Dec. 1, 1964 W. CAWI 3,158,969

GRINDING MACHINE

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Fig. 1

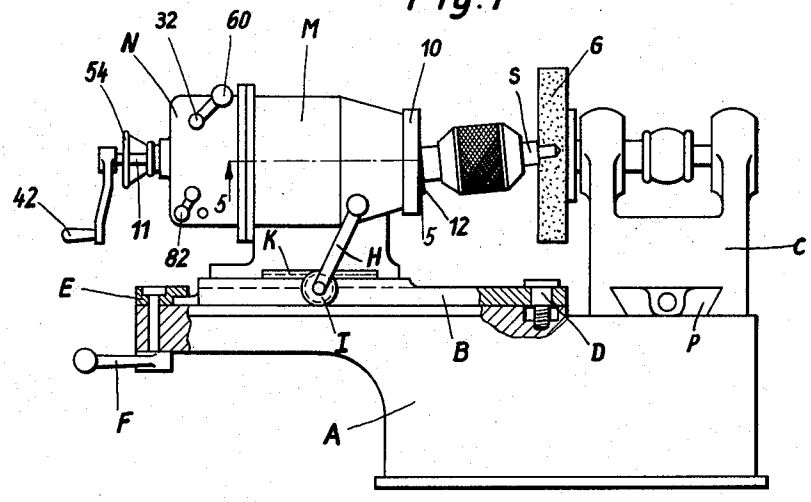


Fig. 2

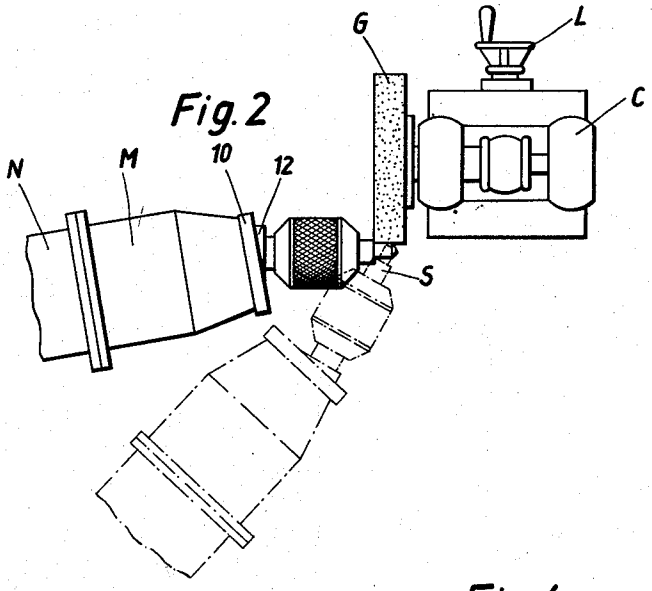


Fig. 3

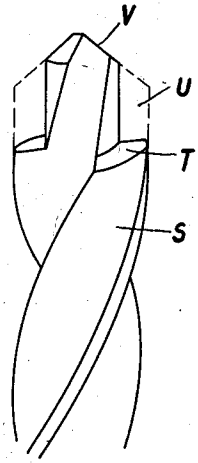
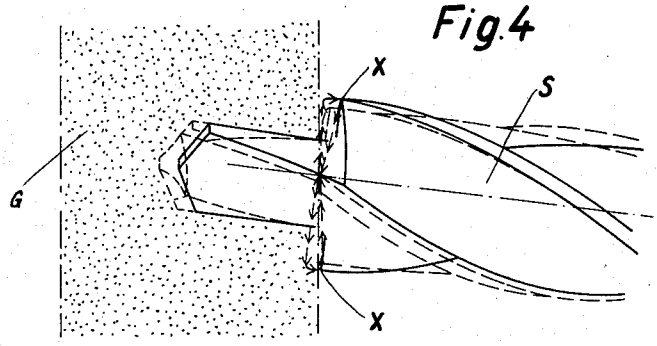


Fig. 4



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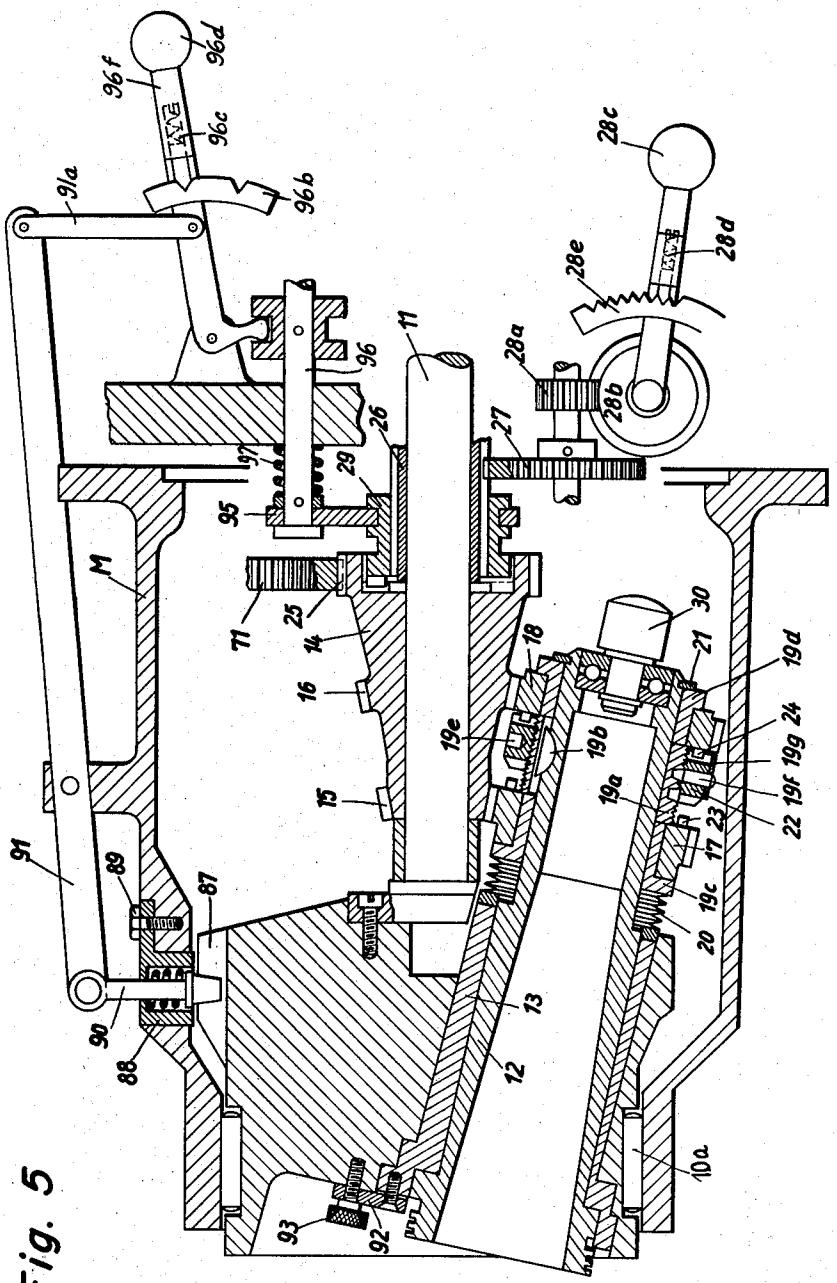


Fig. 5

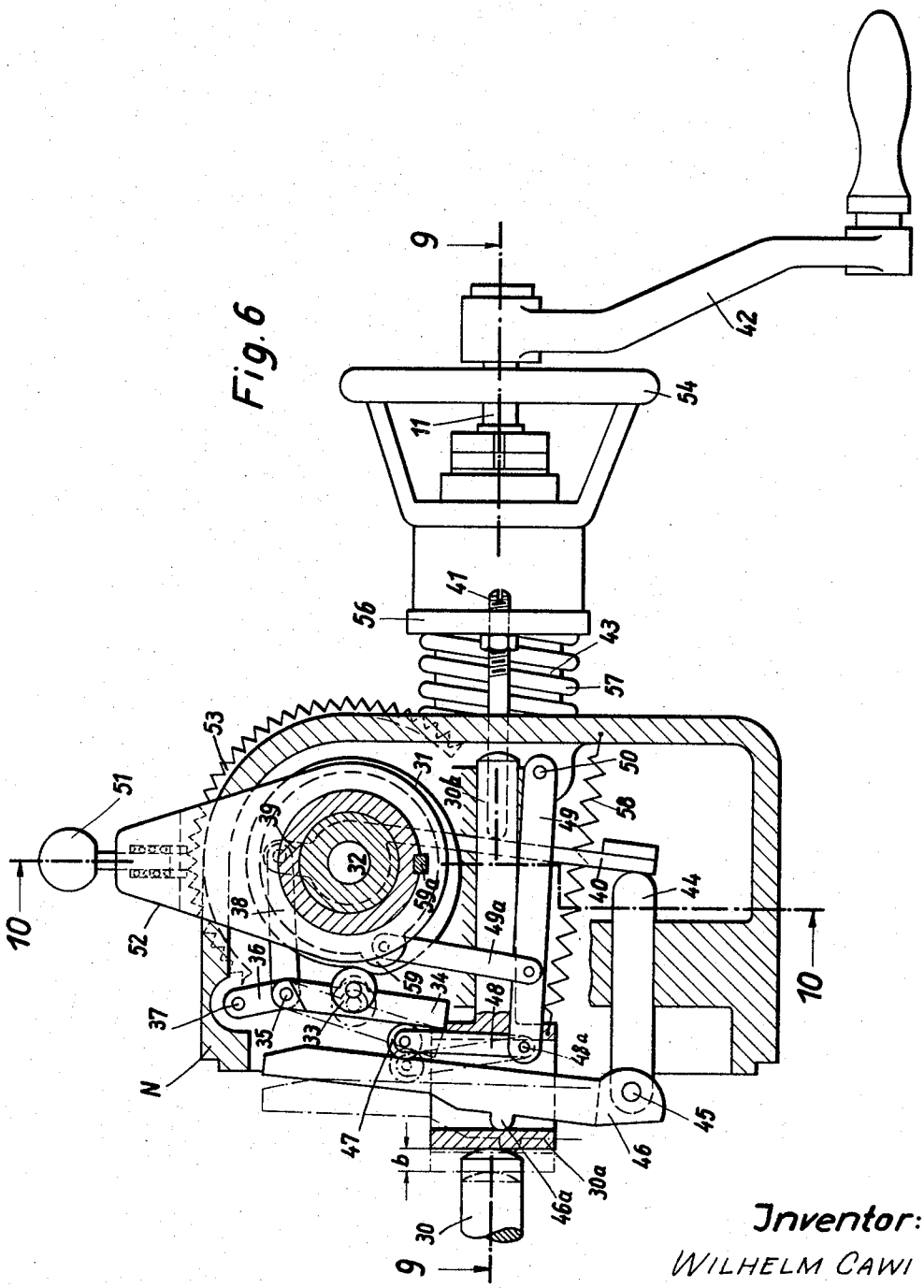
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GRINDING MACHINE

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Fig. 6



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Fig. 8

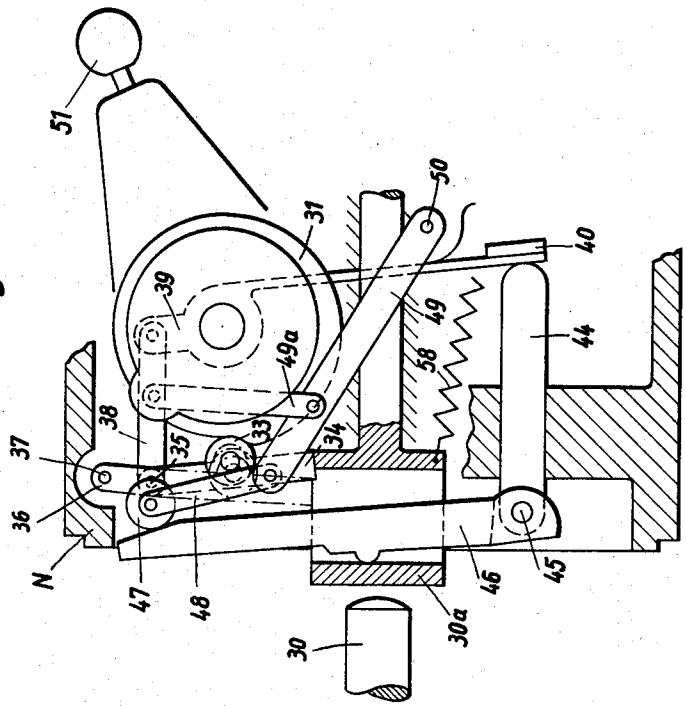
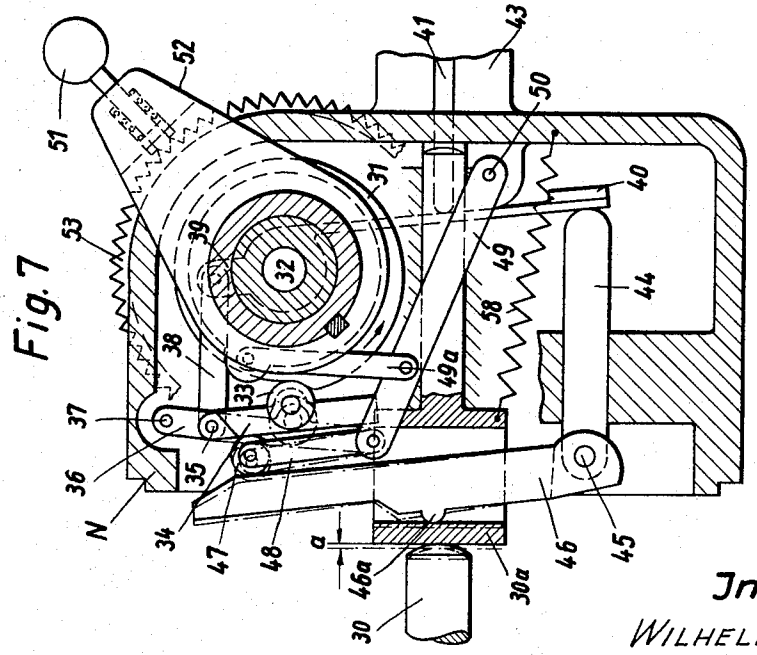


Fig. 7



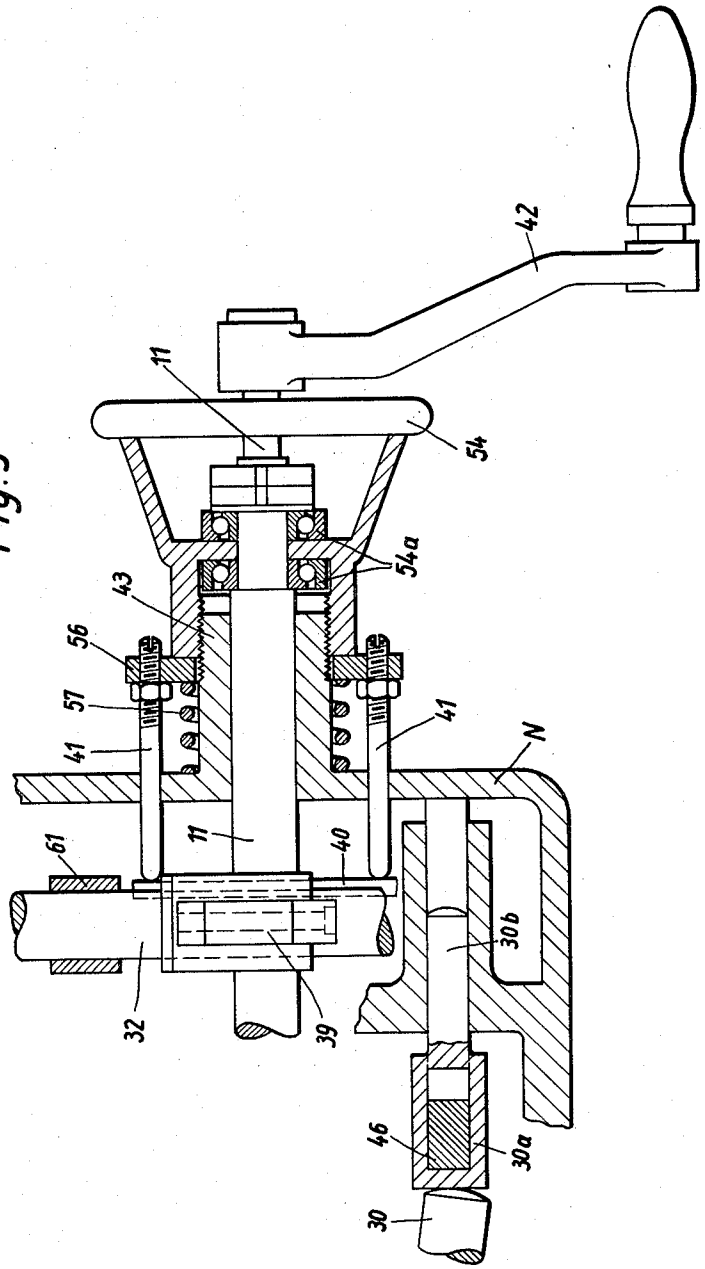
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Fig. 9



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Fig. 12

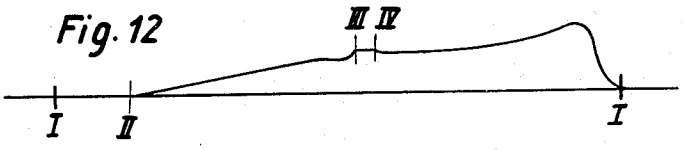


Fig. 10

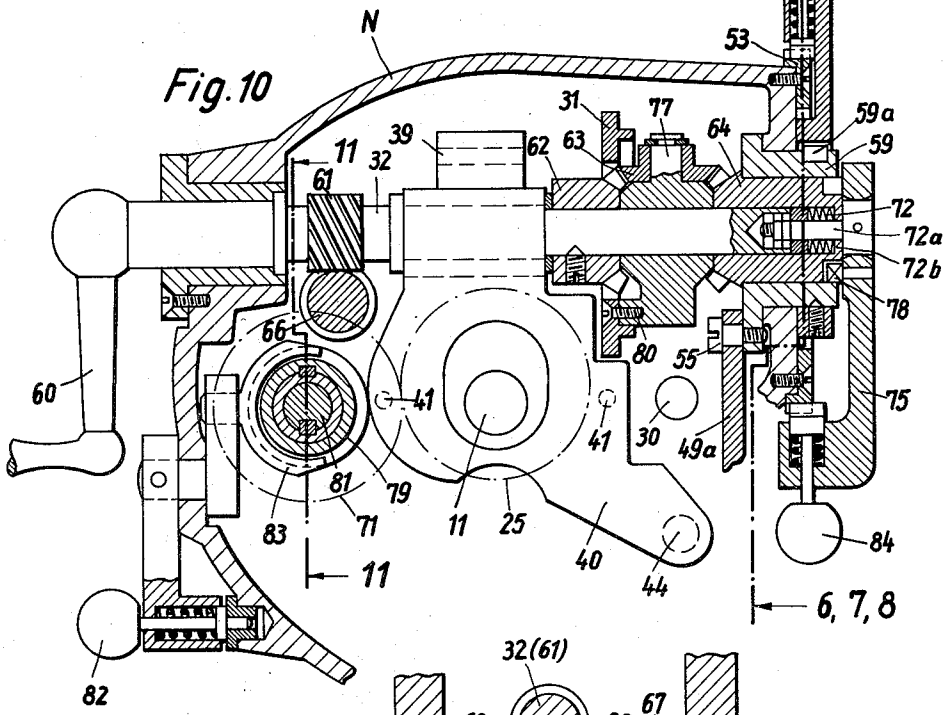
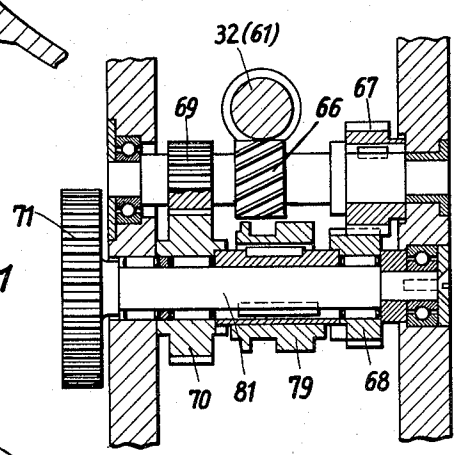


Fig. 11



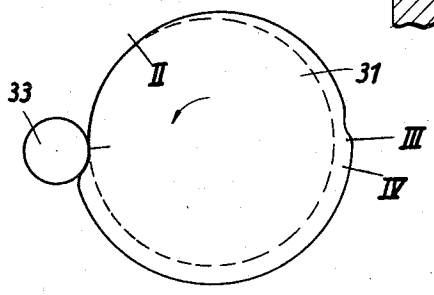


Fig. 13

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United States Patent Office 3,158,969 Patented Dec. 1, 1964

3,158,969

GRINDING MACHINE

Wilhelm Cawi, Berlin-Lichterfelde, Germany, assignor to Cawi & Co., G.m.b.H., Berlin-Steglitz, Germany, a firm

Filed Jan. 15, 1962, Ser. No. 166,210
Claims priority, application Germany, Jan. 24, 1958, C 16,173
10 Claims. (Cl. 51—219)

This invention relates to a grinding machine for sharpening or grinding relief-ground drills, milling cutters, countersinks or the like machine tools, particularly twist drills, which in addition to the usual conical cutting edges provided at the drill point have further cutting edges which serve, for instance, for countersinking or counterboring drilled holes, and which are termed end cutting edges.

According to this invention two different grinding systems are combined in one machine for grinding each of said kinds of cutting edges, the conical cutting edges provided at the drill point being ground in an usual manner, for instance in the manner described for simple twist drills in applicant's United States Patent No. 2,682,736, and the end cutting edges which serve for countersinking or counterboring drilled holes being sharpened or relief ground in a manner independent from the grinding of said conical cutting edges and without unchucking the drill. This application is a continuation-in-part of application Serial No. 788,575, now abandoned.

The accompanying drawings show a twist drill grinding machine, similar to that illustrated in the aforementioned patent, but with its construction so changed in accordance with this invention, that it also grinds end cutting edges.

In the drawings:

FIGURE 1 is a general elevational view of the machine with some outer parts hidden from view,

FIGURE 2 is a partial plan view of FIGURE 1 and illustrates in solid lines the grinding of the conical cutter edges on the point of the drill and in broken lines the grinding of the end cutting edges at the periphery of the drill,

FIGURE 3 is a view of a twist drill as ground in the machine in accordance with the invention,

FIGURE 4 is a view of a twist drill in its position relative to the grinding wheel and illustrates the movement of the drill while grinding the end cutting edges,

FIGURE 5 shows a sectional view taken on line 5—5 of FIG. 1 through one part of the housing and the chucking device for the drill and illustrating its drive and the connection between the index means and the clutch thereof, but rotated 180°,

FIGURE 6 shows a sectional view through the other part of the housing taken in the direction of line 6—6 of FIGURE 10 and illustrates the device for the axial feed of the drill (the differential gear being omitted),

FIGURE 7 shows a sectional view through FIGURE 10 taken in the direction of line 7—7 illustrating another setting of the parts as depicted in FIGURE 6,

FIGURE 8 shows a sectional view through FIGURE 10 taken in the direction of line 8—8 illustrating another setting of the parts as shown in FIGURES 6 and 7,

FIGURE 9 is a partial sectional view through FIGURE 6 taken in the direction of the line 9—9,

FIGURE 10 is a sectional view through FIGURE 6 taken in the direction of line 10—10,

FIGURE 11 is sectional view through FIGURE 10 taken in the direction of line 11—11, and

FIGURES 12 and 13 show the development of the shape of the curvature of a cam which serves to axially displace the tool holder and as shown in FIGS. 6 and 7

and the resulting movement during one rotation of said cam.

As can be seen from FIGURE 1, the machine has a pedestal A, on which a table B is mounted and which is rotatable about a pivot D. The table may be fixed in any set position by a clamping device E–F.

The table B is provided with guides along which the bipartite housing M, N of the grinding machine may be moved to and fro by means of a hand lever H, fixed to the axis of a gear wheel I supported on said table and engaging a rack K fastened on the housing, so that a coarse adjustment of the housing relative to the grinding disk G is possible.

The pedestal A also has a dovetailed guide P along which the grinding slide C with the grinding wheel G may be moved by a hand wheel L (FIG. 2),

In the housing M there is provided a head 10 (FIGURE 5), which is rigidly connected with a shaft 11 and which is rotatably supported with this shaft in the housing M, by means of bearings 10*a*.

The head 10 constitutes the bearing for the tool holder 12, which is of a general known type, and which supports a chuck for mounting the tool to be ground.

Such a tool may be a cylindrical drill S of known type, see FIGURE 3, provided at its point with conical cutting edges and at its periphery with spiral flutes and lands.

By grinding away a portion U at the point of the drill, end cutting edges T are formed, while, at its upper end, the drill is tapered so as to form in known manner, the conical cutting edges V. Both sets of cutting edges are to be ground in the presently disclosed machine.

The drill to be ground may be inserted into the conical bore of the tool holder 12, which has a cylindrical outer surface and which is supported in a cylindrical bore of an eccentric bush 13 so as to allow the tool holder to rotate as well as to move axially relative to the bush 13. By rotating the bush 13 relative to the head 10 the eccentricity of the bush causes an alteration of the distance of the axis of the tool holder 12 from the axis of rotation of the head 10 and also an alteration of the position of the point of intersection of these two axes, which rotation permits drills of different diameter sizes to be ground. The bush 13 may be fixed in its adjusted position in the head 10 by means of a clamping device 92 and a set screw 93 (FIGURE 5).

The machine allows the performance of two different grinding operations. Namely, a first grinding operation of the point V (FIGURE 3) of the drill, which operation is similar to that of the U.S. patent mentioned above. As the axes of the drill holder 12 and of the head 10 cross each other in space and have a certain rectangular distance from each other, i.e. are neither parallel nor intersect each other, the drill holder 12 will perform a tumbling movement. This movement is caused when the head 10 rotates which in turn causes the drill holder 12 to rotate around its axis due to its coupling therewith by its planet gears 17 or 18, respectively with the toothings 15 or 16 of sun wheel 14 which remains stationary at that time with respect to its shaft 11 and secondly a grinding operation of the end cutting edges T after having adjusted the machine according to the invention, in such a way that the head 10 stands still and the drill holder 12 is driven by the rotating sun wheel 14 and simultaneously moves in the direction of its axis, as will be explained hereinafter.

When grinding conical cutting edges V at the point (FIGURE 3) of a drill, the head 10 may be set in rotation by means of the hand crank 42. During this grinding operation, the sun wheel hub 14 remains stationary by a locking device 27, 28*a* which will be described hereinafter.

When the end cutting edges are to be ground the head

10 is stopped by an index 90 or similar device to be described hereinafter, and locked in such a position that the tool holder 12 is brought into the correct position and inclination relative to the grinding wheel G for removing a portion X (FIGURE 4). Simultaneously an abutment 30 rotatably supported by the drill holder 12 is adjusted in the correct position relative to a pressure sleeve 30*a* (FIGURE 6) so as to be capable of being advanced by it. For the purpose of being correctly engaged by the sleeve 30*a* when the latter advances it axially, as will be explained hereinafter, the pressure sleeve 30*a* (FIGURE 7) has a plane front surface engaging the rounded end of abutment 30 and thereby insures an undisturbed initiating of the feeding movement, independent of the adjustment of the index 90.

When grinding the end cutting edges the crank 42 is not operated and the head 10 is relatively fixed to the housing M by an index 90. This index is so constructed that, after the clamping screw 89 has been removed, the index guide 88 which e.g. is eccentrically inserted into the housing M, is adjusted by being turned by a certain amount around its axis and fixed in its new position by inserting the screw 89 in another hole, a plurality of these holes being provided. The lower end of the index thereby engages a longitudinal slot 87 provided at the circumference of the head 10, turns the said head for a small amount around its axis and thereby changes the inclination of the drill holder 12 relative to the side face of the grinding disk G to alter the desired clearance angle.

The position of the drill relative to the grinding wheel G when grinding the conical cutting edges at the point of the drill is shown in FIGURE 2 in dash and dot lines, while when grinding the end cutting edges the table B is rotated around the pivot D into the position as shown in FIGURE 2 in solid lines.

During this last mentioned grinding operation the grinding wheel G may be fed by advancing the adjustable grinding slide C by means of the hand wheel L (FIG. 2) for grinding out from the drill the desired portion U (FIG. 3). The coarse feed in the longitudinal direction of the drill is made by the hand lever H, the gear wheel I and the rack K (FIG. 1), the fine feed by an outward movement of the head 10 by a hand wheel 54 in a manner to be explained hereinafter.

The tool holder 12 is connected with the head 10 by means of an epicyclic gearing, which in the embodiment shown in FIGURE 5 also incorporates a change-speed gear. The sun wheel hub 14 of the epicyclic gearing is mounted on the shaft 11 so as to loosely rotate around it and has two toothed rims 15 and 16, meshing with the two planet wheels 17 and 18. The two wheels 17 and 18 are loosely rotatable on bushes 19*c* and 19*d*, respectively, which are displaceably mounted on the tool holder 12. Between the bushes 19*c* and 19*d* there is provided a further bush 19*a* which is secured for rotation with the tool holder by means of a key 19*b*. A jaw clutch annulus 22 is arranged to be axially displaceable on the bush 19*a*, but is secured against rotation on it.

On the clutch annulus 22 a leaf spring 19*g* is provided having an index 19*f* fastened thereon and engaging into corresponding borings of the bush 19*a* thereby securing the coupling against being displaced. If the leaf spring 19*g* is lifted and the index 19*f* is removed from the sleeve the clutch annulus may be engaged with the claw 23—or 24 provided on the toothed wheels 17 and 18, respectively, by means of a pin to be inserted into a boring 19*e* of the annulus, and the clutch may be secured by inserting the index 19*f* into the second boring of the sleeve 19*a*.

A spring 20 urges the bushes 19*c*, 19*a* and 19*d* and hence the whole train of gears toward the right hand side of FIGURE 5 against a retaining ring 21, and holds the bushes with free end clearance, and also renders it possible to move the tool holder 12 in its bearings in the direction of its axis by means of the abutment 30 and spring 20, respectively. The jaws provided at opposite

sides of the clutch annulus 22 may be brought, when the clutch is moved laterally, alternately into engagement with the corresponding jaws 23 and 24 on the gearwheels 17 and 18 respectively, in order to connect the one or the other of these two gearwheels with the bush 19*a*, and thereby also with the tool holder 12.

In the position shown in FIGURE 5 the gearwheel 18 is engaged, so that the gears 16, 18 are operative for a rotation of the tool holder 12, while the gears 15, 17 are running idle and vice versa, thus constituting a change-speed gearing serving the purpose of grinding tools with different numbers of point cutting edges and also end cutting edges.

The ratio of the number of teeth between the toothed rim 16 and the toothed gear 18 may be e.g. 1:1.5 (2:3). When the sun wheel 14 remains stationary and the head 10 rotates, one rotation of the head 10 results in 1⅔ rotations of the drill holder 12, the toothed wheel 18 rolling off on the stationary toothed rim 16.

When switching the clutch annulus 22, and driving the drill holder 12 through the toothed rim 15 and the toothed wheel 17 and when the ratio of transmission between or the number of teeth of the toothed rim 15 and the toothed wheel 17 is 1:2 one rotation of the head results in 1½ rotations of the drill holder, the wheel 17 rolling off on the rim 15.

When the head 10 remains stationary and the clutch 29 is disengaged from sun wheel 14 and the sunwheel 14 is driven by an intermediate gear 71 meshing with a further toothed rim 25 on the hub of the sun wheel 14, the ratio of speed between the rotation of the sun wheel 14 and the drill holder 12 is equal to the ratio of the teeth, i.e. if the toothed rim 16 drives the toothed gear 18 this ratio is equal to 1:1.5 and if the toother rim 15 drives the toothed gear 17 the ratio is equal to 1:2.

Thus, at each rotation the cutting edges which are the next in the opposite direction of the rotation are ground. The cutting edges change inversely to the direction of rotation because each time 1½ and 1⅔ rotations are concerned.

Of course the change-speed gear may have any desired number of speed ratios.

The gear 71 is driven by a gearing 61 (FIGURES 10 and 11) on a shaft 32 (FIGURE 10), in order to cause the tool holder 12 to rotate about its own axis while the head 10 remains stationary and is kept so by the index 90.

The shaft 11 of the sun wheel hub 14 carries a further sleeve-like component 26, which is rotatably supported thereon and is provided with a toothed rim meshing with a gearwheel 27 fixed on a shaft on which a worm gear 28*a* is also fastened. The worm gear 28*a* meshes with a worm 28*b* and the two components 28*a* and 28*b* constitute an irreversible gearing, i.e. the worm gear 28*a* may be rotated by the rotation of the worm 28*b* but not inversely. The worm 28*b* may be rotated by a hand lever 28*c* and fixed in the adjusted position by an index 28*d* engaging a rack 28*e*. The sleeve 26 can be engaged with, or disengaged from the sun wheel 14 by means of a clutch 29.

The operation of the clutch 29 is initiated by the shifting lever 96*f* (FIG. 5). When this lever is in its upper position, as illustrated in FIG. 5, the rod 96 and the fork lever 95 have disengaged the clutch 29 from the sun wheel 14. Simultaneously the index 90 is actuated by the connection lever 91*a* and the lever 91 and thereby the head 10 is blocked. In the lower position of the shifting lever 96*f*, and if the index 96*c* is in its locking position, the clutch 29 is coupled with the sun wheel 14 and simultaneously the index 90 is disengaged by the leverage 91, 91*a* and the head 10 can move freely.

When the clutch 29 is engaged the sun wheel 14 remains stationary as necessary when the conical cutting edges at the drill point are ground, in which process the head 10 rotates, so that the planet gears (17 or 18) run-

ning around the sun wheel cause the tool holder 12 to rotate. When grinding end edges the clutch 29 is disengaged.

The gearing 27, 28*a*, 28*b* has the additional purpose of permitting the sun wheel to be rotated by the lever 28*c* for a certain amount for changing the position of the tool holder 12 relative to the respective position of the head 10, thereby adjusting the clearance angle at the point of the drill. The adjusted value is maintained by the index 28*d* engaging the rack 28*e*.

The toothings 15 and 16 of the sun wheel have the form of bevel wheels and have their teeth provided with flanges convex in the axial direction, i.e. they are thick in its middle and thin at the ends, to allow a small turning of the eccentric bush 13 without influencing the meshing of the wheels 15, 17 and 16, 18, respectively. The cone of the sun wheel rims corresponds to the mean inclination of the axes of the sun wheel and the drill holder relative to each other. The planet wheels 17 and 18 are each formed as normal straight toothed spur wheels for the purpose of allowing the drill holder to be moved in the direction of its axis.

The nature of the bearing of the drill and its drive by an epicyclic gear corresponds essentially to the known kind of construction used in the above mentioned US patent for grinding simple twist drills, except that in the present embodiment (1) the sun wheel system is divided, and the two parts 14 and 26 can be connected and disconnected, (2) a change-speed gear is interposed between the sun and planet wheels for the purpose stated above, and finally, (3) the teeth of the planet wheels 17, 18 are straight so that a small axial displacement along the axis of the tool to be ground with its tool holder is possible, without the engagement of the gear wheels or the clutch being disturbed.

Such axial displacement is necessary to produce relief grinding of the end cutting edges. If the drill is engaged by the grinding wheel and is revolving it has, in addition to this movement, also a displacement against the surface of the grinding wheel. The amount of this displacement is determined by the clearance angle which is adjusted by the index 90 and also by the size of the drill to be ground. A big drill and a large clearance angle demand a large amount of displacement while small drills and small clearance angles need a minimum of displacement.

The abutment 30 for the axial displacement of the tool holder 12 when relief grinding is rotatably supported in ball bearings, and is moved axially during the operation of the machine in the manner illustrated in FIGURES 5, 6 and 7.

FIG. 4 shows the movement of the drill at the grinding disk G during the grinding operation. In the initial position shown in full lines the two outer corners *x* of the cutting edges are positioned in a plane substantially vertical with respect to the axis of the drill and are staggered relative to each other in the longitudinal direction corresponding to the inclined position of the drill relative to the grinding disc. During the rotation the drill is then continuously advanced and the cutting edges to be ground rotates until the vertical line connecting the corners *x*—*x* lies exactly horizontal. Shortly before reaching this point the advancing movement of the drill increases for a short time and the cutting edge is pressed strongly against the disc. During further rotation the cutting edges are withdrawn again somewhat from the grinding disc and are then continuously fed by only an amount so that the corners of the cutting edges themselves do not any more contact the grinding disc, thus material is only removed from the cutting edges so that they may freely rotate.

This feeding movement of the drill is caused by the abutment 30 actuated by the cam 31. The shape of the cam 31 is clearly shown in FIGS. 12 and 13 and will be more clearly described in connection with these figures hereinafter.

In FIGURE 7 the initial position of the abutment 30 is shown and the minimum amount of displacement is indicated by *a*, while the maximum amount of displacement is indicated in FIGURE 6 by *b* and shown in dot-and-dash lines. The cam 31 actuating the abutment 30 is driven by a shaft 32 via a differential gearing (FIGURE 10) which renders it possible for the cam to be adjusted relative to any position of the tool, independently of the drive, that is, through this adjustment the place of the tool, at which the tool springs back after each grinding of a cutting edge can be so altered that it returns correctly into the flute between the cutting edges when the flute passes the grinding wheel.

The shaft 32 is set in rotation, after the clutch 29 is released (FIGURE 5), by rotation of a crank handle 60 fixed on the shaft 32 (FIGURE 10), and entrains in its rotation a helical gearwheel 61 which meshes with a helical gearwheel 66 (FIG. 11). The toothed wheels 61 and 66 are helical gears which permit a transmission between non-parallel and non-intersecting shafts, as is the case here, in the conventional manner. The gear 61 can have by way of example nine teeth and a bevel of 63°, while the gear 66 can have eighteen teeth and a bevel of 27°. (Thereafter, the ratio of the wheels 61, 66 is 2:1, so that two rotations of the crank handle 60 result in one rotation of the gearwheel 66. On the shaft of the gearwheel 66 and on an intermediate shaft 81 (FIGURE 11) are two further pairs of meshing gearwheels 67, 68 and 69, 70. These pairs can be brought into operation alternately by a dog clutch 79, a fork lever 83 engaging clutch 79 and manually operated lever 82 connected to lever 83. By bringing into operation the intermediate gearwheels 67, 68, whose transmission ratio is 1:1, the wheel 71 and also the toothed rim 25 of sun wheel 14 meshing with each other with a ratio of 1:1, make one complete rotation for every two rotations of the crank handle 60.

By the interposition of the gear set 15, 17 in FIGURE 5, with a ratio of 1:2, the tool holder 12 would make half a rotation for every two rotations of the crank handle 60, with tools with two cutting edges the cam 31 must be given one rotation while the tool during this time is moved once forwardly and backwardly.

The cam 31 is fixed by screws 80 to the cage of a differential gear (FIGURE 10). Thus when the shaft 32 is rotated, with the bevel wheel 64 stationary, the differential action causes the bevel wheel 63 and hence the differential cage with the cam 31 to make only half the number of rotations of the driving bevel wheel 62, that is to saw for two rotations of the crank handle 60 only one rotation of the cam 31 takes place corseponding to half a rotation of the tool holder with a drill with two cutting edges.

If drills are to be ground having four end cutting edges, the clutch 79 is coupled with the wheel 70 and the pair of wheels 69, 70 (FIG. 11) is set into operation. In this position two rotations of the crank 60 result in one rotation of the wheel 69, and due to the ratio of transmission of 1:2 between the wheels 69 and 70, a half rotation of the wheel 71 and of the toothed rim 25 of the sun wheel is effected, and through the toothed rim 15 and the gear wheel 17 a ¼ rotation of the drill holder 12 during one rotation of the cam 31 is effected in conformity with the one forward and backward movement with drills having four cutting edges.

With the same position of the clutch 79 i.e. for two rotations of the crank 60 and half a rotation of the sun wheel 14 one third rotation of the drill holder 12 results from one rotation of the cam when the pair of wheels 16, 18 is inserted having a transmission of 1:1.5 (2:3), in conformity with three cutting edges at the circumference of a drill.

The interposition of the differential gear is necessary in order to avoid the necessity to change the chucking of the drill. The bevel wheel 64 can be adjusted for any desired position for the purpose of displacing the

zero point O (FIGS. 12 and 13) of the cam 31. This arrangement is important for the purpose to take up, with the drill firmly chucked, the leaping back by the flute between the teeth of the drill, that is to say, to bring both outer edges *x* of the cutting edges in the vertical plane (FIG. 4). For this purpose the bevel wheel 64 is provided with recesses into which an index 78 fastened to a lever 75 may enter. The lever 75 is provided with a further index engaging the toothed rim 53 and carrying a handle 84 by which the lever 75 may be turned and adjusted for the desired amount. Lever 75 cannot be fully rotated, since a device 51, 52 (FIGURE 10) which still has to be described, is accommodated on the same toothed rim 53. The index 78 can be made to engage in any recess of the bevel wheel 64 by drawing the lever 75 with the pin 72*a* outwardly against the pressure of the spring 72 and bringing it into engagement again with another recess at the wheel 64. The spring 72 is coiled around the pin 72*a*, which has a head supported in a boring of the lever 75, and carries at its end a washer and nuts by which the spring is held, while the other end of the spring is supported by an annular projection 72*b* of the wheel 64. The spring secures the index 78 within a selected recess. By this construction the gearwheel 64 may be circularly adjusted in practically any desired position.

The levers 75, and 51 are accommodated both on the same toothed rim 53 for simplified operation. The cam 31 actuates the abutment 30 in the following way. A roller 33, engages the cam and may be moved by it between two positions during one rotation of the cam, indicated in FIGURE 5 in full and in dot-and-dash lines. The roller is supported on a rocker arm 34, which can swivel about a pivot 35 mounted on the free end of a lever 36, which can swivel about a fixed pivot 37. A link 38 has one end pivoted to the pivot 35, and its other end is pivoted to one arm 39 of a double-armed lever, whose second arm is designated 40. The lever 39, 40 can swivel loosely about the shaft 32 and will hereinafter be referred to as the main rocker. The lever arm 40 is engaged by push rods 41, which, as can be seen from FIGURE 9, can be moved by hand in an axial direction by means of the handwheel 54.

The handwheel 54 is provided with a bush screwed onto a threaded pivot 43 (FIG. 9) projecting from the portion N switch is provided on the housing. The pivot 43 simultaneously forms a bearing for the shaft 11, and the handwheel 54 is supported on a portion of shaft 11 having a smaller diameter by means of bearings 54*a*. When adjusting the handwheel 54 not only the shaft 11 with the head 10 are moved axially forward, but also at the same time the push rods 41 connected to annulus 56. The purpose of this arrangement is to make a fine adjustment when grinding the cutting edges and to provide simultaneously that the lever 46 (FIG. 7) and the pressure sleeve 30*a* engage the abutment 30, by the movement imparted to said lever 46 by the push rods 41 and levers 40 and 44. The free end of the main rocker 39, 40 rests against said rod 44 displaceably supported in the frame, and articulated at 45 to the lever 46 acting as an auxiliary rocker (FIG. 6).

Between the levers 34 and 46 a roller 47 is inserted, which roller is supported at the end of a link 48, which is pivotally connected with the end of the lever 49. The other end of the lever 49 is pivotally connected with a projection of the housing N by means of a pivot 50. The lever 49 may be adjusted by the double armed adjusting lever 52 provided on the shaft 32 which adjusting lever may be fixed in the adjusted position by the toothed rim 53 and an index 51 springily supported by the lever 52 and engaging said rim under the pressure of a spring, said double armed adjusting lever being connected with the lever 49 by an intermediate lever 49*a*.

By adjusting the lever 49 the roller 47 is moved up or down respectively, and rolls lengthwise between the opposite faces of the levers 46 and 34. Two positions of the link 48 are to be seen in FIGURES 6 and 7, FIGURE 6 simultaneously showing in solid and dotted lines respectively, the two end positions of the roller 47, when in its lowest position, caused by the displacement of the lever 34 by the cam 31.

The device described is intended to insure that the lever 46 is urged towards the intermediate pressure sleeve 30*a* and the pivot 30 without play, when the head 10 is moved forward for adjustment during grinding via the handwheel 54 and the shaft 11.

The sleeve 30*a* has an outer plane surface to allow the rounded end of the abutment 30 to correctly engage it, even if the said abutment is inclined at different angles. The sleeve 30*a* is guided in the housing by means of a rod 30*b* connected to said sleeve.

As already mentioned above the clutch 29 (FIG. 5) is preferably connected with the index 90 locking the head 10, that by releasing the clutch 29 the head 10 is automatically locked in the correct grinding position and simultaneously in the correct position relatively to the front face of the pressure sleeve 30*a*. When setting the handwheel 54 for ajusting the cutting edges, as already mentioned, the rods 41 are actuated, which act on the main rocker 39, 40, whose axis of rotation (shaft 32) coincides with that of the cam 31. The lever arm 40 moves via the rod 44 the pivot 45 of the lever 46, which thereby can follow the changes in position of the tool holder, that is of the aboutment 30. The points at which the rods 41 engage the lever 40 and the point at which the pressure point 46*a* of the lever 46 and the inner surface of the sleeve 30*a* contact lie in the same plane, thus preventing any play.

The roller 47 serves to ensure a varying feed of the abutment 30 corresponding to the different size of the drills and also a different clearance angle in spite of the constant rise of the cam 31. By the adjustment of this roller 47 between the pressure surfaces of the two levers 34 and 46 the lever arm of the transmission is increased and thus the path of the abutment 30 is varied as desired, in spite of the cam rise remaining constant.

Thus by setting the hand lever 51 and simultaneously the lever 49 through the connecting lever 49*a*, and hence the roller 47, the displacement of the abutment 30 by the cam 31 is altered, and in this way the displacement of the drill against the grinding wheel G can be adjusted. With the roller 47 in the upper position, as shown in FIGURE 7, the movement of the roller is, for example about half the throw of the cam, and by the ratio of the distance between the center of rotation of lever 46 and the engaging point of the roller 47 on the one hand and the pressure point 46*a* of the lever 46 on the other hand, this value is still further subdivided, for example halved, so that the displacement of the tool is less than ¼ of the throw or lift of the cam. However, as shown in FIGURE 8 the adjustment of the roller 47 by the lever 49, 52 can also be designed—and this is particularly advantageous—that the roller may be adjusted upwards as far as the height of the pivot 35 and that at this upper end point of the upward movement of the roller the forward movement is zero (FIGURE 8), since reciprocating motion of the roller 33 by the cam 31 can no longer impart reciprocating motion to the roller 47. To secure the free revolving of the head 10 with the planetary movement of the abutment 30 the uppermost part of the lever 46 has an inclined surface allowing the roller 47 to return, and also giving the lever 46 and the sleeve 30*a* clearance enough for the abutment 30 to pass.

FIGURE 8 shows that the roller 47 can not initiate a feeding movement of the lever 46 with any position of the cam 31 in the zero position.

By this arrangement it becomes possible to adjust the reciprocating motion of the said roller from zero to the maximum value, according to the steps of the segment 53.

It is suitable to connect the index 90 and the clutch 29 also with the lever 52 in such a way that the clutch 29 can only be engaged while the index 90 is disengaged from head 10 if the roller 47 is brought into its uppermost position so that, with any position of the cam, the abutment 30 now rotating with the head 10 cannot abut against the front face of the sleeve 30*a*.

In the lowest position of the roller 47 between the two pressure surfaces of the levers 34 and 46 it transmits about twice the throw or lift of the cam, while at the same time the fulcra of the levers 34 and 46 are altered, so that now about ⅔ of the roller movement, that is to say about 1⅓ of the cam throw or lift is transmitted to the abutment 30.

The levers are arranged in such a manner that the two pressure surfaces of the levers 34 and 46 between which the roller 47 slides are parallel to each other in the position of rest, i.e. before the beginning of the advance of the drill to be ground, for the purpose that no displacement of the abutment 30 and the workpiece carrier arises when the roller 47 moves up and down. Besides, the parallel position of said levers must be maintained even with the different positions of the push rods 41 and of the abutment 30 as may be possible by adjusting the hand wheel 54.

For this purpose the lever 34 is conected with the lever arm 39 by the lever 38, so that the swinging axis of the lever 34, i.e. the axis 35, is adjusted correspondingly when the double lever 39, 40 swings so that also the inclination of the lever 34 can be changed.

The described quadrilateral 39/40, 38, 34, 46, 44 warrants that, in the position of rest, the surfaces of the lever 39/40 engaging the push rods 41, the levers 34 and 46 engaging the roller 47 and the lever 46 engaging the abutment 30 remain always parallel. To always maintain this parallel position the pivot 35 must be suspended freely swinging about a stationary pivot 37; besides it must be connected with the lever arm 39 via the link 38, by means of which, when the main rocker 39/40 is rocking, the swivelling point of the lever 34 can be controlled accordingly and the angular direction of the lever can be altered.

When the length of the push rod 44 is correctly adapted to the length of the lever 38, it is secured by the pivoting of the transmission elements like a parallelogram so that with any position of the double lever 39, 40 the pivots of the levers 46 and 34, i.e. the pivots 45 and 35, are so displaced that the two opposite pressure surfaces of the transmission levers 46 and 34 engaging the roller 47 are changed, it is true, both commonly with respect to their angular position, but remain always parallel to each other with a distance corresponding to the diameter of the roller 47.

The return spring 53 maintains all engaging points of the feeding elements of the abutment 30 in contact with each other, namely the roller 47 and the levers 36, 34, 38 and 39 through the pressure sleeve 30*a* and the lever 46 as well as through the push rod 44 and the double lever 40, 39, and at the same time also the double lever 39, 40 in contact with the push rods 41 which cause the respective inclination of the transmission parallelogram.

By adjusting the various feed movements the machine can be adapted to whatever relief is desired or at the same time to the smaller or larger feed required for varying diameters of the drill. The pusher for moving the abutment 30 consists of a sleeve 30*a* allowing the lever 46 to pass therein and a rod 30*b* to be guided in the housing.

FIGURES 12 and 13 demonstrate the curvature of the cam 31. As can be seen from FIG. 13, a special feature of the cam 31 consists in its feeding action on the roller 33 and also of the drill to be sharpened towards the grinding disc caused, after a standstill between the points I and II of the cam, by the increase of the cam diameter between the points II and III is shortly interrupted by a small piece of a cylindrical circumference between the points III and IV which becomes effective at the moment in which the edge to be ground is positioned exactly horizontal to the side surface of the grinding disc. Thereby an absolutely straight form of the front cutting edge is obtained and, besides, the relief grinding is brought to the value adjusted at the index 90. Besides, the amount of feeding caused by the position of the roller 47 is variable within certain limits without changing the relief grinding. The zero-point is the point I, it corresponds to the position of the cam which is engaged by the roller 33 in FIGS. 6 and 7, the cam rotating in a counter clockwise direction. Between the points II and I the cam face slowly rises and only the back of the cutting edge is ground, shortly before the zero-point I the cam face decreases rapidly.

The dash line in FIG. 13 shows a circle around the axis of the cam 31 and only serves to better recognize the form of the curvature.

A development of the curvature of the cam 31 is shown in FIG. 12. The points designated with I to IV corresponds to the points of curvature of cam 31 which are designated with the same reference numbers.

I claim:

1. In a tool sharpening and grinding machine comprising in combination, means for sharpening the conical cutting edges provided at the drill point consisting of a rotatable driving shaft, a supporting head fixed on said shaft, a tool carrier eccentrically mounted in said head to rotate therewith and also rotatable about its own axis, the rotational axis of said tool carrier and the rotational axis of said head crossing each other in space, namely neither being parallel nor intersecting each other, an epicyclic gearing including sun and planet wheels to rotate said head and said tool carrier, means for axially displacing said tool carrier for grinding end cutting edges on the tool, and means for switching over from the first-mentioned means to the second-mentioned means, and wherein the sun wheel of said epicyclic gearing is loosely rotatable on said shaft and is bipartite, a coupling mounted adjacent said sun wheel to engage and disengage said sun wheel, a blocking device connected to said coupling for blocking said sun wheel and stopping movement of said head when said coupling is engaged with said sun wheel, and an additional gearing connected to said sun wheel to drive said sun wheel when the coupling is disengaged from said sun wheel.

2. In a tool sharpening and grinding machine for sharpening the conical cutting edges and for grinding end cutting edges of a tool comprising in combination, a rotating driving shaft, a rotatable supporting head fixed to said shaft, a tool carrier eccentrically mounted in said head to rotate therewith and also rotatable about its own axis, the rotational axis of said tool carrier and the rotational axis of said head crossing each other in space, namely neither being parallel nor intersecting each other, an epicyclic gearing consisting of sun and planet wheels to rotate said head and said tool carrier, and means for axially displacing said tool carrier relative to said head, said means for axially displacing the tool carrier relative to the head comprising a pivot freely rotatable relative to and axially of the tool carrier, a rotatable cam having a constant throw, a first lever pivoted at one end and displaceable by the cam, a second lever pivoted at one end opposite to said one end of said first lever and engaging the rotatable pivot, and transmission means interposed between the levers and displaceable longitudinally of the levers for transmitting movement of one lever to the other.

3. A tool sharpening and grinding machine according to claim 2, further comprising means for adjusting the position of the transmission means and retaining it in adjusted positions.

4. A tool sharpening and grinding machine according to claim 2, further comprising a double-arm lever pivoted

intermediate its ends coaxially with the cam, a link connecting one end thereof to the pivoted end of the first lever, and means connected to the pivoted end of the second lever and engaging the other end of the double-arm lever.

5. A tool sharpening and grinding machine according to claim 4, further comprising manually adjustable means for urging said other end of the double-arm lever into engagement with said last-mentioned means.

6. In a tool sharpening and grinding machine comprising in combination, means for sharpening the conical cutting edges provided at the drill point consisting of a rotatable driving shaft, a supporting head fixed on said shaft, a tool carrier eccentrically mounted in said head to rotate therewith and also rotatable about its own axis, the rotational axis of said tool carrier and the rotational axis of said head crossing each other in space, namely neither being parallel nor intersecting each other, an epicyclic gearing including sun and planet wheels to rotate said head and said tool carrier, means for axially displacing said tool carrier for grinding end cutting edges on the tool, and means for switching over from the first-mentioned means to the second-mentioned means, and wherein said means for grinding the end cutting edges comprise a cam adapted to axially advance the tool carrier carrying the tool to be ground, and adjusting means comprising a rocker arm and a lever acting the one to the other by means of an adjustable intermediate means so that the axial advance may be altered with equal stroke of the cam.

7. In a tool sharpening and grinding machine comprising in combination, means for sharpening the conical cutting edges provided at the drill point consisting of a rotatable driving shaft, a supporting head fixed on said shaft, a tool carrier eccentrically mounted in said head to rotate therewith and also rotatable about its own axis, the rotational axis of said tool carrier and the rotational axis of said head crossing each other in space, namely neither being parallel nor intersecting each other, an epicyclic gearing including sun and planet wheels to rotate said head and said tool carrier, means for axially displacing said tool carrier for grinding end cutting edges on the tool, and means for switching over from the first-mentioned means to the second-mentioned means, and wherein said means for grinding the end cutting edges comprise a cam adapted to axially advance the tool carrier carrying the tool to be ground, adjusting means comprising a rocker arm and a lever acting the one to the other by means of an intermediate means so that the axial advance may be altered with equal stroke of the cam, adjusting means for adjusting said intermediate means for changing the ratio of the transmission between said arm and lever, and means for fixing said intermediate means in the adjusted position.

8. In a tool sharpening and grinding machine comprising in combination, means for sharpening the conical cutting edges provided at the drill point consisting of a rotatable driving shaft, a supporting head fixed on said shaft, a tool carrier eccentrically mounted in said head to rotate therewith and also rotatable about its own axis, the rotational axis of said tool carrier and the rotational axis of said head crossing each other in space, namely neither being parallel nor intersecting each other, an epicyclic gearing including sun and planet wheels to rotate said head and said tool carrier, means for axially displacing said tool carrier for grinding end cutting edges on the tool, and means for switching over from the first-mentioned means to the second-mentioned means, and wherein said sun wheel comprises a plurality of rims having teeth thereon, the teeth of each rim being different in number, said teeth having a convex shape in their longitudinal direction.

9. A sharpening and grinding machine as claimed in claim 8, wherein said tool carrier is axially displaceable and the toothed gears provided thereon have the flanks of their teeth straight-lined so as to enable a certain alteration of their angular position and simultaneously of the distance between said tool carrier and the axis of said head, in spite of their meshing with the level wheel-like form of the toothed rims.

10. In a tool sharpening and grinding machine for sharpening the conical cutting edges and for grinding end cutting edges of a tool comprising in combination, a rotating driving shaft, a rotatable supporting head fixed to said shaft, a tool carrier eccentrically mounted in said head to rotate therewith and also rotatable about its own axis, the rotational axis of said tool carrier and the rotational axis of said head crossing each other in space, namely neither being parallel nor intersecting each other, an epicyclic gearing consisting of sun and planet wheels to rotate said head and said tool carrier, and means for axially displacing said tool carrier relative to said head, and wherein the sun wheel includes two gears and the planet wheel includes two gears meshing with the two gears of the sun wheel with different ratios, the gears of one of the epicyclic gearing being freely rotatable relative thereto, and means for selectively coupling one of the freely rotatable gears to drive said epicyclic gearing.

References Cited in the file of this patent

UNITED STATES PATENTS

641,107	Heister	Jan. 9, 1900
1,656,388	Nielsen	Jan. 17, 1928
2,386,687	Jearum	Oct. 9, 1945
2,513,694	Turrettian	July 4, 1950
2,682,736	Cawi	July 6, 1954