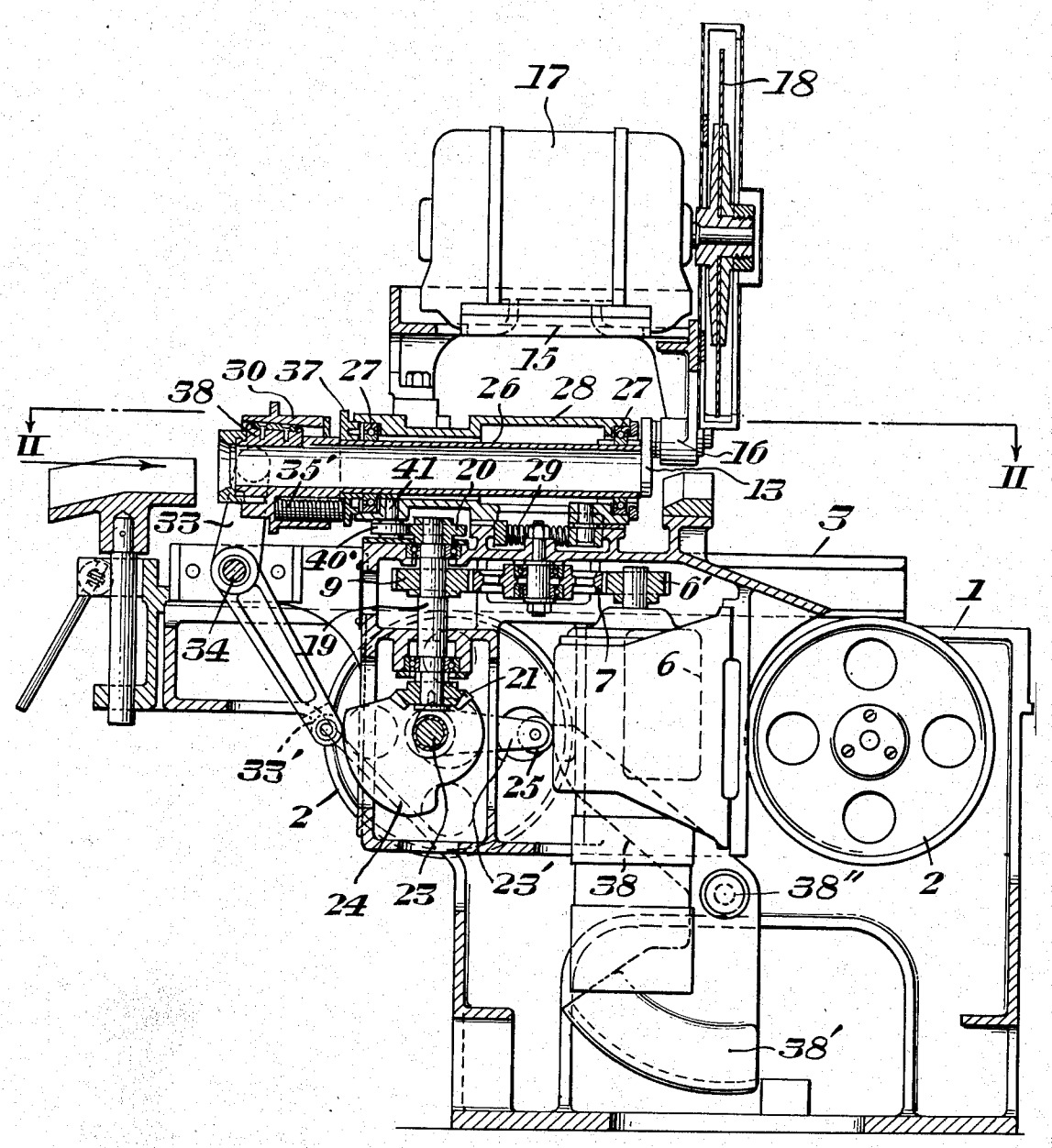
Jan. 2, 1945. W. E. EDWARDS 2,366,243

APPARATUS FOR AUTOMATICALLY SEVERING TUBING AND THE LIKE

Filed Dec. 9, 1943 7 Sheets-Sheet 1

Fig. 1.



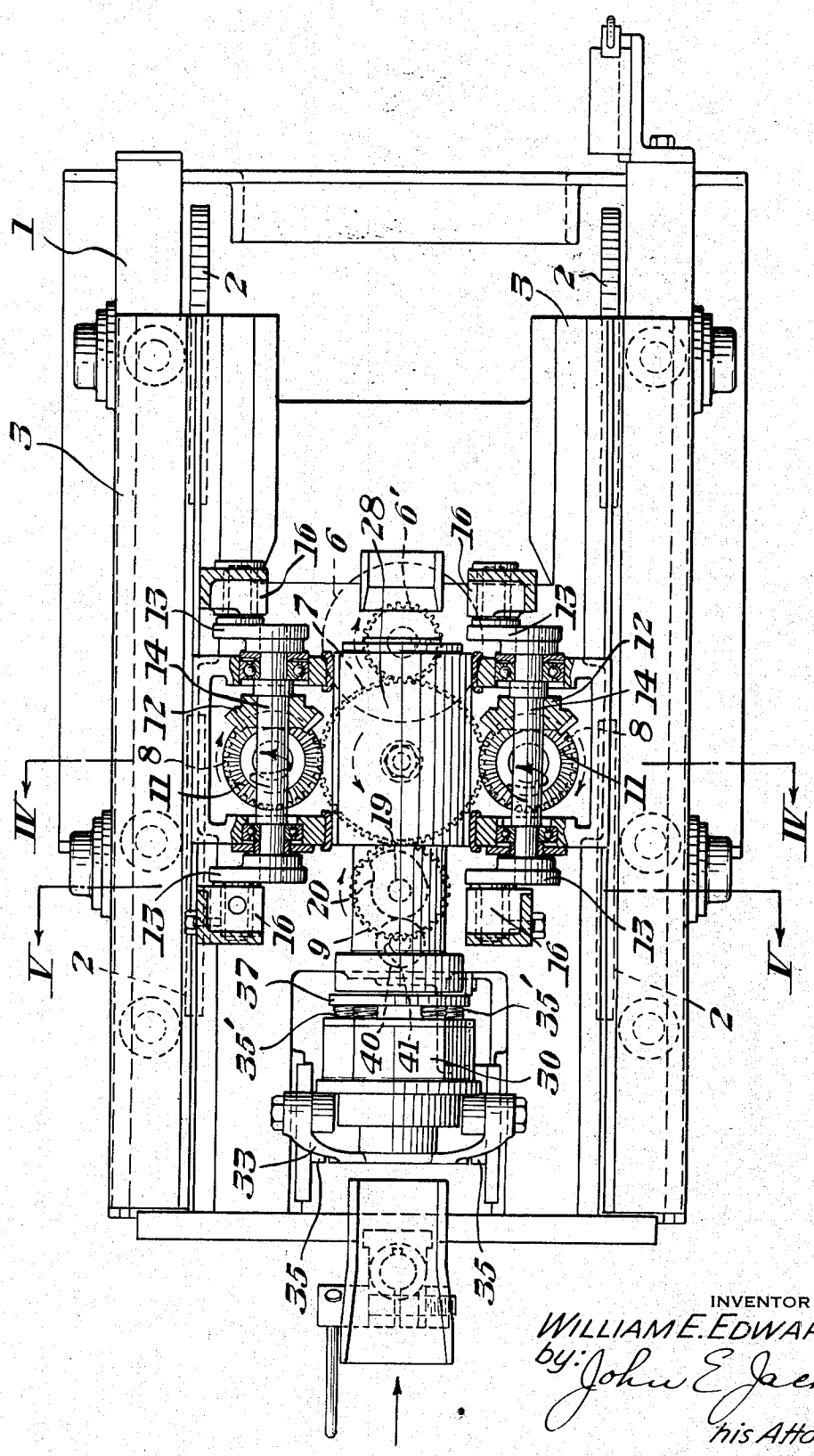
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APPARATUS FOR AUTOMATICALLY SEVERING TUBING AND THE LIKE

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Fig. 2.



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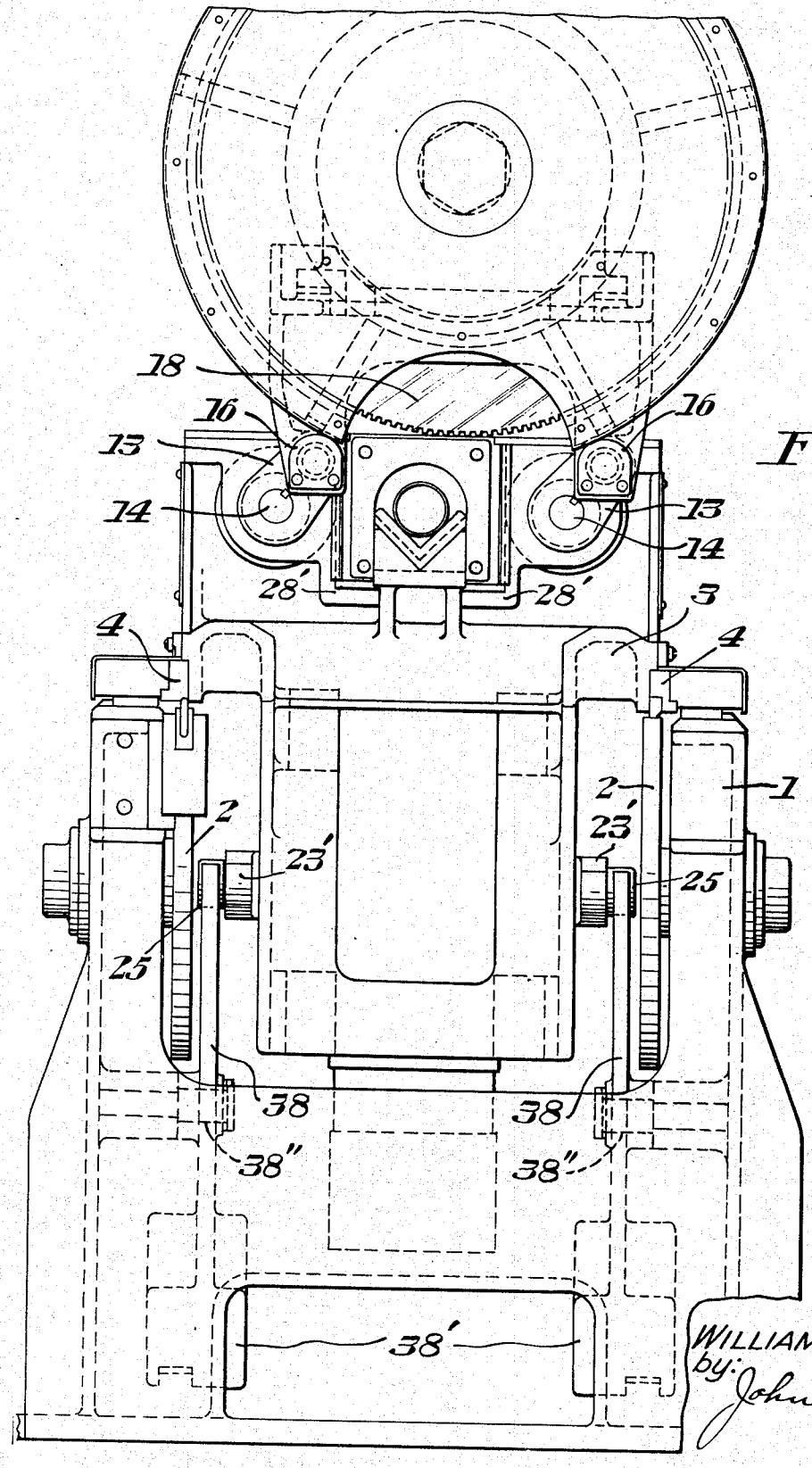


Fig. 3.

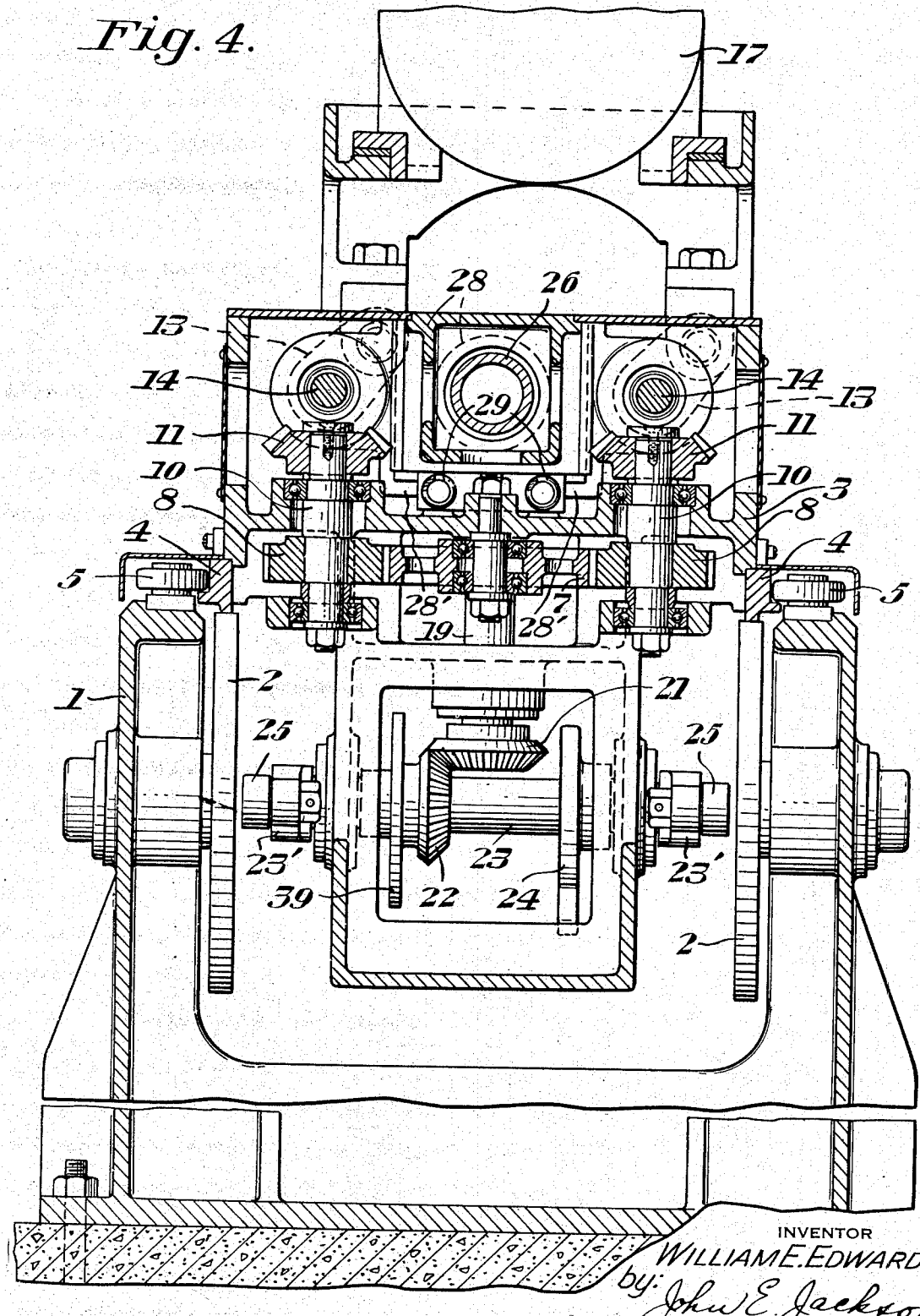
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Fig. 4.



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Fig. 5.

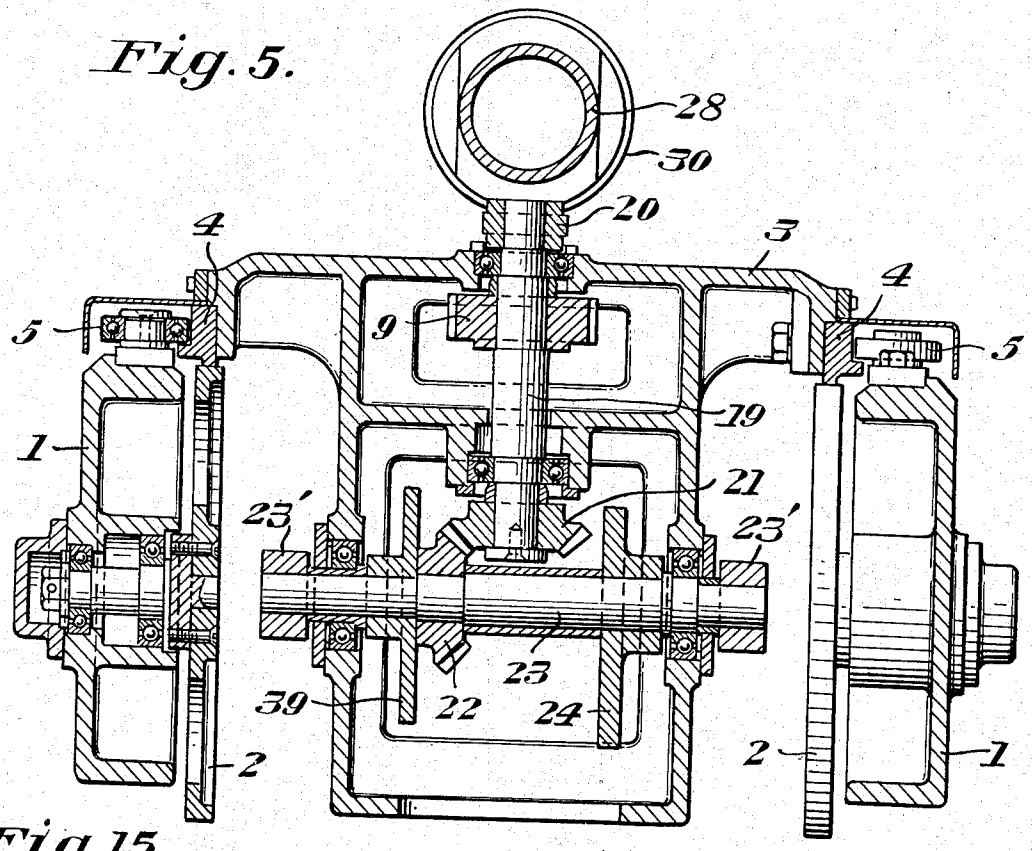
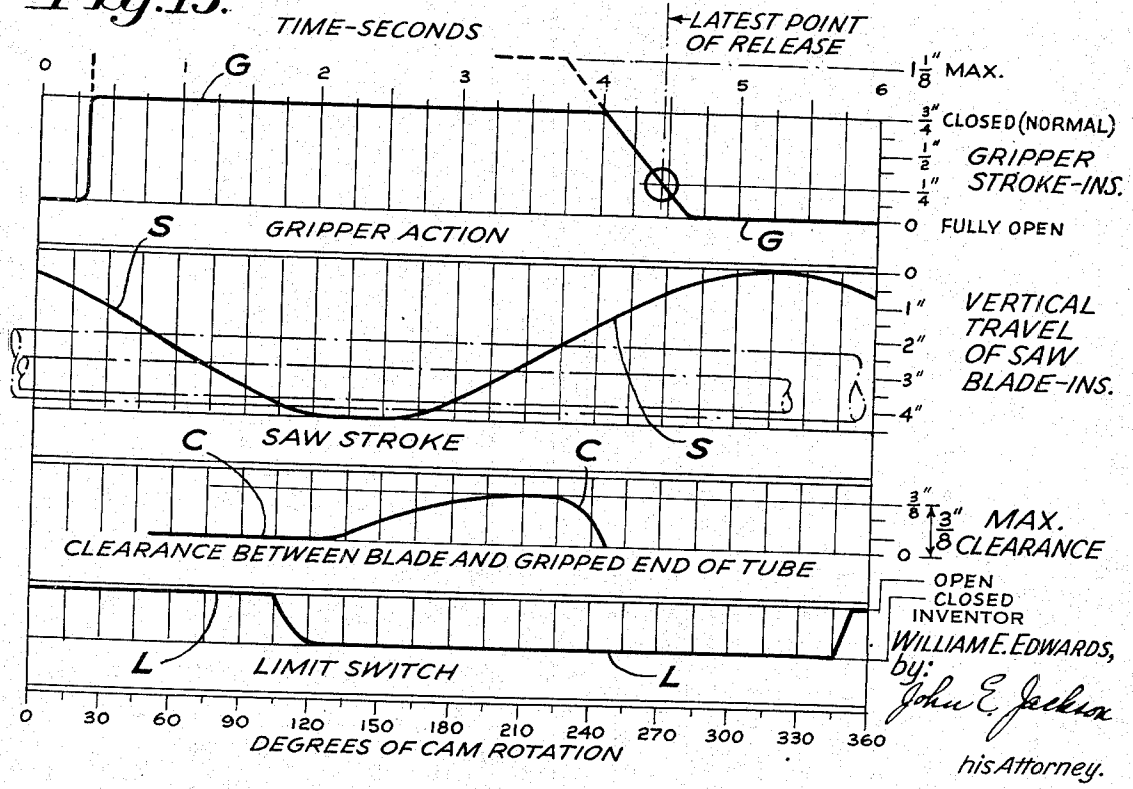


Fig. 15.



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APPARATUS FOR AUTOMATICALLY SEVERING TUBING AND THE LIKE

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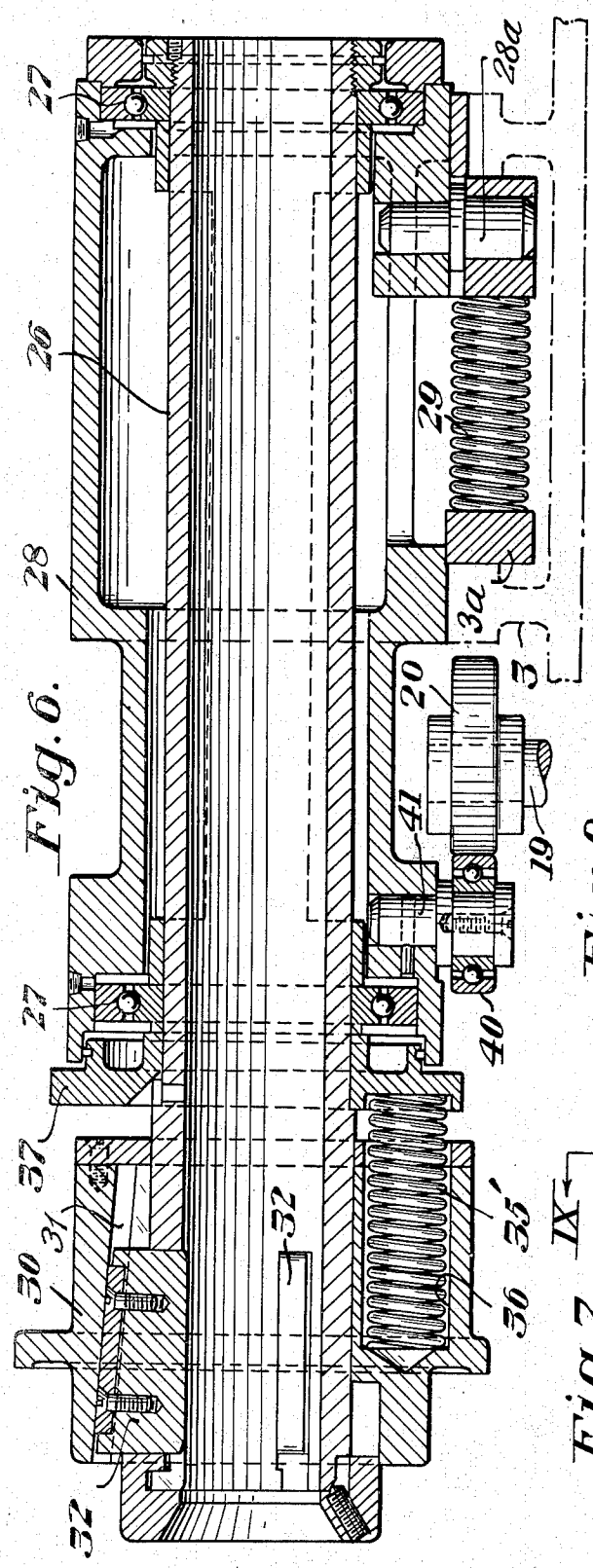


Fig. 6.

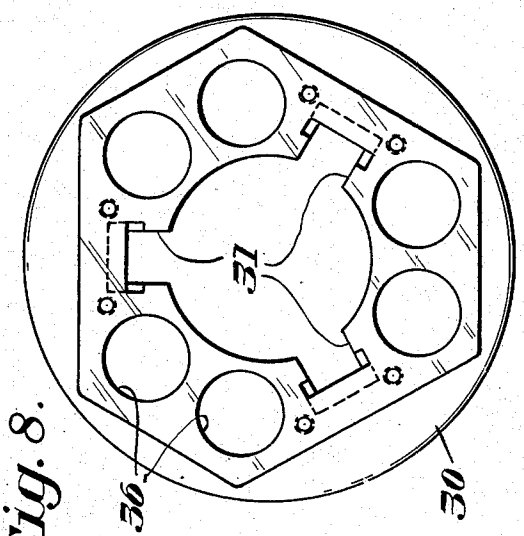


Fig. 8.

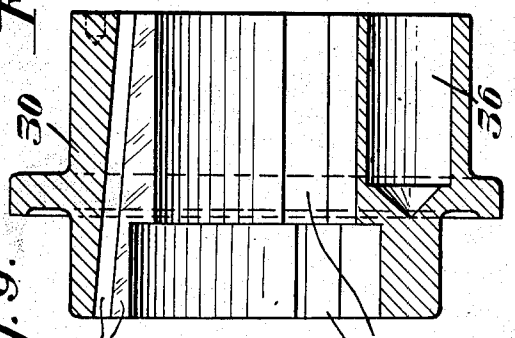


Fig. 9.

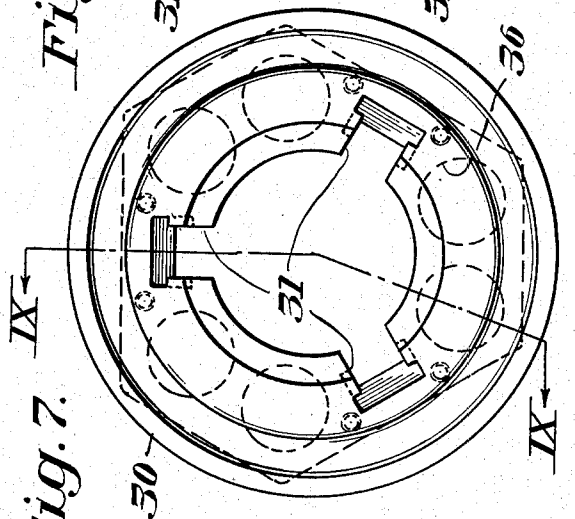


Fig. 7.

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Fig. 10.

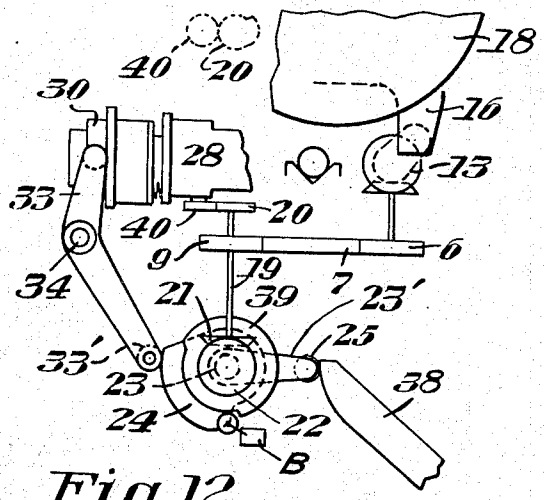


Fig. 11.

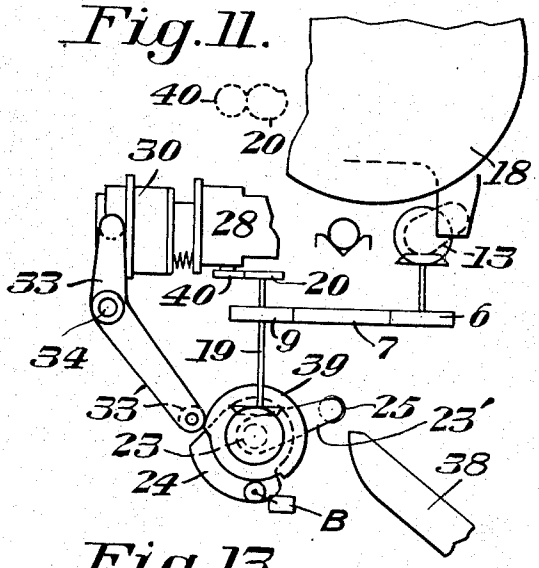


Fig. 12.

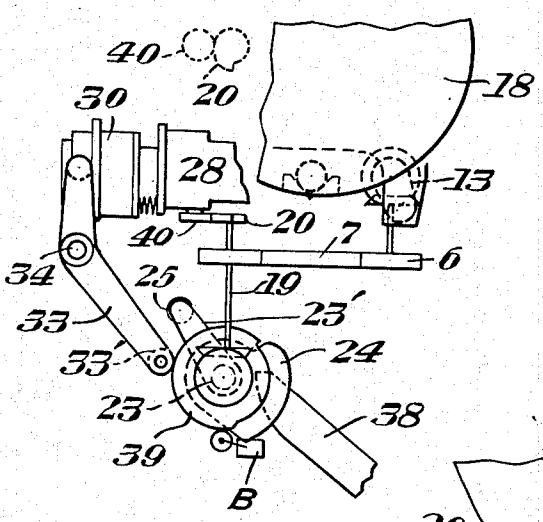
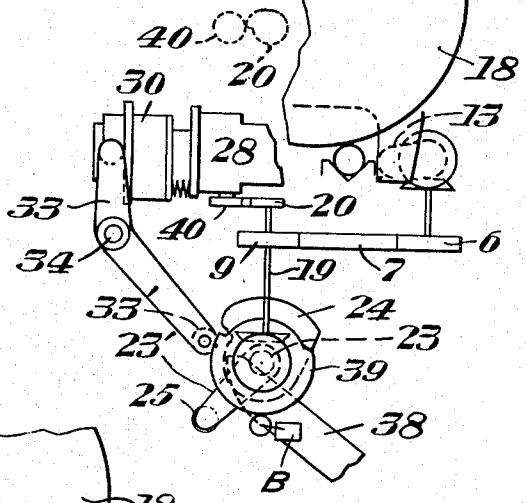


Fig. 13.



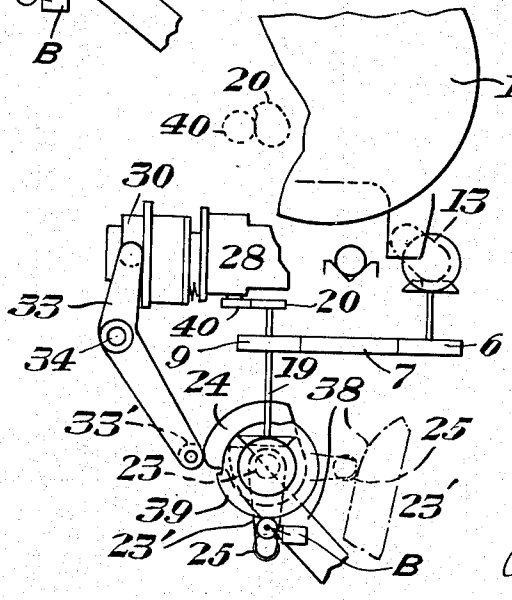


Fig. 14.

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Patented Jan. 2, 1945

2,366,243

UNITED STATES PATENT OFFICE

2,366,243

APPARATUS FOR AUTOMATICALLY SEVERING TUBING AND THE LIKE

William E. Edwards, Ellwood City, Pa., assignor to National Tube Company, a corporation of New Jersey

Application December 9, 1943, Serial No. 513,505

4 Claims. (Cl. 29—69)

In Patent No. 2,340,870, issued February 8, 1944, in which I am named as one of the joint inventors, there is revealed an improved apparatus for automatically severing tubing or similar elongated work into predetermined lengths as it comes from a reducing machine of known construction.

The present invention relates to an improvement over the apparatus shown in the above identified patent, whereby the saw blade is moved axially away from the severed end of the gripped portion of the workpiece before the back stroke of the saw is effected.

The machine includes a carriage to which is imparted the longitudinal movement of a traveling tube. A saw is supported by the carriage in such a way that it can sever the tube transversely while both the tube and carriage are in motion. The mechanism preferably includes a kick-out table for receiving the severed tube, and means such as illustrated in the above identified patent are provided for releasing the severed tube so as to permit it to roll by gravity to a storage point or to a suitable shipping receptacle.

As more fully explained hereinafter, my present improvement contemplates the provision of automatic means on a carriage for gripping a tube, automatic control means for timing the movements of a saw to sever the tube in combination with means for automatically moving the saw axially away from the severed end of the gripped portion of the tube, so that as the saw is retracted to starting position it will adequately clear the tube and thus prevent damage to the saw or mutilation of the work on the back stroke.

For a full understanding of all aspects of the present invention, reference should be made to the following detailed description, the accompanying drawings, and the appended claims.

In the drawings:

Figure 1 is a central longitudinal vertical sectional view of a machine embodying the present invention.

Figure 2 is a plan view, partly in horizontal section, the section being taken on line II—II of Figure 1.

Figure 3 is an end elevation looking from the right-hand side of Figure 1.

Figure 4 is a vertical section on line IV—IV of Figure 2.

Figure 5 is a vertical section on line V—V of Figure 2.

Figure 6 is a longitudinal section of the tube-gripping element.

Figure 7 is a front elevation of Figure 6, looking from the left.

Figure 8 is an elevation at the opposite end of Figure 6.

Figure 9 is a section on the line IX—IX of Figure 7.

Figures 10 through 14 are diagrams illustrating various stages in operation of sawing an advancing tube, the diagrams showing the various positions of the saw, cams, levers, and related means for controlling the movements of the saw in proper timed relation with great precision.

Figure 15 is a timing diagram showing the performance by curves plotted on a chart calibrated in degrees of one complete revolution of a control cam shaft.

The severing mechanism, the operation of which is coordinated with that of the tube-reducing mechanism and kickout table, includes side frames 1 supported on a suitable base. Mounted at longitudinally spaced points on the inward side of each side frame are two track wheels 2 the axles of which are supported by antifriction bearings housed in side frames 1. A saw carriage 3, equipped with rails 4, making a rolling contact with wheels 2 and restricted from lateral deflection by ball bearing rollers 5, is housed between the side frames 1, thus being arranged for longitudinal travel in one plane.

Supported on the under-side of the carriage, as shown in Figures 1 to 3, is a gear motor 6 having a shaft carrying a gear 6' which meshes with distributing gear 7 which in turn engages saw crank drive gears 8 and vertical cam shaft drive gear 9. Rotation of saw crank drive gears 8 transmits motion through shafts 10 to bevel gears 11 which mesh with mating bevel gears 12. Rotative motion of bevel gears 12 transmits motion to four similar cranks 13 affixed to extreme ends of the two crank shafts 14. Attached to four extreme corners of saw motor mounting 15 are respective one-piece, longitudinally bored bearings 16 by means of which outer ends of cranks 13 are pin connected thereto. Rigidly mounted upon saw motor mounting 15 is saw motor 17 having a circular disk saw 18 firmly attached to the armature shaft thereof. Thus simultaneous rotation of the four cranks 13, by means of gearing heretofore explained, produces the desired forward and retracting stroke of the saw transversely of the line of travel of the carriage, for severing the tube or similar workpiece.

Properly synchronized and meshing with distributing gear 7 is a vertical cam shaft gear 9 having keyed thereto vertical cam shaft 19 which

serves to rotate relief cam 20 and bevel gear 21 which are keyed respectively to extreme top and bottom of said vertical cam shaft. (Figures 4 and 5.) Bevel gear 21 engages mating bevel gear 22 keyed to horizontal cam shaft 23 to which are affixed gripper cam 24, cranks 23' carrying return rollers 25, and a limit switch operating cam 39, hereinafter referred to.

In order to impart a feeding motion to the carriage, it is equipped with gripping mechanism adapted to grip the workpiece as it is fed forward by the reducing unit, in the manner shown in the above identified application, or by any other suitable feed. The gripping mechanism, best shown in Figures 1 and 6, is supported from a hollow spindle 26 journalled on ball bearings 27 mounted in a housing 28 normally moving with the carriage but slidably mounted thereon in guides 28', permitting a slight relative axial movement between housing 28 and carriage 3 when compression spring 29, one end of which engages housing 28 and the other end carriage 3, is compressed by the action of said cam 20 acting through follower 40. After the tube is severed by the saw, the coaction of cam 20 and follower 40 is effective to impart an additional forward movement to the saw carriage, saw motor, motor mounting and saw blade as a unit with respect to the gripper housing 28 and the cut end of the gripped tube. The thus-produced added movement provides an advantageous clearance between the saw blade and the cut end of the tube on the upward or retracting stroke of the saw blade.

The gripping mechanism includes a collar 30 which is mounted near one extremity of the hollow spindle 26, the collar being formed with a plurality of T-shaped guide slots 31 (best shown in Figures 6 to 9) which are inclined at an angle to the longitudinal axis of the advancing tube. Slidingly engaging the slots 31 are a plurality of gripper jaws 32 which, when the collar 30 is moved axially to the left in Figure 6, are effective to wedgingly force the several gripper jaws into firm engagement with the tube or similar workpiece. Since the collar 30 is supported by the spindle 26 which is in turn journaled on the carriage, this will compel the carriage to partake of the movement imparted to the tube by the reducing unit.

A gripper bell crank yoke 33 (Figures 1 and 2) is pivotally mounted on studs 34 extending through bosses 35, said bosses being integral with and protruding inwardly from vertical sides of carriage 3 and in a suitable longitudinal position for engagement of the gripper bell crank yoke 33 with gripper collar 30 on the yoke end and with gripper cam 24 on the crank end. The gripper cam 24 is secured to the horizontal cam shaft 23 and is adapted to impart movement to follower roller 33' mounted on the crank end of said gripper bell crank yoke 33. Rotative movement of the gripper cam 24 allows the follower roller 33' to eventually seek the smaller diameter of cam 24, which movement is urged by compression springs 35' (Figures 6 to 8), lodged within cylindrical slots 36 formed in collar 30, one end of each spring bearing against the bottoms of said cylindrical slots 36 and the other end of each spring bearing against a ring 37 surrounding and firmly attached to spindle 26. Thus upon expansion of compression springs 35', the collar 30 is slidingly moved to the left in Figure 6, to effectively wedgingly force gripper jaws 32 into firm engagement with the tube or similar workpiece. Further rotation of the gripper cam 24 to such a point where the large diameter of the cam 24 is presented to the follower roller 33' positively moves the gripper bell crank yoke 33 in a direction to move the collar 30 in the opposite direction, with resultant disengagement of the grippers. To suit varying diameters of work to be handled, different size gripping jaws may be employed. Firmly affixed to each end of the horizontal cam shaft 23 there are cranks 23' carrying return rollers 25. Suitably located for contact with return rollers 25 and pivotally mounted on stationary side frames 1 are return fingers 38 carrying counterweights 38' arranged to exert a turning moment about a finger pivot stud 38'' whereby contact with the aforementioned return rollers 25 exerts a horizontal force, tending to move carriage 3 in a direction opposite that imparted thereto by the feeding movement of the workpiece. Thus the arrangement of return rollers 25 on horizontal cam shaft 23 for contact with return fingers 38 at the proper point in the severing cycle, effects immediate return of the saw carriage 3 to starting position at the moment the jaws 32 are released from the workpiece.

The aforementioned limit switch operating cam 39 is also mounted on the horizontal cam shaft 23, and the limit switch "B," shown in Figures 10 to 14, is suitably mounted on the carriage 3 to maintain circuit through the gear motor 6, which circuit is originally established by the tube tripping a target switch on the outlet table as the tube is fed forward over the run-out table. Maintenance of this circuit by limit switch B assures complete severing of the tube or workpiece and the return cycle of saw 18 and consequent circuit breakage upon its completion.

Except for the saw supporting means and the slidable mounting for the spindle housing 28 and means for shifting it relatively to the carriage 3, the above described mechanism is in many respects similar to that shown in the above mentioned patent No. 2,340,870.

An important novel feature of the herein claimed improvement is the means whereby the saw blade is moved axially away from the severed end of the gripped portion of the tube before the back stroke of the saw is effected. A preferred relief means for securing this safe saw clearance will now be set forth in detail.

The relief cam 20, as mentioned above, is keyed to the upper end of the vertical cam shaft 19 journaled in the saw carriage 3. Thus when a tube is gripped in the jaws 32 the sleeve 26 and housing 28 are held against movement with respect to the tube and the roller 40 carried by the housing 28 becomes a fixed reaction point against which the cam 20 acts. Accordingly, it is seen that rotation of the cam 20, which is mounted on the saw carriage 3, will move the saw carriage relative to the gripped tube axially thereof, said axial movement being in the same direction as that imparted by the tube reducer and increasing in velocity as compared to the axial movement being constantly effected by the feeding action imparted to the tube by the tube reducer. Thus the correct synchronization of the relief cam 20 with the saw stroke cycle will, by means of the aforementioned added movement of the saw carriage 3, shift the saw blade 18 and the saw base 3 on which it is mounted, longitudinally away from the severed end of the gripped portion of the tube before the back stroke of the saw is effected.

The saw carriage 3 and spindle housing 28 are so constructed and arranged that movement in the required direction to cause the saw to clear the severed end of the tube is resisted by compression spring 29 having one end bearing against a projection 3a on the saw carriage 3 and the other end reacting against a pin 28a secured to the spindle housing 28, as best shown in Figure 6. Thus, upon return of the relief cam to inactive position, the spring 29 effects relative return motion between the saw carriage 3 and spindle housing 28 at conclusion of the saw return stroke, thus resetting the mechanism for positive saw relief action or clearance from the work at the end of the next tube severing operation.

Figures 10 to 15 inclusive graphically illustrate relative positions of the parts during different periods in the operating cycle. In Figures 10 to 14 I have shown in dotted lines in plan view the different relative positions of the relief cam 20 and the roller 40 by means of which relief movement is imparted to the housing 28, these parts being also shown in side elevation in full lines in the same views.

In Figures 10 to 14 inclusive the saw blade, crank shaft, and crank drive gears are shown 90° from their true positions with respect to the gripper spindle carriage, to facilitate showing relative motions. The true positions are shown in Figures 1 to 9.

In the diagram of Figure 15, the vertical reference lines represent 15° increments. The speed of the shaft 23 is such that a complete revolution of 360° takes place in six seconds. The numerals at the top of the diagram represent time intervals in seconds and those at the bottom denote 30° angular intervals during the course of one complete revolution charted. The graph G represents the gripper action; graph S represents the saw stroke; graph C shows the amount of clearance between the flat side face of the saw blade and the severed end of the gripped portion of the tube; graph L shows the intervals during which the limit switch B, controlling the circuit of motor 6, is opened and closed respectively. A complete cycle constitutes 360° rotation of the cam shaft 23, or complete rotation of shaft 19 geared 1:1 thereto. The synchronization of the various operating parts can be readily visualized by comparison of the relative positions shown in Figures 10 to 14 inclusive in conjunction with the graphs in Figure 15.

Figure 10 illustrates the relative positions of the parts at either the start or conclusion of a cycle. The cycle starts when the leading end of a tube fed by the tube reducing machine trips a conventional form of target switch mounted on the outlet trough, as shown in the prior application above mentioned. This starts the drive motor 6, the circuit of which is maintained when the limit switch cam 39 closes limit switch B. The cycle stops when the limit switch cam 39 allows limit switch B to open, thus stopping drive motor 6.

Figure 11 shows the position of the parts after the shaft has turned 20° from the position of Figure 10. At this stage of Figure 11, the saw blade is moving down, the gripper cam 24 has passed from under the gripper fork roller 33', and springs 35' have caused the gripper jaws 32 to move radially inwardly and grip the tube. Return roller 25 has been lifted clear of the returning finger 38, and the saw carriage is now free to travel forward with the tube under influence of movement imparted thereto by the tube-forming machine.

Figure 12 indicates the condition of the parts after they have rotated 125° from the position shown in Figure 10. In this position the saw blade is approaching the end of its down-stroke, and the tube is completely cut through. The limit switch cam 39 then closes limit switch B, energizing a solenoid (not shown) which actuates the outlet trough, discharging the cut tube in the manner shown and described in the above identified patent. The limit switch B when closed also maintains a power circuit through the drive motor 6. This is required since the target switch in the outlet trough, which started the cycle, has been opened by the discharge of the severed tube. Relief cam 20 has contacted roller 40 on the spindle housing, causing saw carriage 3, motor mounting 15, and saw blade 18 to move with respect to the spindle housing 28 and the gripped tube. This motion provides clearance between the face of the saw blade and cut end of the tube, so as to avoid damage to either the saw or the severed end of the tube on the up-stroke of the saw.

Figure 13 illustrates the disposition of the parts after they are moved 225° from the starting position. In this figure the saw blade is moving up and has just cleared the tube. The relief cam 20 has provided maximum clearance between the end of the gripped tube, and is now moving away from the roller 40, allowing springs 29 to shift the spindle housing 28 to its original position on the carriage. The gripper cam 24 will contact roller 33' of the gripper fork at this stage if the gripper is closed the maximum distance. This action will take place a short time later if the gripper is normally closed. The engagement of the gripper cam with roller 33' starts the release of the tube, and as soon as the grip on the tube is released, the travel of the carriage stops.

Figure 14 shows the relative positions of the parts after they have turned 270° from the position of Figure 10. At this stage the saw blade continues to move up. The relief cam 20 has moved away from the roller 40, allowing springs 29 to return the spindle housing 28 to its original position on the carriage. The gripper is fully opened and released, and the carriage 3 is thus free to return to its original starting position. At the conclusion of the 360° rotation, the limit switch cam 39 allows limit switch B to open, thereby stopping the motor 6 and concluding the cycle. The parts then assume the condition illustrated in Figure 10, for repetition of the described cycle.

While I have described quite precisely a preferred construction which an actual reduction to practice has proven to be quite successful, it is to be understood that I do not wish to be limited precisely thereto, since modifications and substitutions of equivalents may be made within the scope of the appended claims.

I claim:

1. In an apparatus of the character described, a carriage having a spindle coacting with a workpiece to be severed, a gripper mounted therein which when closed causes the carriage to partake of travel of the workpiece, a motor and saw for severing the workpiece, a mounting for the motor and saw movable transversely of the axial line of workpiece travel, housing means slidably supporting said gripper on the carriage with freedom for movement relative thereto in a direction axial of the line of workpiece travel, and means

for imparting additional axial movement to said carriage while the saw is being retracted after severing the workpiece so as to cause the saw to clear the severed end of the workpiece held by said gripper.

2. In an apparatus of the character described, a carriage having a spindle coacting with a workpiece to be severed, a gripper mounted therein which when closed causes the carriage to partake of travel of the workpiece, a motor and saw for severing the workpiece, a mounting for the motor and saw movable transversely of the axial line of workpiece travel, housing means slidably supporting said gripper on the carriage with freedom for movement relative thereto in a direction axial of the line of workpiece travel, means yieldingly urging said housing means axially in one direction, a relief cam for moving said housing means in the opposite direction, a saw-moving cam and connections for moving the saw mounting transversely of the axial line of workpiece travel, and a gripper cam for actuating said gripper, the several cams being so shaped and synchronized that the gripper remains in closed gripping contact with the workpiece while the saw is severing the latter and releases after the saw has been retracted transversely.

3. In apparatus of the character described, a carriage having a spindle coacting with the workpiece to be severed, a gripper mounted therein which when closed causes the carriage to partake of travel of the workpiece, a motor carrying a saw for severing the workpiece, a mounting for the motor, a plurality of cranks supporting said mounting, said cranks being rotatable in a plane transverse of the axial line of workpiece travel, driving means supported by and movable with the carriage for rotating said cranks in unison, a housing slidably supporting said gripper on the carriage with freedom for movement relative thereto in a direction axial to the line of workpiece travel, and means for imparting axial movement to said carriage relative to the housing while the saw is being retracted after severing the workpiece so as to cause the saw to clear the severed end of the workpiece held by said gripper.

4. An apparatus of the class described, comprising a carriage, a spindle supported thereon carrying a gripper effective to cause the carriage to partake of movement in the axial direction of travel of the workpiece, a saw and driving means therefor, a mounting for the latter mounted on the carriage with freedom for movement transversely to the line of axial travel of the workpiece, means for moving said mounting transversely of the axial line of travel to cause the saw to sever the workpiece, a housing slidable with respect to the carriage and supporting said gripper, and means for moving said carriage axially of the line of workpiece travel in a direction away from the end of the workpiece upon completion of the severing operation and prior to the return of the saw transversely to a starting position clear of the path of workpiece travel.

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