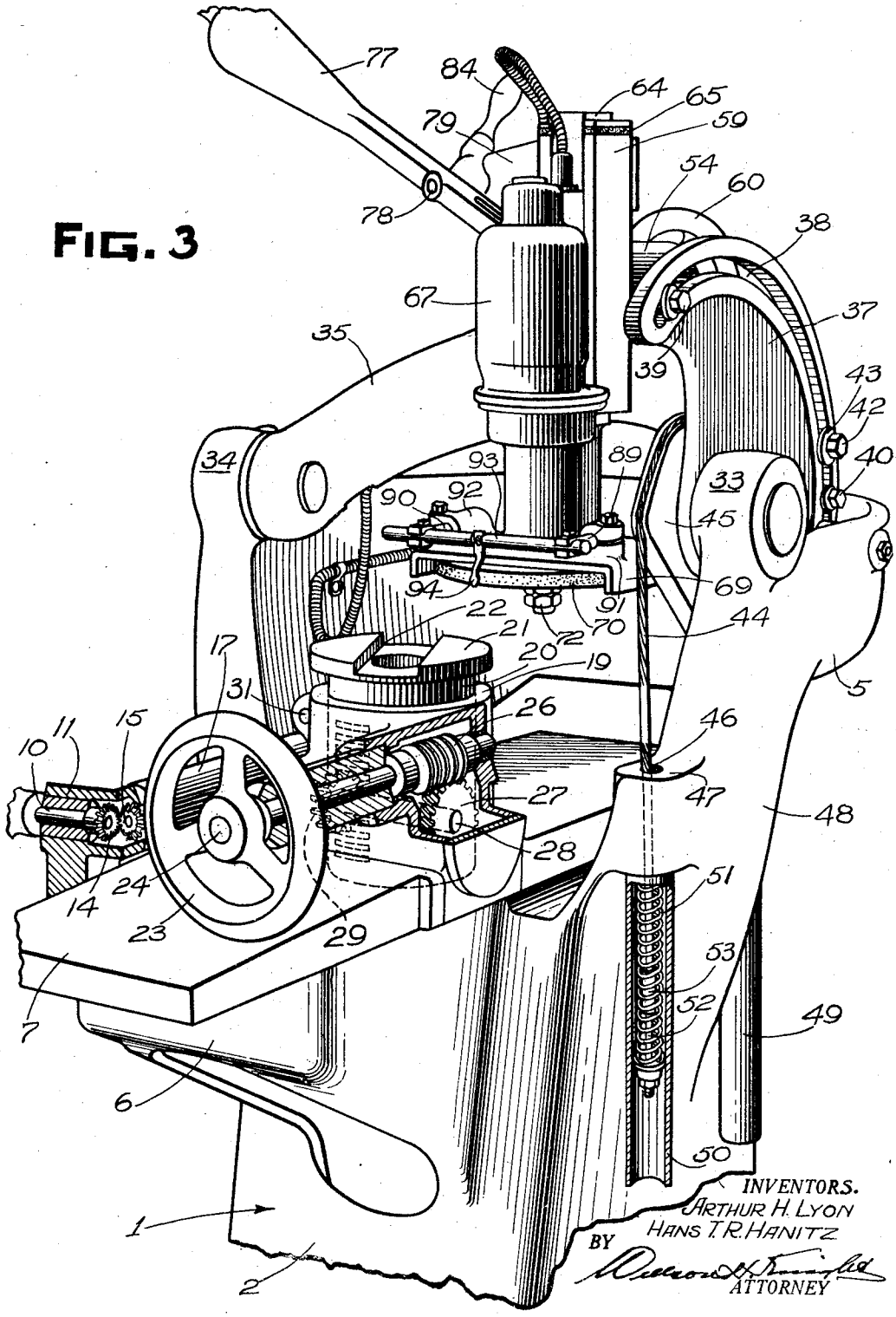
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GRINDING MACHINE

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FIG. 3



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GRINDING MACHINE

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FIG. 4

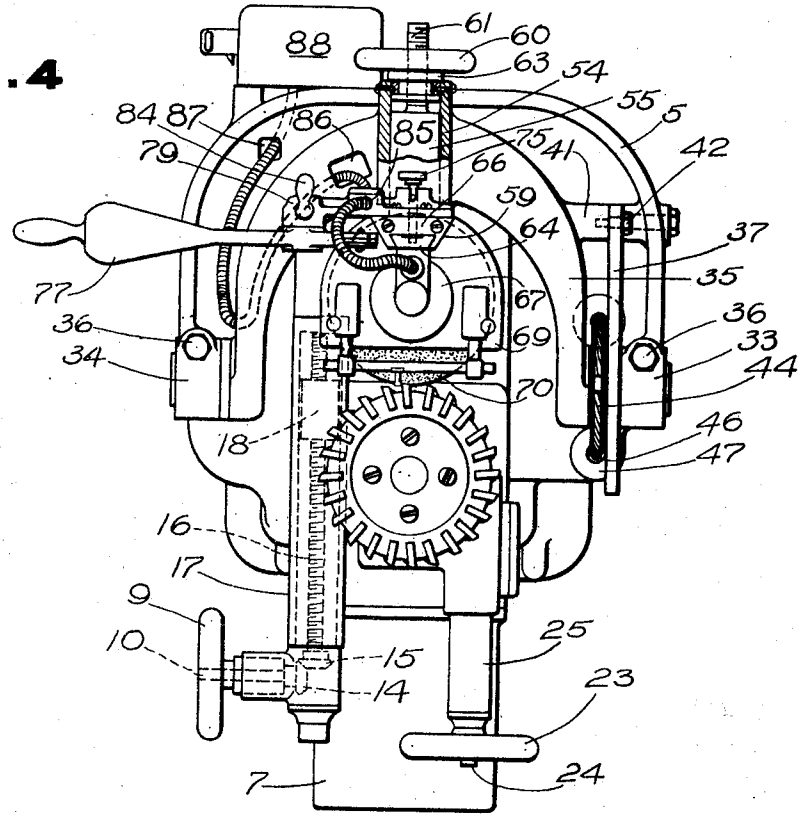
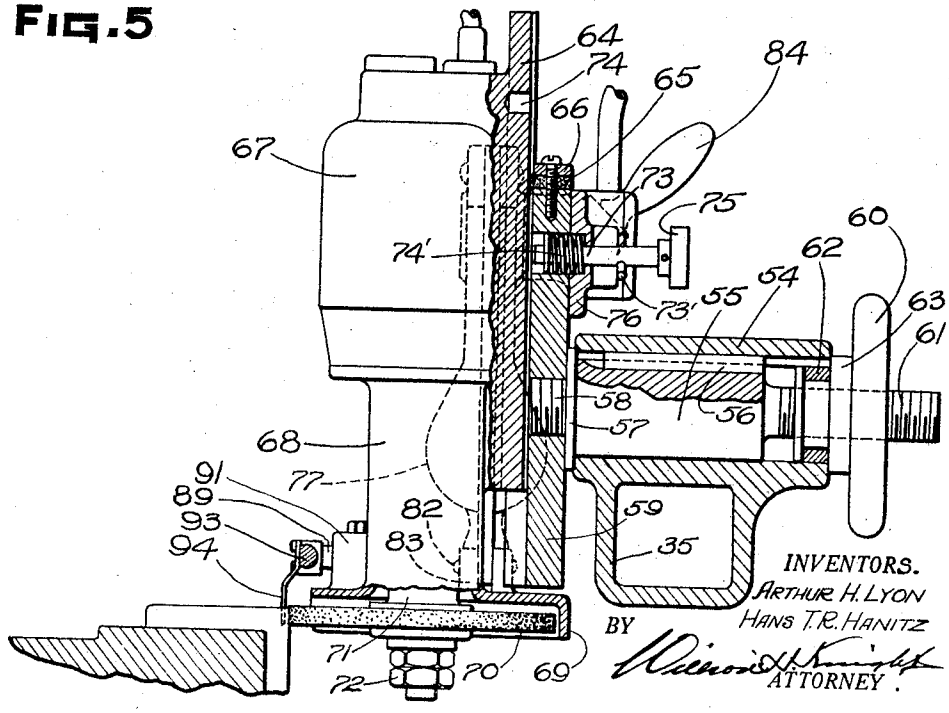


FIG. 5



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UNITED STATES PATENT OFFICE

ARTHUR H. LYON AND HANS T. R. HANITZ, OF ROCKFORD, ILLINOIS, ASSIGNORS TO THE INGERSOLL MILLING MACHINE COMPANY, OF ROCKFORD, ILLINOIS, A CORPORATION OF ILLINOIS

GRINDING MACHINE

Application filed May 20, 1929. Serial No. 364,362.

The present invention relates in general to grinders and has particular reference to a machine for grinding cutting tools especially various types of face mills for milling machines.

The primary object of the invention is to improve the construction and operation of that type of grinding machine shown in Patent No. 1,039,075, issued September 17, 1912 to The Ingersoll Milling Machine Company. In the machine disclosed in this prior patent provision is made for carrying the tool to be ground upon a cutter spindle which is rotatably mounted in a saddle supported vertical quill. The table of the assembly is horizontally adjustable and the spindle quill is vertically adjustable. These vertical and horizontal adjustments contribute to the proper setting of the tool to be ground so that its position relatively of the grinding wheel may be accurately determined for grinding. When once set the tool to be ground is held in a predetermined position and is free to be rotated in a fixed plane to successively present the teeth thereof to the grinding wheel. The grinding wheel is mounted to be manually reciprocated back and forth across the teeth of the tool while being rotated from a source of power suitable for the purpose. Owing to an unusually wide range of adjustment which is provided for the grinding wheel when used in combination with the adjustments for the cutter holder cutters of various types may be accommodated without inconvenience and properly ground.

The machine embraced by the present invention retains all of the above important characteristic features noted in the prior conception and in addition thereto includes certain improved structural features which are concerned for the most part with the mounting and drive for the grinding wheel and the counterbalance therefor. Other detail improvements have also been made in the general structure of the machine which enter into the combination and contribute their share to a common end.

One embodiment of a machine showing the improvements embraced by the present invention is shown in the accompanying drawings for the purpose of illustration but it will of course be understood that the invention is susceptible to other different modified embodiments which come equally within the scope of the appended claims.

In the accompanying drawings Fig. 1 is a front elevation of the machine; Fig. 2 is a view in side elevation; Fig. 3 is a perspective view; Fig. 4 is a top plan view; Fig. 5 is a detail view partly in section of the mounting for the grinding wheel head and Fig. 6 is a detail view partly in section of the grinding wheel head.

Referring now to the drawings in detail 1 represents the machine frame which is preferably made as a one piece casting and comprising an approximately square hollow column 2 having a base flange 3 for supporting the machine upright upon a floor or other surface and to which it may be bolted or otherwise secured as at 4. The upper portion of the casting terminates in an integral bowl like structure 5 which is open at its front, top, and for a portion of the back. Projecting outwardly from the open front of the bowl 5 and formed integral with the column 2 is a bed 6 for the table 7. This bed extends into the bowl 5 and is provided with horizontal ways upon which the table is dove-tailed to slide freely in opposite directions when caused to do so by the manual manipulation of the hand wheel 9. This hand wheel is fixed upon the end of a horizontal shaft 10 which is journaled in the bearing 11 on the end of the elbow 12, which in turn is fixed to the side of the bed 6 as at 13. Keyed or otherwise fixed upon the opposite end of the shaft 10 is a bevel gear 14 which is in constant mesh with a mating bevel gear 15 fixed on the end of the screw 16. The screw 16 extends longitudinally of the table and within a tubular housing 17. Entering the housing 17 from the bottom thereof is a nut 18 which is formed as a part of the table 7 or else made separately therefrom and attached in some manner so that it may serve as an integral part of the table.

By means of the hand wheel 9 and the

feed mechanism which it controls the table may be moved backward and forward upon the ways 8 all for the purpose to be hereinafter described.

Centrally mounted upon the table 7 is a circular saddle 19 in which the quill 20 is mounted for reciprocal movement.

Mounted within the quill 20 is a spindle 21 which is adapted to carry the cutter to be ground. Since in operation the cutter must be mounted to be freely rotated by hand to bring the teeth thereof successively into position to be ground the spindle 21 is mounted within the quill 20 with freedom of rotation. Suitable anti-friction bearings (not shown) being employed in the mounting so that the spindle may be rotated with the cutter carried thereby with little or no effort on the part of the operator.

To mount a cutter on the spindle the customary cutter shank is inserted in the spindle. The keyway 22 in the spindle head locks the cutter with the spindle so that they both rotate together. For some types of cutters the usual adapters may be employed to accommodate the spindle to the cutter.

Both face mill and solid shank cutters are held in the spindle of the machine in the same way they are held in the milling machine spindle when cutting. This insures that they will always run concentric with the milling machine spindle and that all of the teeth in any cutter will be in exactly the same relation to the axis of that spindle.

The quill 20 may be elevated and lowered by manual manipulation of the hand wheel 23 which is mounted on the end of the worm shaft 24. This worm shaft is journaled in a housing 25 and the housing assembly also encloses the worm 26 which is fixed upon the shaft 24. Meshing with this worm 26 is a gear 27 which is fixed on a cross shaft 28. On the opposite end of the shaft 28 is a spur gear 29 which is in constant mesh with the rack face 30 on the side of the quill 20.

With this feed mechanism the quill may be elevated or lowered by turning the hand wheel 23 to the right and left respectively. Tension on the quill may be regulated by adjusting nut 31 on the end of the screw 32 which tightens or loosens the split part of the saddle 19 which encircles the quill.

It will thus be seen that a cutter or for that matter any other object to be ground may be fixed to the spindle and then by selectively or collectively manipulating the hand wheels the cutters' position may be definitely determined relatively of the grinding wheel. As the grinding wheel is also angularly adjustable relatively of the cutter to be ground a wide variety of cutters and other objects may be accommodated for a grinding operation.

Trunnioned in the bearings 33 and 34 is a U-shaped yoke 35. The bearings 33 and 34 for the yoke are formed at the front upper edge of the bowl 5 and as an integral part thereof. They are split as at 36 and bolts are employed to tighten or loosen the bearings as required.

Fixed at one side of the yoke 35 is a slotted quadrant 37 the slot thereof being made to carry the adjustable stops 39 and 40, which may be set to determine the degree of swinging movement required of the yoke to accommodate the grinding operation to cutter teeth of a given radius. The boss 41 projecting from the side of the yoke will abut against these stops when the yoke is swung in an arc. The boss 41 is also equipped with a stud which projects through the slot 38 in the quadrant and has a clamping nut 42 threaded on the end thereof. Behind the nut is a washer 43 which bridges the slot 38. By tightening up on the bolts for the split bearings 33 and 34 the yoke may be held in any angular position within the range of the quadrant slot for grinding those cutters which require the grinding wheel to be wiped across the cutter teeth at a given angle relatively thereto.

When the yoke is being constantly swung back and forth in a given arc or when it is in a fixed position it is properly counter-balanced by a spring tension device comprising a cable 44 which is passed over and fixed to a sheave 45 which is pivotally mounted to oscillate with the yoke 35. Opposite ends of the cable 44 are passed through apertures 46 in shoulders 47 formed at the front and back of one of the upright supports 48 which are made in the casting and merge into the column 2 and the bowl 5. Threaded into the bottom of the shoulders 47 are cylinders 49 and 50 into which the cable ends extend. Housed within the cylinders are coiled compression springs 51. For a portion of their lengths the springs are coiled around bolts 52 and a suitable coupling 53 on one end of the bolts joins the cable ends. The opposite ends of the bolts carry washers and nuts to support the lower ends of the springs. The upper ends of the springs are seated against the bottom of the shoulders 47 within the cylinders. With the counter-balance device the yoke 35 is at all times under the influence of the springs which maintain a constant tension on it.

The grinding wheel head assembly is carried wholly by the yoke 35. As best illustrated in Fig. 5 the intermediate portion of the yoke 35 is formed with an integral cylinder housing 54 in which a holding stud 55 is slidably mounted. This stud while adapted to slide in the housing 54 is held against rotation by a key 56 which is inserted in a complementary keyway in the internal bore of the housing and the circumference of the stud. The forward end of the stud 55 is made with a flange 57 which is of larger

radius than the bore of the housing 54. In advance of this flange 57 the projecting end of the stud is reduced in diameter and screw threaded as at 58 for threaded engagement with an opening made to receive it in the ways 59. In this manner the grinding wheel head assembly is mounted on the yoke 35. In some grinding operations it will be desirable to set the grinding wheel assembly away from the yoke, that is to say move it forward. To effect this adjustment the hand wheel 60, which is threaded on the shaft 61 is manually manipulated so as to slide the stud 55 in the housing to the left viewed from Fig. 5 which will impart a forward thrust to the grinding wheel head assembly and move the same way from the yoke. It is, of course, understood that the shaft 61 on which the wheel 60 is threaded is secured to the holding stud. The wheel 60 is made with a collar having a reduced diameter 62 within the housing 54 and a graduated outer diameter 63 which bears against the end of the housing. The wheel is secured to the housing with freedom of rotation by the set screw held segments which are seated in the annular groove in the reduced end of the collar. The split part 54′ of the housing serves to hold the stud in an adjusted position.

The slide 64 of the grinding wheel head assembly is dove-tailed into the ways 59 and to exclude dust a suitable felt packing 65 covers the top of the ways and is retained in place by a screw retained cap 66. The slide 66 is formed with a motor housing 67 on the front thereof and this housing extends downwardly in the form of a sleeve 68 which terminates in a guard 69 for the grinding wheel 70. The grinding wheel 70 is mounted upon a spindle 71 by means of the holding nuts 72 and the spindle is connected with the driving shaft 72′ of the electric motor which is housed in the motor casing 67 by means of an internal gear 72^2 on the end of the spindle and a pinion 72^3 on the end of the motor shaft is in constant mesh with this internal gear. The internal gear is formed as an integral part of the spindle. Any other gearing may be substituted for that shown, depending upon the driving ratio desired. The spindle is supported in the sleeve part of the housing by upper and lower anti-friction bearings. It will thus be seen that the grinding wheel as well as the motor is carried by the slide 64. The grinding wheel is thus mounted for reciprocal movement by means of the sliding engagement between the slide 64 and the ways 59.

For those grinding operations which necessitate oscillating the yoke 35, as for example when grinding a radius the grinding wheel must be locked against sliding movement and this is effected by means of a locking pin 73, which extends through the ways 59 and is adapted to seat in an opening 74 in the slide. The pin is under the influence of a spring 74^1 which is coiled around it and bears against a shoulder on the pin to thrust the same forward into the opening 74. The normal influence of the spring is overcome by holding the pin out or rather retracted by a cross key 73′. The pin may be pulled back by the head 75 on the end thereof. A suitable boss 76 is secured to the back of the ways 59 through which the pin extends.

For those grinding operations which require reciprocal movement of the grinding wheel on the ways 59 a lever arrangement is provided which comprises a weighted manually operable arm 77 the same being pivoted as at 78 to a boss 79, and connected to a link 80 as at 81. The opposite end of the link is pivoted at 82 to a clevice 83 on top of the wheel guard 69. The boss 79 to which the arm 77 is fulcrumed is formed as a part of the casting 76 and does not move with the slide 64. It will thus be seen that the operator by elevating and lowering the arm 77 may impart a downward thrust and a lifting action respectively to the grinding wheel which will result in the wheel and the motor block sliding back and forth on the ways 59.

For those operations which necessitate oscillation of the yoke 35, the hand grip 84 is provided and the same is mounted upon the boss 79 where it will be conveniently accessible to the operator.

Lead wires to the motor are conducted through flexible tubing and by referring to Fig. 4 it will be seen that this tubing extends through a retainer 85 on the back of the ways 59 and formed as a part of the boss 79. This retainer is simply to offset the disadvantage of having too long a length of the cable hanging loosely around the operating parts of the grinding wheel assembly. Attention is also called to the fact that the yoke 35 being hollow provides a very convenient channel through which the cable may be shunted out of the way. The cable, therefore, enters the yoke through an opening 86 in the top thereof and leaves the yoke from the bottom where it extends through an opening 87 in the bowl to the switch box 88 which is mounted at the back of the bowl.

Before explaining a typical method of using the machine for grinding operations attention is invited to the indexing feature which while simple in construction and manner of operation is of an unusual advantage in realizing a perfect grinding job.

This indexing device is carried upon the wheel guard 69 by means of two parallel side clamping rods 89 and 90. One end of these rods is clamped in holders 91 and 92 made to receive them and their opposite ends are split to clamp the cross bar 93 which carries the indexing finger or finder 94 intermediate its ends. The adjustable possibilities of this indexing device adds to its desirability

and in this connection it should be noted that the cross rod 93 may be adjusted by loosening the clamping nuts on the ends of the rods 89 and 90 and that the rods 89 and 90 may be adjusted relative to their clamps 91 and 92 by loosening similar clamping nuts.

As illustrated in Fig. 5 the finger or pointer 94 of the indexing device is disposed in the path of the cutter teeth. In practice the operator when rotating the cutter to be ground in successive stages so as to bring the teeth thereof into position to be ground by the grinding wheel one at a time, will see to it that the side of the tooth to be ground bears against the finger 94. He will then know that the tooth thus brought into contact with the finder will be in proper position to be ground by the wheel. This indexing feature operates to the same advantage regardless of the angular position of the wheel and the type of tooth being ground. For the most part the adjustable features of the indexing device is for adjusting the finger for either right or left hand cutters. For convenience in setting the cross rod 93 is graduated at the left hand end, as previously stated the side of the cutter tooth to be ground should rest against the finger and be held there by the grinding wheel revolving toward it.

From the above outline of the construction and possible operating advantages of the machine it will be readily seen that cutters with angular faces may be ground at any angle within the range of the machine and the corners on all cutters may be ground square, angular or with a radius. All of this is readily accomplished with but a single setting of the cutter. This desirable feature is made possible by the fact that the grinding wheel spindle is always in the same plane with the axis of the cutter and at the same time can be set at different angles to that axis or can be rotated in an arc over the cutter.

Particular attention is called to the fact that the machine is able to grind all of the teeth in any cutter in the same relative plane to the axis of the cutter. This relation is essential if the cutter is to produce first class work.

Many classes of cutters besides face milling cutters may be ground with the machine. The peripheral edges of the teeth may be at any angle up to 96-degrees from the face. Corners may be squared, ground off at an angle, or with any radius up to 2¼ inches.

Where the term "cable" is used in the specification and claims to identify the part 44 of the balance device it should be construed as describing a cable in the strict meaning of the term or any other equivalent flexible connection such as a chain, belting, rope, or the like.

Having thus described and shown an embodiment of this invention, what we claim and desire to secure by Letters Patent of the United States is:

1. In a grinding machine a work holder, a swinging support, a grinding member mounted for reciprocal movement on said support and to swing therewith, a prime mover mounted to reciprocate with the grinding member and swing with the support for continuously driving the grinding member during both its reciprocating and swinging movements and a spring influenced counterbalance for said swinging support, comprising a sheave member mounted to oscillate in response to the swinging movement of the support, a cable extending over the cam member with the ends thereof joined to spring devices mounted to the side of the frame structure of the machine.

2. In a grinding machine, a frame structure, a work support mounted for vertical and horizontal adjustments thereon, a support mounted on the frame structure for swinging movement in an arc about the work holder, means for holding the support at a projected angle relatively of the work holder, a counter-balance for the support, ways on the support, a motor slidably mounted thereon, a grinding wheel driven by the motor shaft, means for reciprocating the motor on said ways with the grinding wheel carried thereby, means for holding the motor against reciprocation at will and means for swinging the support with the motor carried thereby.

3. In a grinding machine, a frame structure comprising a column shaped casting having a knee portion projecting from one side to provide a table bed, a bowl shaped portion at one end of said bed, a table slidable upon the bed, a hand wheel for sliding the table upon the bed, a work holder mounted upon the table and vertically adjustable relatively thereof, a U-shaped yoke journaled in bearings formed at the front edge of the bowl and adapted to swing at an angle to the axis of work holder a quadrant having adjustable means co-operating therewith for limiting the angular swinging movement of said support, means also co-acting with said quadrant for holding said support at a predetermined angle to the work holder, a grinding wheel including a motor for driving the same carried by the support and mounted for reciprocal movement while the motor is driving the wheel, mean for holding the motor and wheel against reciprocal movement at will and means for moving the mounting for the motor and wheel to and from the support for adjusting the position of the wheel relatively of the work holder.

4. In a grinding machine, a work holder, a swinging support, a spring counter-balance therefore, and means for mounting a grinding wheel and motor for driving the same on said support, comprising a unitary mounting for the wheel and motor, ways on said support on which said unitary mounting is slidably secured, a manually operable lever, a link

motion connecting the lever with the unitary mounting for the motor and wheel for reciprocating the same while the motor is driving the wheel.

5. A grinding machine comprising in combination a vertically and horizontally adjustable work holder, a manually operable support mounted for swinging movement in an arc about the work holder, a counter-balance for said support, comprising a sheave movable with the support, a cable embracing the sheave, spring means for anchoring the cable under tension, a quadrant on said support, adjustable means co-operating with the quadrant for limiting the swinging movement of the support means also co-operating with the quadrant for holding the support at an angle relatively of the work holder, ways carried by the support and adjustable relatively thereof, a slide for said ways, a grinding wheel and a motor for driving the wheel carried by the slide, a hand lever co-operating with a link motion for reciprocating the slide on said ways with the motor and grinding wheel movable therewith, and an indexing device carried adjacent the grinding wheel, all substantially as and for the purpose described.

6. In a grinding machine, the combination with a work holder of a swinging support mounted to oscillate about the worker holder for performing a grinding operation, means for holding the support at an angle to the work holder for performing another grinding operation and a counter-balance for said support comprising a pair of fixedly mounted housings, a spring in each housing, a sheave on the support, and a cable embracing said sheave with its ends anchored to the springs in said housings.

7. In a grinding machine, a frame structure, comprising a casting formed to provide a column like pedestal for supporting the machine upon a floor or other surface, the upper part of said pedestal terminating in an open top and front bowl like portion, a horizontal bed within the bowl like portion and projecting outwardly through the open front thereof, a table slidably mounted on said bed a work holder carried by said table, a swinging support, a grinding wheel mounted for reciprocal movement and carried by said support to swing therewith in an arc about the work holder and means for driving said wheel while it is being reciprocated and when it is swinging with the support.

8. In a grinding machine, a frame structure comprising a casting formed to provide a column like pedestal for supporting the machine upon a floor or other surface, a horizontal bed on said pedestal, a knee like ledge cast integral with the side of the pedestal for extending the length of the bed in projected relation to the upper part of the pedestal, a table slidably mounted upon the bed, a work holder carried by said table and vertically adjustable relatively thereof, a swinging support, a grinding wheel mounted for reciprocal movement and carried by the support to swing therewith in an arc about the work holder and means for driving said wheel while it is being reciprocated and when it is swinging with the support.

9. In a grinding machine, a work holder mounted for both horizontal and vertical adjustment, a yoke member mounted for swinging movement about the work holder, a grinding device mounted intermediate the ends of said yoke member, and to swing therewith, means for releasing the yoke member for swinging movement, means for holding the yoke member against swinging movement at any position within the range of its swinging movement for adjusting its position, means for reciprocating the grinding device at any adjusted position of the yoke member, means for holding the grinding device against reciprocation and means for driving the grinding device during its reciprocation and while it is being held against reciprocation.

10. In a grinding machine, a rotatable work holder, a support mounted to swing about the work holder, a self-contained reciprocal grinding unit, including a grinding wheel and motorized drive therefor, mounted on said support to swing therewith; means for holding said support stationary at any position within the range of its swinging movement for locating the grinding wheel with its axis of rotation at predetermined angles relative to the axis of rotation of the work holder; said support holding means being releasable to leave the support free for swinging movement about the work holder; said motorized drive of the grinding unit being operable to drive the grinding wheel in any fixed position within the range of the swinging movement of the support and while the support is swinging about the work holder and means for bodily reciprocating the grinding unit at will.

11. A grinding machine as described in claim 10, in which the grinding unit is mounted upon the support for adjusting its position to and from the support and in which the work holder is mounted for adjustable movement in directions parallel to its axis of rotation and transversely to its axis of rotation.

12. In a grinding machine, the combination with a frame structure, of a work holder, a support mounted for oscillation in a fixed orbital path about the work holder, a counterbalance for said support, a grinding member mounted on said support, means for reciprocating said grinding member at will and a prime mover for driving said grinding member mounted on said support and reciprocal with the grinding member.

13. In a grinding machine of the class de-

scribed, a frame structure, comprising a pedestal like support, terminating in a bowl like top portion having an open front, an integral knee structure projecting in advance of said open front of the bowl portion, a tool holder slideably mounted on said knee like structure for translation in a horizontal plane, a feed screw for translating said tool holder, means for elevating the tool holder, a yoke like member trunnioned for oscillating movement above the bowl like top portion of the frame structure in straddling relation to the tool holder, a motor driven grinding spindle mounted for reciprocation on said support, a weighted operating arm for reciprocating said grinding spindle and a spring influenced counterbalance for said support.

14. In a grinding machine, the combination of a frame structure, a work holder mounted on said frame structure, a yoke like support mounted for swinging movement about said work holder, slideways on said support, a motor driven grinding wheel assembly mounted for reciprocation on said slideways and to swing with said support, and means for adjusting the position of the grinding wheel assembly relatively to said support.

Signed at Rockford, in the county of Winnebago, and State of Illinois, this 16th day of May, 1929.

ARTHUR H. LYON.
HANS T. R. HANITZ.