Jan. 14, 1958 W. G. BIRKEL ET AL 2,819,743

APPARATUS FOR CUTTING RECTANGULAR OPENINGS IN DOORS AND THE LIKE

Filed Nov. 2, 1956

4 Sheets-Sheet 1

Fig. 1.

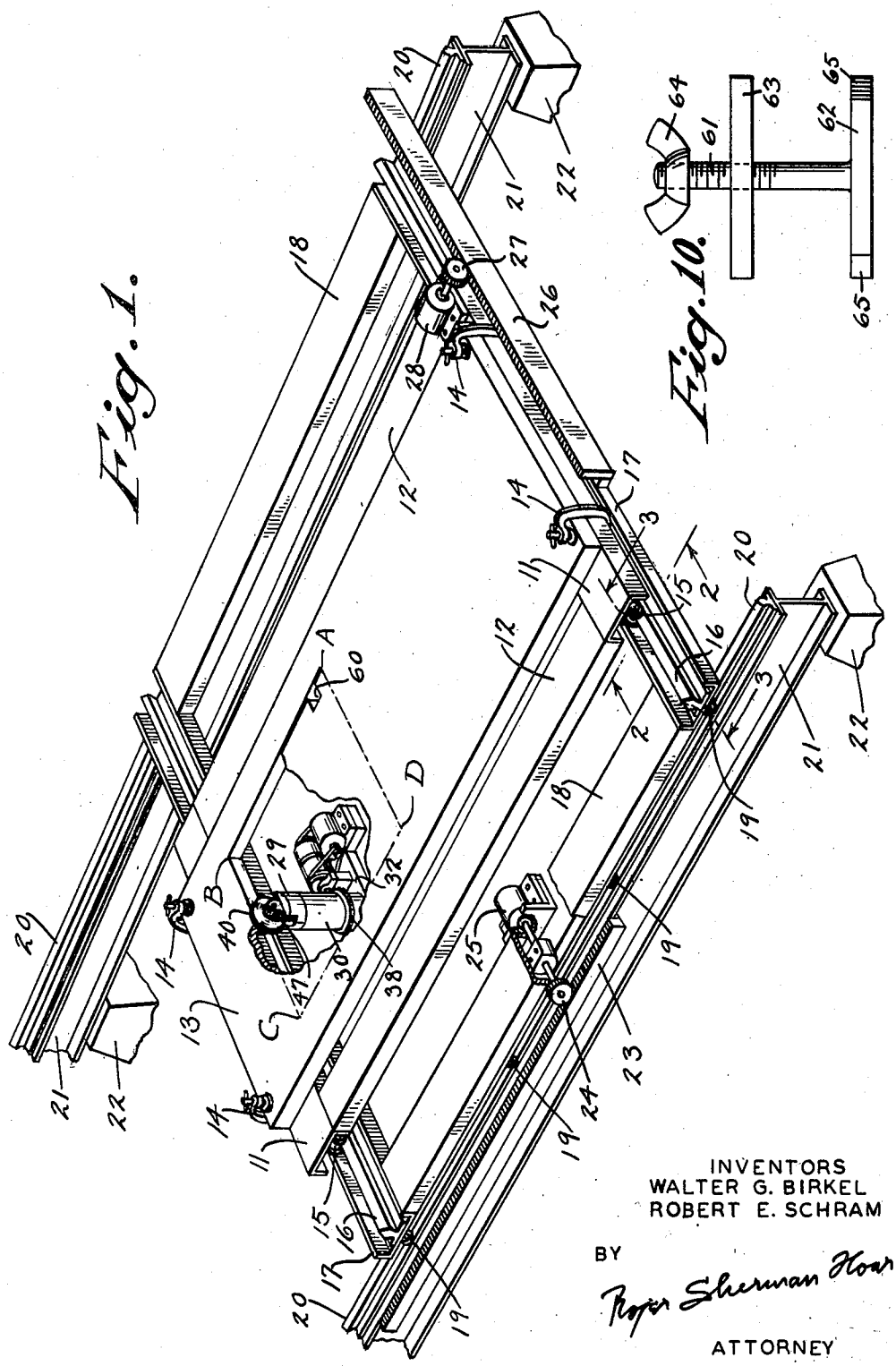


Fig. 10.

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4 Sheets-Sheet 2

Fig. 4.

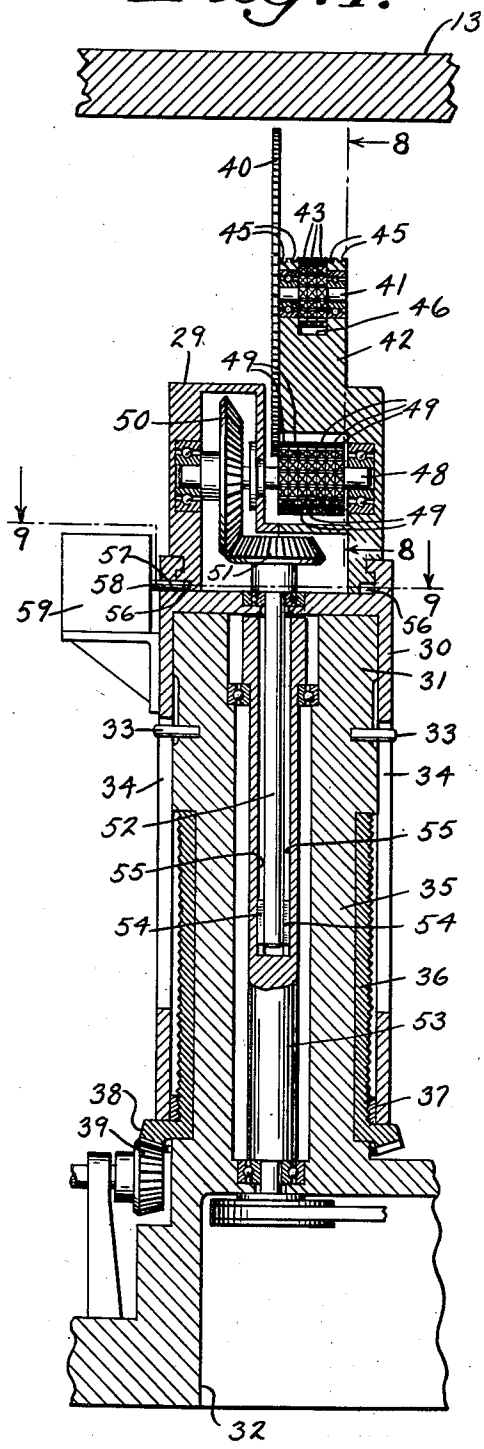


Fig. 2.

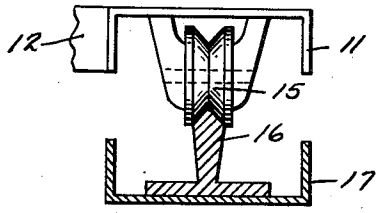
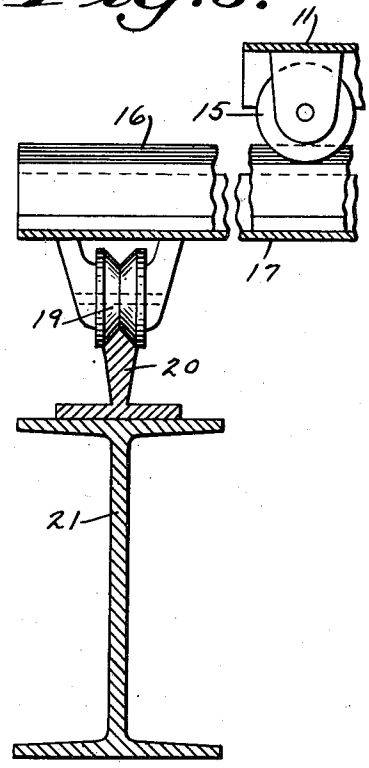


Fig. 3.



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Fig. 5.

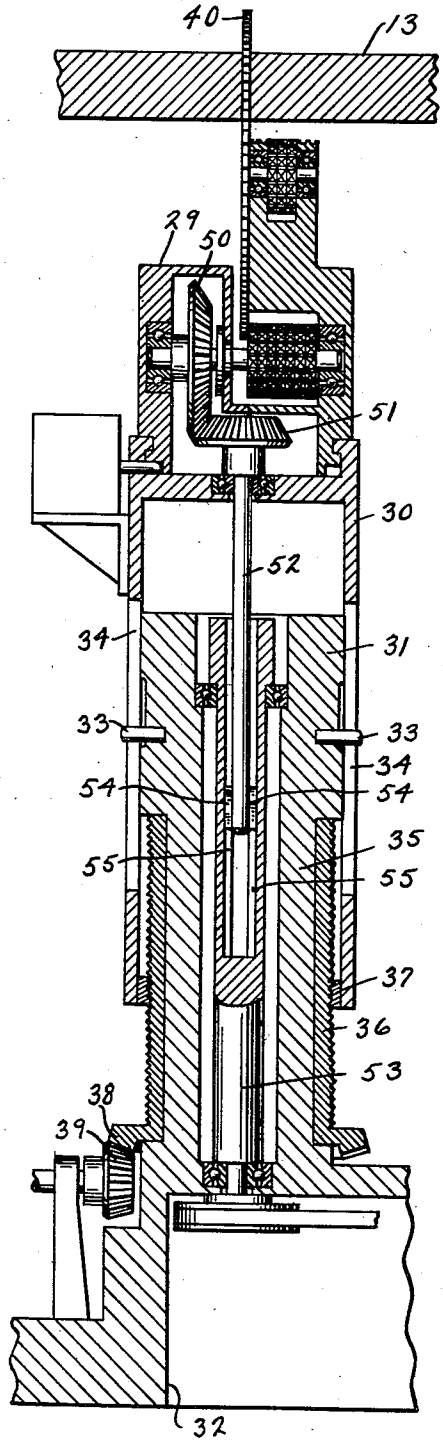
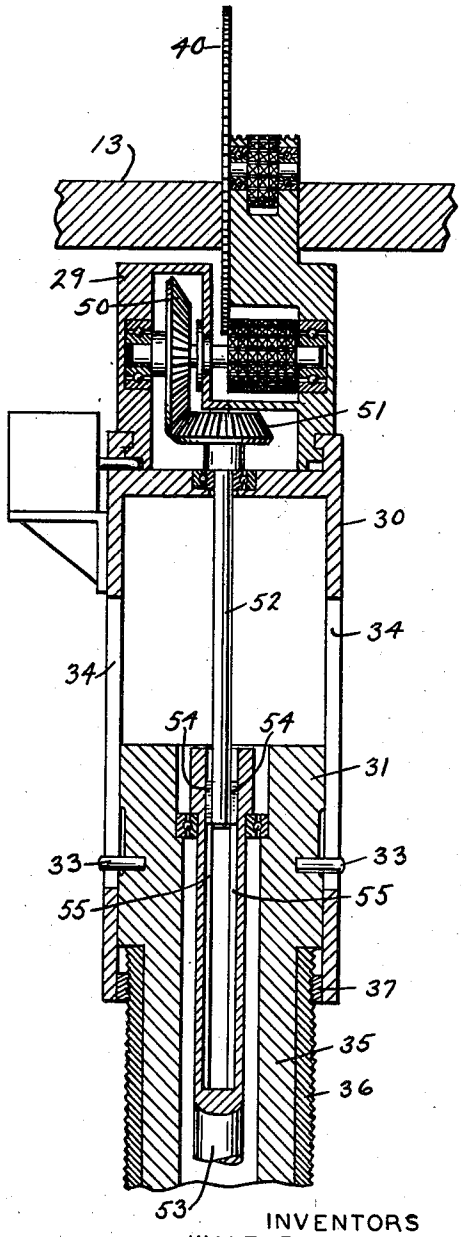


Fig. 6.



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Fig. 7.

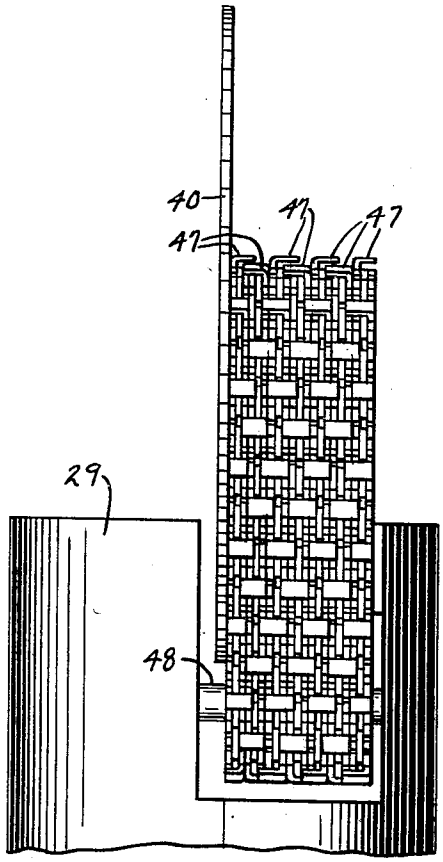
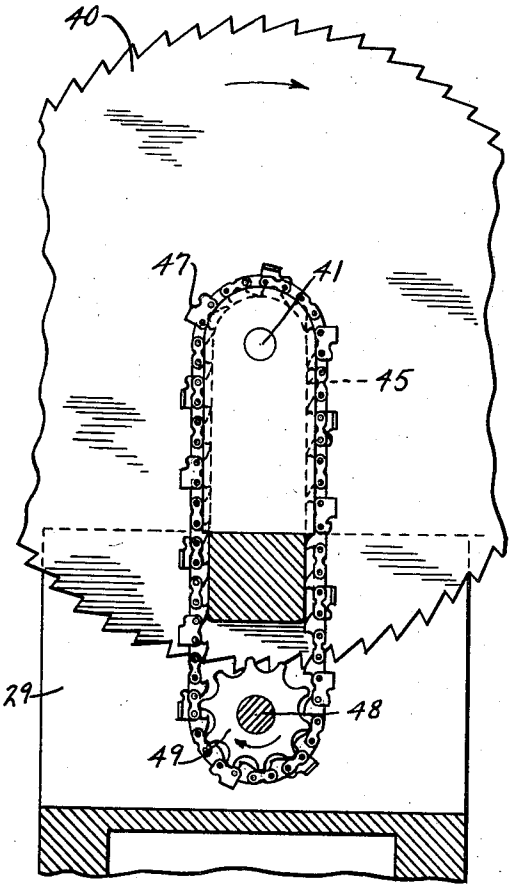


Fig. 8.



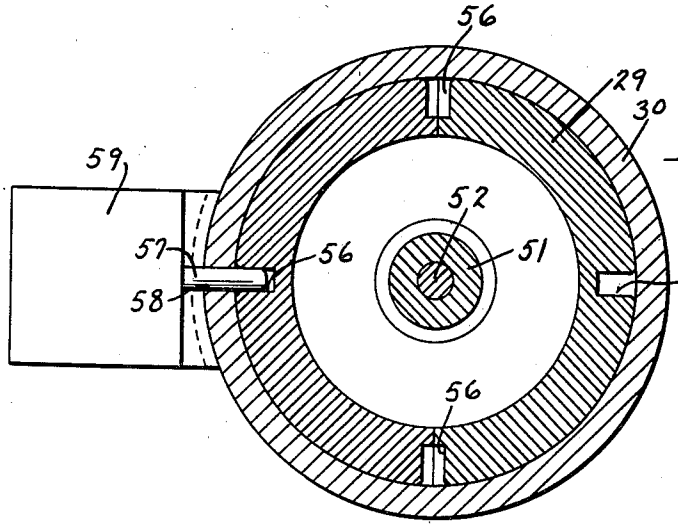


Fig. 9.

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2,819,743

Patented Jan. 14, 1958

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APPARATUS FOR CUTTING RECTANGULAR OPENINGS IN DOORS AND THE LIKE

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Application November 2, 1956, Serial No. 620,061

14 Claims. (Cl. 143—48)

This invention relates to apparatus for cutting rectangular openings in doors and the like; and resides more particularly in the combination of: a cutter-head; a work-holding table, traversable longitudinally and laterally relative to the cutter-head; a single circular-saw blade, lying in a plane substantially perpendicular to the work, and mounted on a stub-axle extending to one side only of the blade, said stub-axle being journaled in the cutter-head; means, supported on the cutter-head, and surrounding the stub-axle and the end of the cutter-head, for cutting a path through the work to enable the stub-axle and the end of the cutter-head to pass therethrough, so that the blade can cut clear to the corners of the opening; means for swiveling the cutter-head about an axis perpendicular to the work, to change the orientation of the blade in successive increments of 90°; and means for advancing the cutter-head into the work, perpendicularly thereto, and for withdrawing the cutter-head therefrom; all motions being considered as relative.

Still more particularly the invention resides in such apparatus, wherein the recited motions are absolute.

Invention also inheres in the cutter-head per se, and in certain details of various elements of the cutter-head and its associated mechanisms.

It is the principal object of the invention to provide novel, useful, and simple apparatus for cutting rectangular openings in doors and the like.

It is a further object of the invention to provide such an apparatus which will perform the entire operation, insuring absolute rectangularity, without splintering, and without the need of clean-up, especially not at the corners of the opening.

It is a further object of the invention to dispense with the use of reciprocating cutters, and to eliminate the need of aligning successive cutters for cutting any one kerf.

It is a further object of the invention to provide such an apparatus in which the entire cutting of the opening, per se, is done with a single circular-saw blade, even at the corners of the opening.

It is a further object of the invention to accomplish the reorientation of the plane of the circular-saw blade, by power, without the employment of an additional power-drive for this purpose.

Inasmuch as the cut-out pieces have a definite salvage value, it is a further object of the invention, to provide an apparatus which will remove these pieces as intact as possible.

These and other objects and advantages of the invention will appear in the description to follow.

It is to be understood that, although the invention is designed, primarily, for cutting openings in doors, it may be used for other similar purposes, such as for cutting openings in panels or other wall-sections.

In the description, reference is made to the accompanying drawings which form a part hereof, and in which there is shown, by way of illustration but not of limitation, one specific form in which the invention may be embodied.

In the drawings:

Fig. 1 is a parallel perspective view of the present invention, largely conventionalized. It illustrates the relative positioning of the cutter-head assembly, the door, the work-holding means, and the means for traversing the latter both longitudinally and laterally.

Fig. 2 is a longitudinal elevation, partly in section, viewed as though cut along the line 2—2 of Fig. 1. It illustrates a typical wheel mounting, whereby the work-holding table rolls laterally on the tracks of the intermediate table. It is to a more open scale than Fig. 1.

Fig. 3 is a transverse elevation, partly in section, viewed as though cut along the line 3—3 of Fig. 1. It illustrates, in addition to another view of the subject-matter of Fig. 2, a typical wheel mounting, whereby the intermediate table rolls longitudinally on the tracks of the stationary base. It is to a more open scale than Fig. 1.

Fig. 4 is a vertical section of the cutter-head assembly, showing the cutter-head in its low position, with the circular saw completely out of the door.

Fig. 5 is the same view, showing the cutter-head in its intermediate position, with the circular saw through the door.

Fig. 6 is a part of the same view, showing the cutter-head in its high position, with both the circular saw, and the path-cutting means through the door.

Fig. 7 is an open-scale elevation of the circular saw, path-cutting means, and part of the cutter-head, viewed as seen from the left in Fig. 8.

Fig. 8 is a view of the same, to the same scale as Fig. 7, partly in elevation and partly in section, viewed as though cut along the line 8—8 of Fig. 4.

Fig. 9 is a horizontal section, to the same scale as Fig. 7, viewed as though cut along the line 9—9 of Fig. 4. It illustrates the means for locking the cutter-head to its base, against swiveling about its vertical axis.

Fig. 10 (sheet 1) is an enlarged elevation of a special clamp to hold the cut-out portion of the door in place, during cutting.

Throughout the description, the same reference number is applied to the same member or similar members.

Referring now to the drawings, more particularly to Figs. 1, 2, and 3, it will be seen that Fig. 1 is largely conventionalized, inasmuch as no invention is claimed to inhere in the work-supporting means or the traversing mechanism per se, or many other of the details, such as the various clamping means.

The work-holding table comprises two transverse channels 11, and two longitudinal channels 12. The work 13, more specifically a door, may be clamped to the work-holding table by any appropriate means, such as four C-clamps 14. Depending from the transverse channels 11 of the work-holding table are a series of wheels 15 (see Figs. 2 and 3), which run on transverse tracks 16, to be hereinafter mentioned.

Below the workholding table 11—12, there is an intermediate-table, comprising two transverse channels 17, and two longitudinal channels 18. Transverse channels 17 support tracks 16, already mentioned. Depending from transverse channels 17 are a series of wheels 19 (see Fig. 3), which run on longitudinal tracks 20, to be hereinafter mentioned.

Below the intermediate table 17—18, there is a stationary base, comprising two longitudinal I-beams 21, resting on piers 22. These I-beams carry longitudinal rack 23, which is engaged by pinion 24, actuable by motor 25 on the intermediate table. Actuation of this pinion causes the intermediate-table (and the work-holding table and door, carried thereby) to traverse longitudinally.

Transverse channels 17 of the intermediate table carry transverse rack 26, which is engaged by pinion 27, actu-

able by motor 28 on the work-holding table. Actuation of this pinion causes the work-holding table (and the door carried thereby) to traverse laterally.

Brakes to lock the two tables in various traversed positions, duplication of the traversing mechanisms for greater stability, and other details not claimed per se, will readily suggest themselves.

Part of door 13 is shown cut-away, to expose the cutter-head assembly, which will now be described.

Turning to Figs. 4, 5, and 6, it will be seen that 29 is the cutter-head which carries the cutting machinery to be hereinafter described. Cutter-head 29 is supported by elevator 30. The two are interlocked in some appropriate manner (such as shown at the top edge of the latter), so as to keep the head from pulling off from the top of the elevator, and to maintain the two axially aligned, and yet permit the head to swivel about a vertical axis with respect to the elevator.

Elevator 30 is a hollow cylinder, supported in turn by, and slidable vertically with respect to, the upper portion 31 of a base 32, which is stationary with respect to stationary base 20 of the traversing mechanism.

Pins 33, projecting from upper portion 31 of base 32, and slidable in vertical slots 34 of elevator 30, prevent the elevator from swiveling, while permitting vertical movement thereof.

Swivelable about a constricted portion 35 of base 32, there is an elevating screw 36, which operatively meshes with elevating nut 37, rigid with the lower end of elevator 30. Integral with screw 36, there is a bevel gear 38, meshing with bevel pinion 39, which is driven by a power source, not shown. Preferably this pinion has two slow elevating speeds, and one fast lowering speed, for reasons which will hereinafter appear.

Fig. 4 shows the relative positions of the above-described elements of the elevating mechanism, when cutter-head 29 is in its low position, with all cutting parts clear of the work 13.

Fig. 5 shows the relative positions, when cutter-head 29 is in its intermediate position, with circular saw 40 projecting through the work 13.

Fig. 6 shows the relative positions, when cutter-head 29 is in its high position, with not only circular saw 40 projecting through the door, but also the path-cutting means (to be hereinafter described) projecting through the work 13.

The cutting-means will now be described. See Figs. 4, 7, and 8. This comprises circular saw 40, and a path-cutting means preferably made-up of chain-saw elements. Except as specified in the claims, the details and the numbers of similar elements are merely illustrative. For example, the chain-saw chains might be in accordance with U. S. Patent No. 2,508,784 to Cox. As shown in Fig. 7, the cutting elements of each chain occur between the cutting elements of adjacent chains; and alternate, overlapping first the chain to the right and then the chain to the left.

Stub axle 41, rigid with circular saw 40, is journaled in the upper end of extension 42 of cutter-head 29. Rigid with this axle, there are three sprocket wheels 43. At each side of these three sprocket wheels are two grooves 45. These grooves may extend to the lower end of extension 42, as shown in Fig. 8. Three similar grooves may extend from space 46 (Fig. 4) to the lower end of extension 42. These seven grooves are for guiding the seven chain-saw chains 47; see Figs. 7 and 8. In Fig. 8, for the sake of simplicity, only the nearer chain 47 is shown; those chains lying between it and circular saw 40 are not shown. In view of the fact, which will appear hereinafter, that chains 47 are used only to cut vertical holes the three similar grooves and the portion of grooves 45 extending below sprocket wheels 43, might be omitted, though their retention is advisable.

Drive shaft 48 is shown journaled in cutter-head 29. Rigid with this shaft 48, there are seven sprocket wheels 49. All ten sprocket wheels are similar to sprocket wheel 49 shown in Fig. 8.

Rigid with shaft 48 is a bevel gear 50, meshing with bevel pinion 51, rigid with the upper end of vertical shaft 52, in the swivel axis of cutter-head 29.

Hollow vertical shaft 53 is shown surrounding vertical shaft 52. Splines 54, carried by the lower end of shaft 52 slide in splineways 55, thus enabling these two shafts to telescope and yet still rotate in unison.

Shaft 53 is driven by a power source, not shown, preferably at constant speed; and thereby, through shaft 52, pinion 51, and gear 50, drives shaft 48, and the seven sprocket wheels 49 thereon. These seven sprocket wheels cuttingly drive the seven chain-saw chains 47, which constitute the path-cutting means. Three of these chains drive the three sprockets 43, which in turn cuttingly drive circular saw 40, through its stub axle.

The journaling of this axle 41 in extension 42 is rendered possible by having only three of the seven chain-saw chains 47 serve as drive-chains for circular saw 40, and hence only three sprocket wheels 43 mounted on axle 41.

The chain-saw chains 47 could be joined together into a single cutting band without losing their identity, but this would have the disadvantage of not providing as smooth a drive for circular saw 40 as do the separate chains.

Next as to the means for orienting circular saw 40. Reverting to Fig. 4, it will be seen that, in order to impart to circular saw 40 the direction of rotation indicated by the arrow in Fig. 8, pinion 51 will have to rotate counter-clockwise when viewed from above. Assume that the resistance (due to friction and inertia) of the various parts carried by cutter-head 29 and actuated by pinion 51, to motion with respect to the cutter-head, is greater than the resistance of the cutter-head and parts carried thereby, considered as a unit, to swiveling with respect to the base. Then, unless the cutter-head is locked against such swiveling, the rotation of pinion 51 will cause the cutter-head to swivel; whereas if it is so locked the rotation of pinion 51 will cause the cutting mechanism to operate. The above-mentioned torque-differential could be accentuated by the interposition of anti-friction bearings at the juncture of cutter-head 29 and elevator 30.

In view of this, the following locking mechanism is provided. Compare Figs. 9 and 4.

The periphery of cutter-head 29 is provided, adjacent its lower extremity, with four horizontal holes 56, 90° apart. Plunger 57, reciprocable in horizontal hole 58 in elevator 30, is spring-actuated to pass into any one of holes 56 which may be opposite it. The spring (not shown) and a solenoid (not shown) for opposing the spring, are contained in box 59. When it is desired to change the orientation of circular saw 40, the solenoid is momentarily actuated, thus withdrawing plunger 57. Whereupon pinion 51 swivels cutter-head 29 counter-clockwise (as viewed from above) until the next hole 56 comes opposite the plunger, which thereupon locks the cutter-head against further swiveling.

Inasmuch as elevator 30 is keyed against swiveling with respect to base 32, then (so far as the swivel-locking mechanism just described is concerned) the elevator may be functionally considered as a part of the base.

Reverting to Fig. 1, the cycle of operations will now be described.

With the cutter-head 29 in low position beneath the door 13, and the circular saw 40 oriented in a longitudinal plane, the door is traversed until the cutting mechanism is below corner A of the hole to be cut. The circular saw and the cutting-chains are running.

The cutter-head is then elevated to its high position, the saw cutting the extreme A end of kerf AB, and the chains cutting the path 60. The fact that, as has been seen earlier herein, the chains completely surround the

stub-axle of the saw and the upper end of extension 42 of the cutter-head, permits the axis of the saw to pass through this path 60, thus permitting the edge of the saw to cut a clean vertical end of the kerf, clear to corner A.

The cutter-head is then retracted to its intermediate position, with only the saw blade projecting through the door, and the door is traversed longitudinally (toward the lower right hand corner of the figure) until the kerf AB is cut to B. Whereupon the cutter-head is raised to its high position, squaring the B end of kerf AB.

The cutter-head is then retracted to its low position, with all cutting means completely out of and below the door. The cutter-head is then swiveled 90° counterclockwise, thus putting it in position to cut the kerf BC as it did the kerf AB.

As shown in Fig. 1 the saw 40, at intermediate height, is cutting the kerf BC, from B toward C, as the door is being traversed laterally toward the upper right hand corner of the figure.

The process is repeated for kerfs CD and DA. Appropriate means for holding the cut-out portion rigid with respect to the door during cutting, and for removing it at the end thereof, should be provided. Such means might take the form of, say, three clamps such as illustrated in Figure 10, wherein a bolt 61 is integral with a fixed bottom-cross-piece 62. A movable top-cross-piece 63 is slidable up-and-down on bolt 61, and (if desired) may be keyed thereto. A wing-nut 64 completes the assembly. Bottom-piece 62 should preferably have its ends beveled to edges 65, and should be less in length than the horizontal diagonals of holes 60.

After the two holes 60 at each of corners B, C, and D, have been cut, one of these clamps should be inserted in one of the holes of each corner, and then be oriented so that its cross-pieces 62 and 63 underlie and overlie both the door and the piece which is being cut out, and then nut 64 should be tightened.

After the cutting is completed, the clamps can be loosened and used to assist in removing the cut-out piece.

As already stated earlier herein, the elevating means has two slow speeds for raising the cutter-head, and one fast speed for lowering it. This saves time in lowering, when no resistance has to be met; and enables the use of a slow speed while the circular saw is cutting upward through the door, and a still slower speed while the chains are cutting upward through the door.

Appropriate controls, automatic or otherwise, may be employed for all the functions of the apparatus, and the sequence of operations.

In the claims it will be assumed that all motions are relative, unless expressly stated to be absolute.

It will be readily evident from the foregoing description that the present invention affords a novel and useful mechanism for cutting rectangular openings in doors and the like, which invention attains the objects and advantages set forth herein.

Now that one embodiment of the invention has been shown and described, and several variations therefrom have been suggested, it is to be understood that the invention is not limited to the specific form or arrangement of parts herein shown and described.

What is claimed is:

1. In an apparatus for cutting rectangular openings in doors and the like, the combination of: a cutter-head; work-holding means, for rigidly supporting the work; means for traversing the work-holding means longitudinally and laterally relative to the cutter-head; a single circular-saw blade; a stub axle rigid with the blade, and extending to one side only of the blade, for drivably supporting the blade; means, adjacent the end of the cutter-head, for journaling the stub axle on the cutter-head, so that the blade lies in a plane substantially perpendicular to the work; means, supported on the cutter-head, and surrounding the stub axle and the end of the cutter-head, for cutting a path through the work, to enable the stub axle and the end of the cutter-head to pass therethrough; means for cuttingly rotating the blade and for cuttingly operating the path-cutting means; means for swiveling the cutter-head about an axis substantially perpendicular to the work, in successive increments of 90°; and means for advancing the cutter-head to and into the work in a direction substantially perpendicular thereto, and for withdrawing the cutter-head therefrom.

2. Apparatus according to claim 1, wherein the work-holding means holds the work substantially horizontally; and wherein all the recited motions are absolute; and wherein the cutter-head approaches the work from below.

3. A cutter-head assembly for use in an apparatus for cutting rectangular openings in doors and the like, which apparatus includes work-holding means for rigidly supporting the work, and for traversing the work longitudinally and laterally relative to the cutter-head assembly, said cutter-head assembly comprising: a cutter-head; a stub axle rigid with the blade, and extending to one side only of the blade, for drivably supporting the blade; means; adjacent the end of the cutter-head, for journaling the stub axle on the cutter-head, so that the blade lies in a plane substantially perpendicular to the work; means, supported on the cutter-head, and surrounding the stub axle and the end of the cutter-head, for cutting a path through the work, to enable the stub axle and the end of the cutter-head to pass therethrough; means for cuttingly rotating the blade and for cuttingly operating the path-cutting means; and means for advancing the cutter-head to and into the work in a direction substantially perpendicular thereto, and for withdrawing the cutter-head therefrom.

4. A cutter-head assembly according to claim 3, wherein there is means for changing the orientation of the saw blade, with respect to the work, in successive increments of 90°, by swiveling the cutter-head about an axis substantially perpendicular to the work.

5. A cutter-head assembly according to claim 3, wherein there are: a base, on which the cutter-head is mounted for swiveling about an axis substantially perpendicular to the work; a shaft, journaled in the base, and axially aligned with the axis of said swiveling; means on the base for imparting rotation to said shaft; means drivingly connecting said shaft to the path-cutting means and the circular-saw blade, to cuttingly actuate them whenever the cutter-head is held against swiveling; and means for locking, at will, the cutter-head to the base, against swiveling, the torque necessary to overcome the resistance of the various parts carried by the cutter-head and actuated by the axial shaft, to motion with respect to the cutter-head, being greater than the torque necessary to overcome the resistance of the cutter-head and parts carried thereby, to swiveling motion with respect to the base.

6. A cutter-head assembly according to claim 3, wherein the path-cutting means comprises a plurality of chain-saw cutting-chains, trained around the stub axle and the end of the cutter-head.

7. A cutter-head assembly according to claim 6, wherein the means for rotating the blade and operating the path-cutting means includes: a drive shaft remote from the stub axle and parallel thereto, and at least one chain-engaging sprocket wheel on and constrained to rotate with said shaft, and at least one chain-engaging sprocket wheel on and constrained to rotate with the stub axle; whereby at least one of the chains serves to rotate the blade.

8. A cutter-head assembly according to claim 7, wherein there is guide means for at least one of the cutting-chains around that portion of the end of the cutter-head where the stub axle is journaled.

9. A cutter-head assembly according to claim 3, wherein the path-cutting means comprises a plurality of chain-saw cutting-chains, trained around the stub axle and the

end of the cutter-head; and wherein there are: a base, on which the cutter-head is mounted for swiveling about an axis substantially perpendicular with the work; a shaft, journaled in the base, and axially aligned with the axis of said swiveling; means on the base for imparting rotation to said shaft; means drivingly connecting said shaft to the cutting-chains and the circular-saw blade, to cuttingly actuate them whenever the cutter-head is held against swiveling; and means for locking, at will, the cutter-head to the base in positions 90° apart, against swiveling; whereby the axial shaft serves to swivel the cutter-head in increments of 90°, whenever the locking means is not locked.

10. A cutter-head assembly according to claim 9, wherein the locking means comprises: a plunger slidably carried by the base, and movable towards and away from the cutter-head substantially radially with respect thereto; a succession of holes, for receiving the end of the plunger, spaced 90° apart around periphery of the cutter-head; means for biasing the plunger towards the cutter-head; and means for momentarily withdrawing the plunger from the hole occupied by it.

11. A cutter-head assembly according to claim 10, wherein the biasing means comprises a spring, and the withdrawing means comprises a solenoid.

12. A cutter-head assembly comprising: a base; a cutter-head mounted on the base, for swiveling with respect to the base; cutting means, mounted on the head, for cutting motion with respect thereto; a shaft, journaled in the base, and axially aligned with the axis of said swiveling, for imparting such cutting motion to the cutting means, whenever the cutter-head is held against swiveling; means on the base for imparting rotation to the shaft; and means for locking, at will, the cutter-head to the base, against swiveling; the torque necessary to overcome the resistance of the various parts, carried by the cutter-head and actuated by the axial shaft, to motion with respect to the cutter-head, being greater than the torque necessary to overcome the resistance of the cutter-head and parts carried thereby, to swiveling motion with respect to the base.

13. A cutter-head assembly comprising: a cutter-head; a single circular-saw blade; a stub axle rigid with the blade, and extending to one side only of the blade, for drivably supporting the blade; means, adjacent the end of the cutter-head, for journaling the stub axle on the cutter-head; a plurality of chain-saw cutting-chains, trained around the stub axle and the end of the cutter-head, for cutting a path through the work, to enable the stub axle and the end of the cutter-head to pass therethrough; and means for cuttingly rotating the circular-saw blade and for cuttingly operating the cutting-chains.

14. A cutter-head assembly according to claim 13, wherein the means for rotating the blade and operating the cutting-chains includes a drive shaft remote from the stub axle and parallel thereto, and at least one chain-engaging sprocket on and constrained to rotate with said shaft, and at least one chain-engaging sprocket on and constrained to rotate with the stub axle; whereby at least one of the chains serves to rotate the blade.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,819,743 January 14, 1958

Walter G. Birkel et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 3 and 13, and in the heading to the printed specification, lines 5 and 6, name of assignee, for "Hardware Products Corporation", each occurrence, read -- Hardwood Products Corporation --.

Signed and sealed this 22nd day of April 1958.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents