May 28, 1946. H. J. M. JOHNSON ET AL 2,400,933

UNDERCUTTING TOOL

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Fig. 4

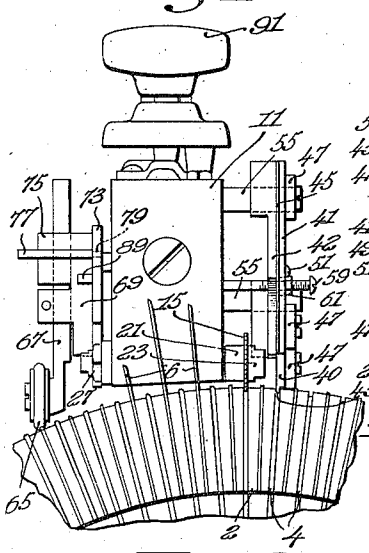


Fig. 1

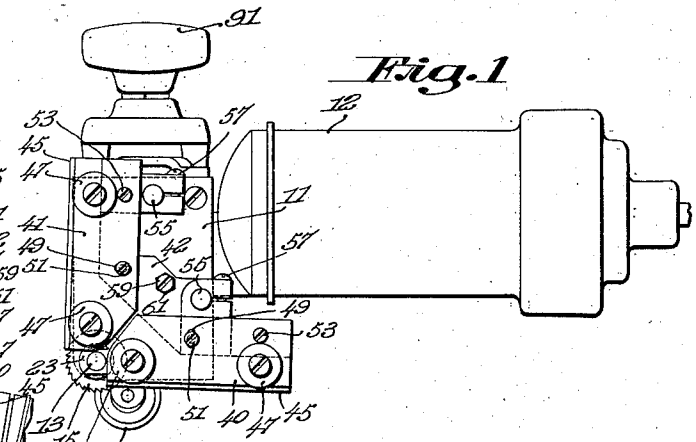


Fig. 3

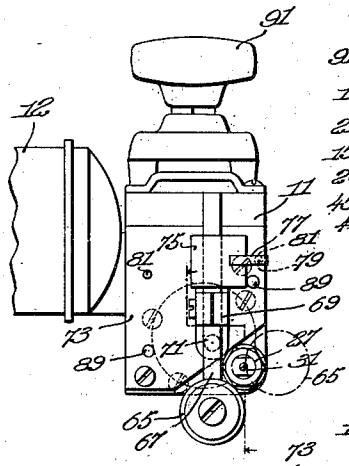


Fig. 2

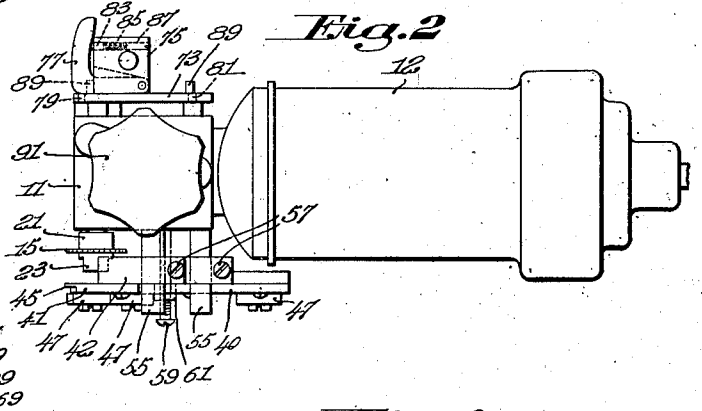


Fig. 6

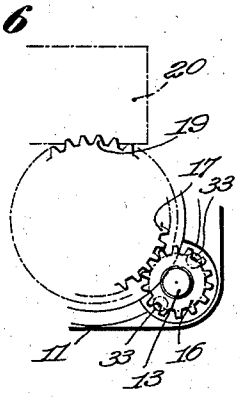
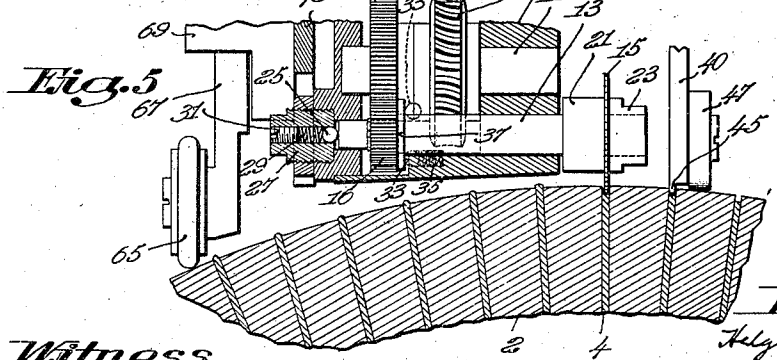


Fig. 5



Witness

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UNDERCUTTING TOOL

Filed Jan. 23, 1943 2 Sheets-Sheet 2

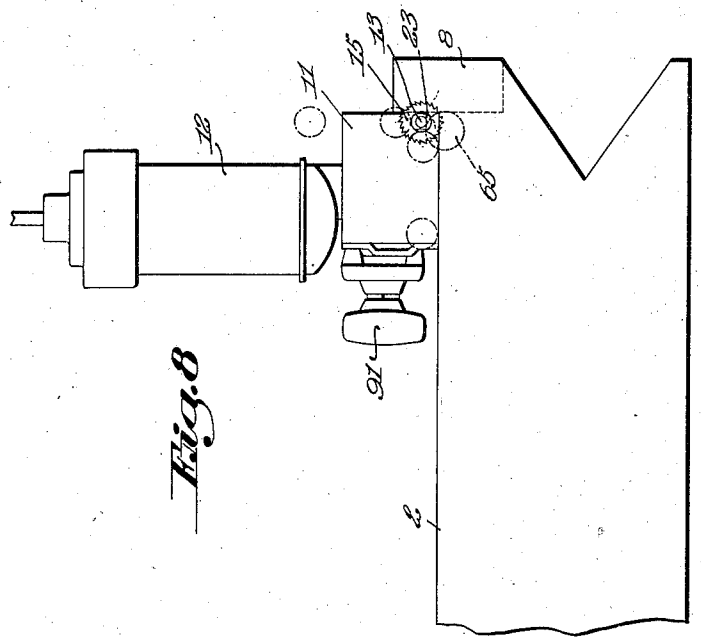


Fig. 8

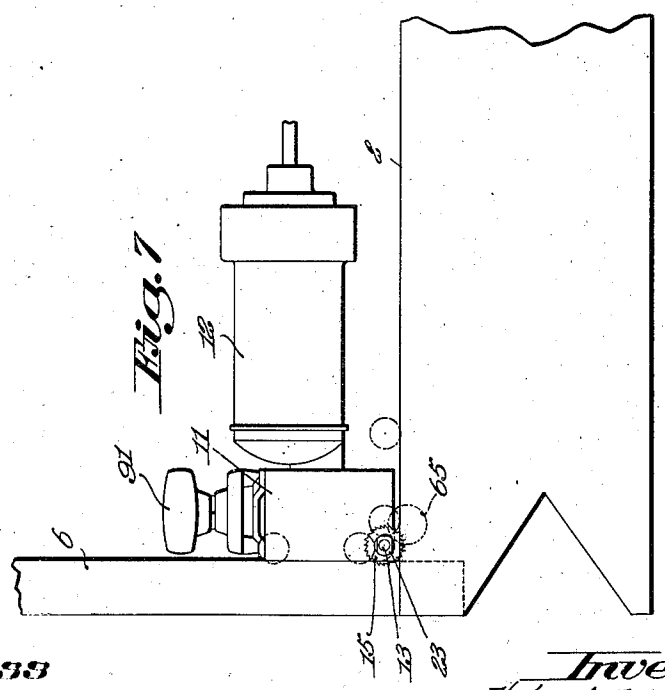


Fig. 7

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UNITED STATES PATENT OFFICE

2,400,933

UNDERCUTTING TOOL

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13 Claims. (Cl. 90—12)

The present invention relates to tools for undercutting mica insulation between adjacent commutator segments of electric generators and motors.

These thin mica insulation strips are more resistant to wear by carbon brushes than is the copper of which the segments are formed, with the result that in course of time the surface of the bars or segments become worn slightly below the outer edges of the mica insulation. As a consequence, the brushes fail to make proper and continuous contact with the bars, causing sparking and otherwise interfering with the proper operation of these parts.

The bars or segments of the commutators, especially those of the larger sizes, are now provided with radial members or extensions at their inner and outer ends. The inner extensions serve as connectors to the outer end of which the windings of the armature or rotor are connected and may extend radially a distance as great as the length of the commutator bars. The extensions at the outer ends of the bars serve as fan blades or cooling fins to maintain a circulation of cooling air over the commutator and brushes. Ordinarily they are much shorter than the inner connectors, extending only a few inches beyond the periphery of the commutator.

Both the inner connectors and the outer fins of the bars are of such radial length that they interfere to an objectionable degree with the operation and manipulation by the operator of the present form of undercutting tools now in use. Not only does the operator have difficulty in properly guiding the tool so that the cutter will operate upon the mica only and without cutting or damaging the commutator bar itself, but it is impossible, because of the radially extending connectors and fins, to use the tool to undercut the entire length of the mica strip, leaving one end, and sometimes both ends to be cut by a hacksaw or similar tool reciprocated and guided by hand, which is a very slow and most exacting operation.

It is the object of the present invention to provide a tool which normally is properly supported and accurately guided during its operation, and which is adapted to cut the entire length of the mica between the connectors and the fins without requiring any subsequent and additional hand operation.

With this object in view the present invention consists in a tool so constructed that when held by the operator in one angular position it will undercut the mica close to the connectors, and when held in another angular position will undercut close to the fins, being provided with suitable guiding and supporting devices for operating in either position at the ends of the slots, as well as through the intermediate portions thereof.

A further feature of the present invention is the mounting of the rotating cutter so that it has provision for a limited movement axially, thereby to permit it to adjust itself with respect to the slot and thus avoid the removal of any appreciable amount of the commutator bar itself at the edge of the slot because of either faulty adjustment of the tool or improper manipulation thereof.

Other features of the present invention will be referred to in the following specification and will be apparent to those skilled in the art from the accompanying drawings in which Fig. 1 is a left side elevation of our improved undercutting tool; Fig. 2 is a top plan view of the same; Fig. 3 is a right side elevation of the cutter head and a portion of the motor casing; Fig. 4 is a front elevation showing the tool in operative position upon the commutator; Fig. 5 is a detail, on an enlarged scale, partly in section, showing the cutter and gearing for driving the same and the guides and supports for the cutter head in operative position upon a commutator; Fig. 6 is a diagrammatic view of the worm and gear drive for the cutter; Fig. 7 is a side elevation of the tool in operative position upon the commutator at the inner or riser end thereof with the motor casing horizontal; and Fig. 8 is a similar view of the tool at the front or cooling fin end of the commutator with the motor casing vertical.

The tool of the present invention comprises, briefly, a cutter head carrying a rotating cutter with its driving gearing, and provided with guiding and supporting devices for guiding and supporting the tool during the undercutting operation. The rear of the head is attached to the casing of a universal motor which, through suitable gearing, drives a small rotary cutter positioned close to the bottom and front faces of the cutter head so that its peripheral teeth extend slightly beyond such faces, thus adapting the tool for operation with the motor axis either horizontal as shown in Figs. 1–7, or vertical as shown in Fig. 8. In the horizontal position the tool may cut close to the risers or connectors at the inner end of the commutator (see Fig. 7), while in the vertical position it will cut close to the cooling fins at the outer end (see Fig. 8). The guiding

and supporting devices are constructed to guide and support the tool in either position.

Preferably the cutter is mounted for a slight yielding movement in either direction, to permit it to follow the slot notwithstanding slight variations in the spacings between slots or imperfect adjustments of the tool or improper manipulation of the same.

Referring to the accompanying drawings in connection with the following detailed description of one specific form of our improved tool and its method of use, Figs. 4, 5, 7 and 8 show portions of a conventional form of a commutator having the segments or bars 2 separated by strips of mica or similar insulation 4, and provided at their inner or rotor ends with the connections or risers 6 and at their outer ends with the cooling fins 8.

In our improved tool, the cutter head 11, which consists of a substantially rectangular block of metal, is rigidly connected at its rear face to the front end of the motor casing 12. Rotatably supported in the lower front portion of the head is the transverse cutter shaft 13 upon which is mounted the rotary cutter 15. The cutter shaft is rotated through the pinion 16 engaging the gear 17 fixed upon the intermediate shaft 18, which also carries the worm gear 19 meshed with the worm 20 mounted upon the front end of the motor shaft.

The use of the intermediate shaft with its speed reducing worm and speed increasing gearing, permits a small pinion to be mounted upon the cutter shaft, thus enabling the latter to be positioned close to the bottom and front faces of the cutter head and a relatively small diameter cutter employed which, nevertheless, projects slightly beyond the cutter head faces.

The rotary cutter 15 is clamped securely upon the projecting end of the shaft 13 and against the hub 21 by means of the clamping nut 23, and in order to permit slight axial movement of the cutter to adjust itself in the slot between adjacent bars, the shaft is arranged to have a slight yielding axial movement in either direction. This is accomplished by providing the spring-pressed thrust balls, one, 25, engaging the inner end of the shaft, being mounted in the threaded plug 27 with the backing spring 29 and adjusting screw 31, and the other pair consisting of the balls, 33, being mounted in counter-bores in the cutter head with backing springs 35, these balls engaging the side of the hub 37 of the pinion 16. Normally, the cutter rotates in substantially fixed position, but if through slight misadjustment of the guides or slight irregularity in the segment or improper manipulation of the tool, the cutter engages one segment or the other under any substantial pressure, the cutter and its shaft will yield slightly to relieve the pressure and avoid damage to the commutator bars.

The guiding devices for guiding and supporting the tool when in operation, comprise a pair of edge guides or members 40 and 41 mounted at right angles to one another upon a supporting member 42. Each guiding member consists of a metal strip with its work engaging edge provided with a lip 45 adapted to enter the adjacent slot which has previously been undercut. Rolls 47 mounted upon the guiding members engage the surface of the commutator bar and permit free and easy movement of the tool along the commutator without liability of scratching or marring the surface thereof. These guides are of sufficient length to maintain the cutter in exact parallelism with the slots, thus avoiding any liability of the operator turning or canting the tool to one side or the other, with consequent enlargement of and damage to the slot.

Slight adjustment of the guides at their ends nearer the cutter to regulate the depth of cut is secured by forming elongated slots 49 for the clamping screws 51. By slightly loosening the screws 53 at the distant ends of the guides as well as clamping screws 51, the guides can be turned slightly to bring the ends adjacent the cutter into proper adjustment, and may then be secured by tightening the screws.

Lateral adjustment of these guides is afforded through movement of the guide supporting member 42 which is mounted upon the two studs 55 fixed in the side of the cutter head, clamping screws 57 securing the member in adjusted position upon the studs.

To assist in bringing the guides to the desired position, and also serving as a location stop or pin so that the guides and member may be removed and replaced in the original position, a screw 59 has been provided extending through the guide supporting member and held in adjusted position by means of the lock nut 61.

It will be understood that when the tool is being operated to undercut the mica, beginning at the inner or riser end of the commutator and progressing outwardly, the horizontal guide 40, as shown in Fig. 1, will be operative to guide the tool. In finishing the outer end of the slot, when the tool is tipped with the motor casing vertical, as shown in Fig. 8, the other guide 41 becomes operative to guide the tool. Since both guides are carried by the same guide support, the lateral adjustment of the first guide will necessarily effect the proper lateral adjustment of the second guide as both are carried on the same adjustable supporting member.

To relieve the operator of the duty of laterally supporting the tool with the plane of the rotary cutter at all times radial to the axis of the commutator, a side support opposite the guides has been provided in the form of a freely rotating wheel or roller 65, with rounded periphery, carried on the end of the swinging arm 67, clamped in the pivoted block 69 mounted upon the pin 71 fixed in the plate 73, rigidly supported upon the side of the cutter head opposite the cutter and spaced therefrom. (See Figs. 2, 4 and 5.) Upon the upper end of the swinging bar is the block 75 carrying the pivoted latch 77 with locking pin or finger 79 arranged to engage one or the other of the holes 81 in the plate to lock the arm and its wheel or roll in either of its operative positions, as indicated in full and broken lines in Fig. 3. The pivoted latch is normally held in locking position by means of the pin and spring 83 and 85 in the recess 87 in the block. Stop pins 89 are fixed in the spaced plate to limit the swinging movement of the arm and supporting roll.

To assist the operator in supporting and guiding the tool a knob or handle 91 has been provided which is rigidly secured to the top of the cutter head. By grasping the motor casing with one hand and the knob or handle 91 with the other, the operator is enabled to position and operate the tool in a convenient and easy manner without requiring any special effort or great skill.

In operation, the tool, after having been properly adjusted with respect to its guides and supports for proper spacing of the commutator bars

and depth of the cut, is positioned as shown in Fig. 7, with the motor casing horizontal and the knob or handle uppermost. In this position the tool is drawn slowly towards the front or outer end of the commutator, that is toward the right of Fig. 7, the rotating cutter at such time cutting away the mica to the desired depth below the surface of the commutator bars. When the tool has been moved outwardly until further movement is difficult or impossible on account of the ventilating fins, the tool is lifted, the swinging arm for the side support turned through slightly less than 90° and the tool replaced, this time with the motor casing in vertical position, as shown in Fig. 8. With the tool held in this position it is drawn the remaining distance to the outer end of the commutator, completing the cutting close to the ventilating fins.

The tool is then removed, returned to its horizontal position with the swinging bar restored to original position, and is then placed upon the commutator to cut the adjacent slot with the guide positioned in the slot last previously cut, as shown in Fig. 5. The cutting operation above described is then repeated and subsequent slots undercut, the commutator with its rotor being turned as required to bring the work in proper position for the operator.

It may be found necessary or desirable before the cutting of the first slot by our improved tool that a preliminary slot cutting operation be performed upon a slot sufficient to enable the guide to operate properly therein. This preliminary cutting may be accomplished by careful manipulation of our tool, or if preferred, by the use of the older and more laborious method wherein a saw blade is reciprocated by hand. But once a slot has been undercut sufficiently to guide the tool, the entire commutator may be undercut in a most expeditious and accurate manner, with none of the strain and effort upon the hand and eye of the operator as with prior tools and appliances heretofore employed.

Nor is it necessary to complete the undercutting of each slot by the slow and laborious hand tool, as our improved tool is adapted to undercut the entire length of the slot merely by changing the position or angularity of presentation to the work. Moreover, by providing for a slight axial, self-adjustment of the rotary cutter, the liability of damage to the commutator bars by improper adjustment of the guides, or for other reasons, is avoided.

While in the accompanying drawings there has been illustrated a specific embodiment of the present invention, it is to be understood that the invention is not limited to the particular form and arrangement of parts as shown therein, but may be embodied in other forms and arrangements within the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting operation adjacent both ends of the insulation, a pair of slot engaging guides, one for guiding the tool when the latter is in one angular position and the other for guiding the tool when it is in the other angular position, and a single adjustable support for said guides.

2. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting operation adjacent both ends of the insulation, a pair of slot engaging guides, one for guiding the tool when the latter is in one angular position and the other for guiding the tool when it is in the other angular position, a single support for the guides adjustable laterally of the plane of the cutter to provide for varying spacing between commutator slots, and means for securing the guides to the support having provision for adjustment of the guides to regulate the depth of cut.

3. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in a plurality of different angular positions to facilitate the undercutting of the insulation in different portions thereof, and a pivoted lateral support for the tool adapted to be turned into one or another operative position according to the angular position of the tool.

4. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting of the insulation adjacent both ends thereof, a pivoted lateral support for the tool adapted to be turned into one or the other of two positions, substantially at right angles to one another, according to the position of the tool, and means for securing the support in the desired position.

5. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting of the insulation adjacent both ends thereof, a pivoted lateral support for the tool adapted to be turned into one or the other of two positions, substantially at right angles to one another, according to the position of the tool, and devices for accurately setting the support in the desired position.

6. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in a plurality of different angular positions to facilitate the undercutting of the insulation in different portions thereof, a lateral support for the tool, a pivoted mounting in which the support is secured having provision for adjustment of its operative length, thereby to provide for various diameters of commutators, and means for accurately positioning the pivoted mounting to locate the support properly for a definite angular position of the tool and for locking the mounting in position.

7. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same, a slot engaging guide for guiding the tool, and a pair of supporting rolls mounted for free rotation on opposite sides of

the plane of the cutter with their axes adjacent and parallel to the axis of the cutter.

8. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a cutter head having two substantially flat faces adjacent and substantially at right angles to one another, a cutter shaft rotatably mounted in the head in proximity to said two faces, a rotary cutter mounted exteriorly of the head on said shaft with its periphery extending beyond both of said faces, a motor for actuating the cutter shaft attached to the head with the motor axis substantially parallel to one face and normal to and on the opposite side of the head from the other, whereby the tool may be operated with either of said faces substantially parallel to the face of an adjacent commutator bar, and rolls carried by the head and positioned on opposite sides of the plane of the cutter for supporting the head out of contact with the surface of the commutator.

9. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting operation adjacent both ends of the insulation, and a pair of identical guides offset laterally from the plane of the cutter on the same side thereof and adapted to enter a nearby commutator slot, one for guiding the tool when the latter is in one angular position and the other for guiding the tool when it is in the other angular position to enable it to perform the same undercutting operation throughout the length of the slot.

10. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting operation adjacent both ends of the insulation, and a pair of similar guides spaced laterally from the plane of the cutter and on the same side thereof, and extending rearwardly of the axis of the cutter in the line of feed for guiding the tool laterally in both operative positions to enable it to perform the same undercutting operation throughout the length of the slot, said guides being each provided with an anti-friction roll to engage the face of a commutator bar and to limit the depth of the cut.

11. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in a plurality of different angular positions to facilitate the undercutting of the insulation in different portions thereof, and a plurality of guides spaced laterally from the plane of the cutter on the same side thereof, one or the other of said guides, according to the angular position of the tool, engaging a nearby commutator slot and the face of the commutator to guide the cutter laterally in the undercutting operation and support the same to thereby regulate the depth of the cut.

12. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting of the insulation adjacent both ends thereof, and a pair of adjustable guides at substantially right angles to one another spaced laterally from the plane of the cutter and both on the same side thereof, each guide having a thin edge to enter a nearby commutator slot, and an anti-friction roll to engage the face of the commutator, the thin edge guiding the cutter laterally in its undercutting operation and the roll supporting the same to thereby regulate the depth of the cut.

13. A tool for undercutting the insulation between adjacent commutator bars having, in combination, a rotary cutter, means for supporting and actuating the same constructed and arranged for operation of the tool in two different positions at substantially right angles to one another to facilitate the undercutting operation adjacent both ends of the insulation, a pair of adjustable guides offset from the plane of the cutter on the same side thereof, each guide being provided with an anti-friction roll to engage the face of the commutator and support the cutter thereby to regulate its depth of cut, a supplementary roll on the opposite side of the cutter from said pair of guides and rolls, and a pivoted adjustable support for said supplementary roll.

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