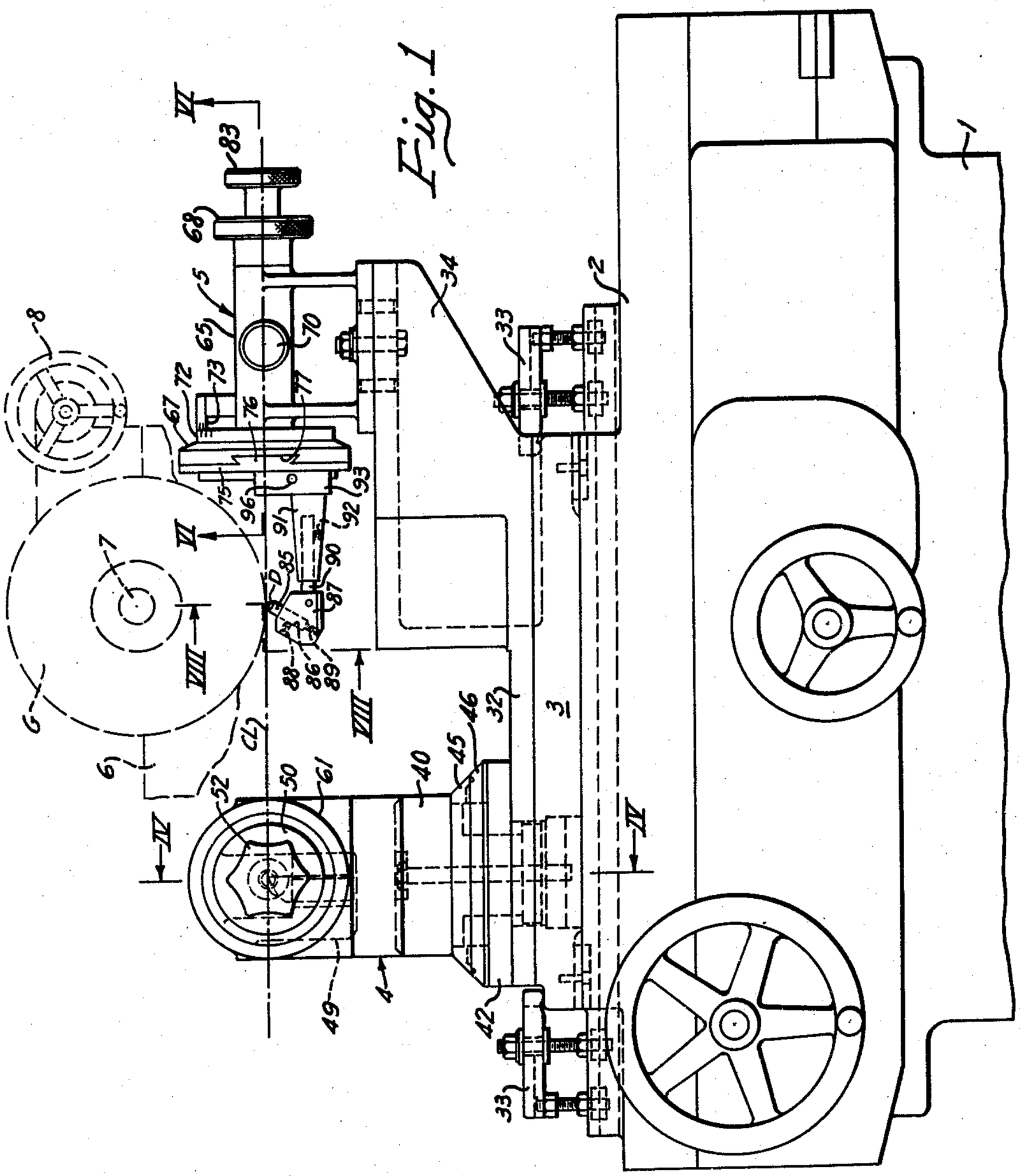
Sept. 2, 1958 A. L. STOECKEL 2,849,840

METHOD AND APPARATUS FOR GRINDING NAIL CUTTER DIES

Filed April 28, 1955 5 Sheets-Sheet 1

Fig. 1



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METHOD AND APPARATUS FOR GRINDING NAIL CUTTER DIES

Filed April 28, 1955 5 Sheets-Sheet 2

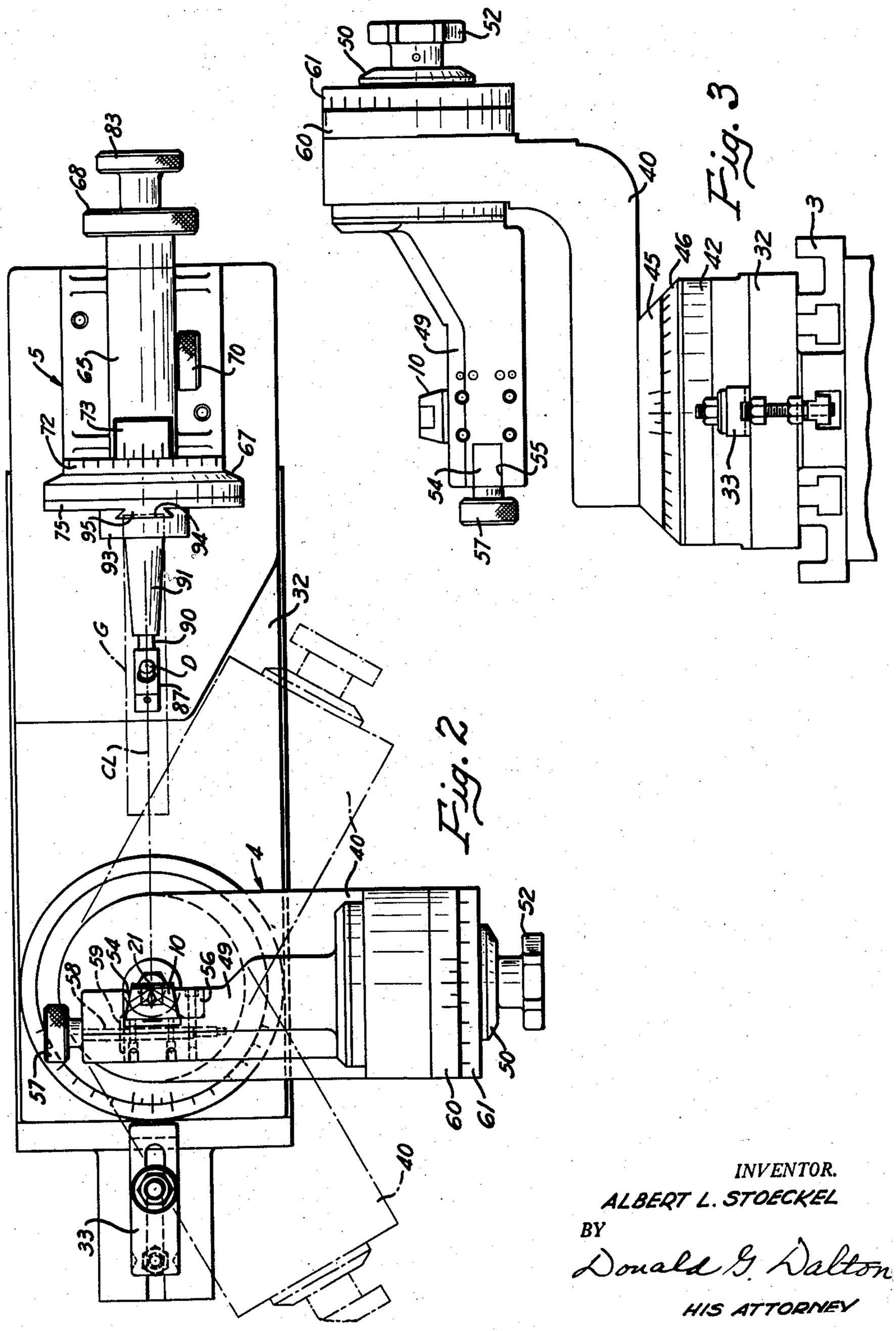

Fig. 2

Fig. 3

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METHOD AND APPARATUS FOR GRINDING NAIL CUTTER DIES

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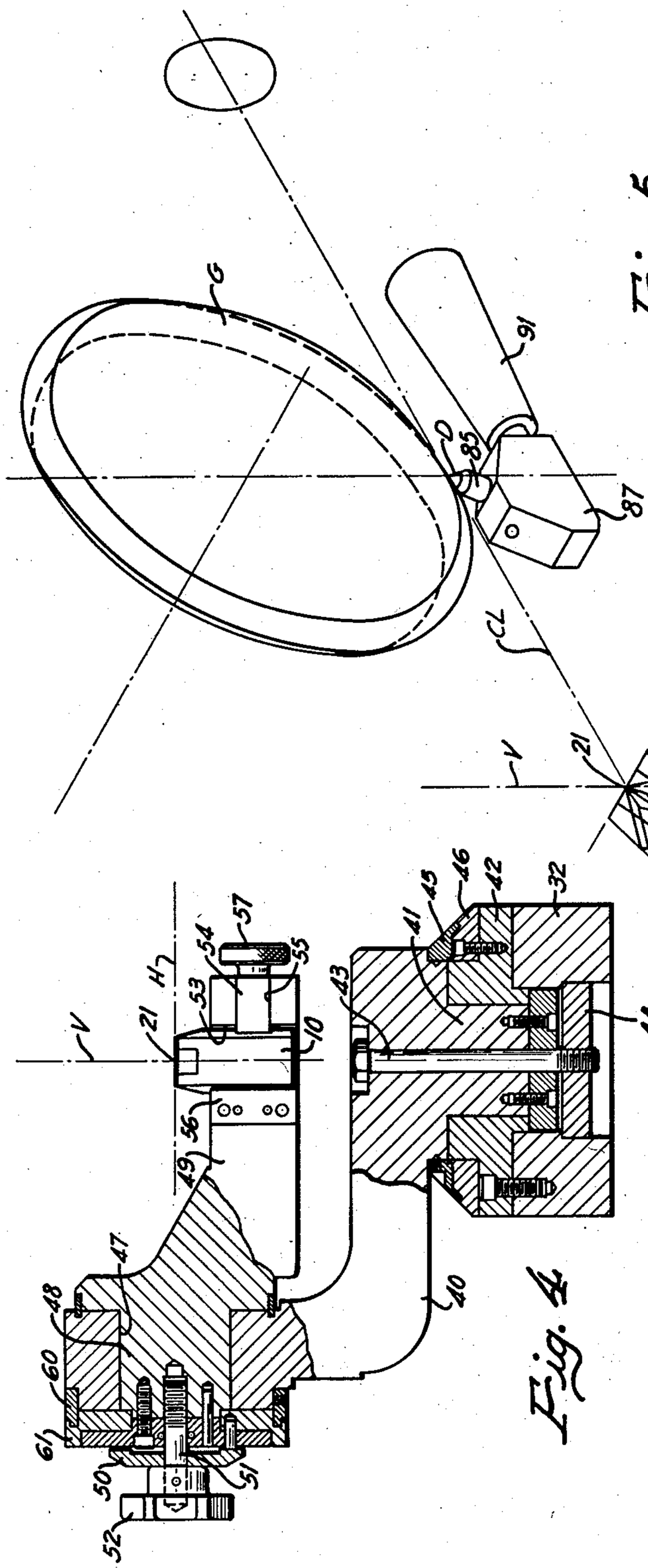

Fig. 5

Fig. 4

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METHOD AND APPARATUS FOR GRINDING NAIL CUTTER DIES

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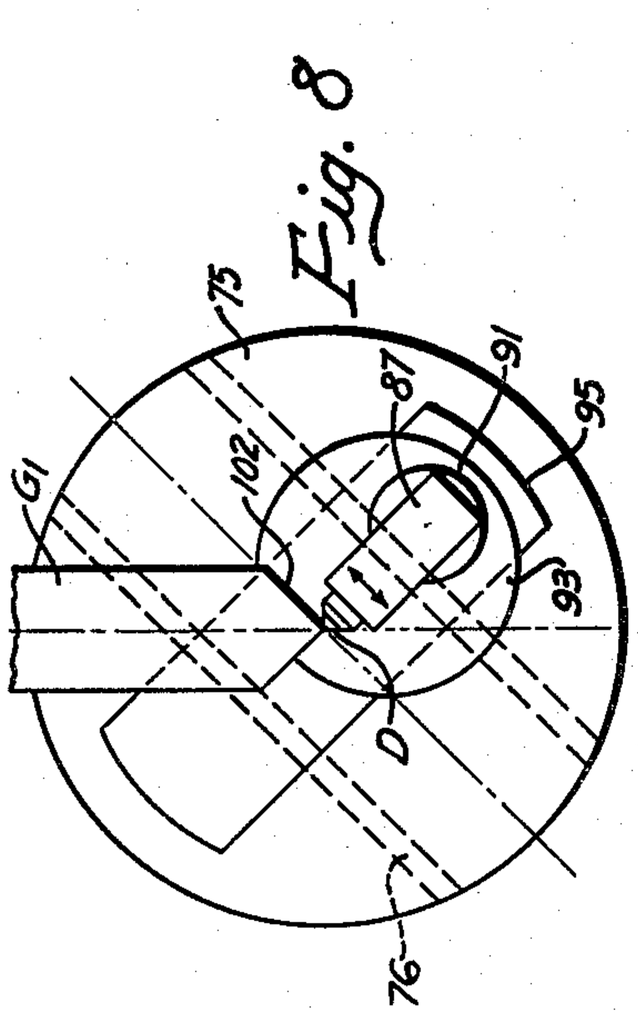

Fig. 8

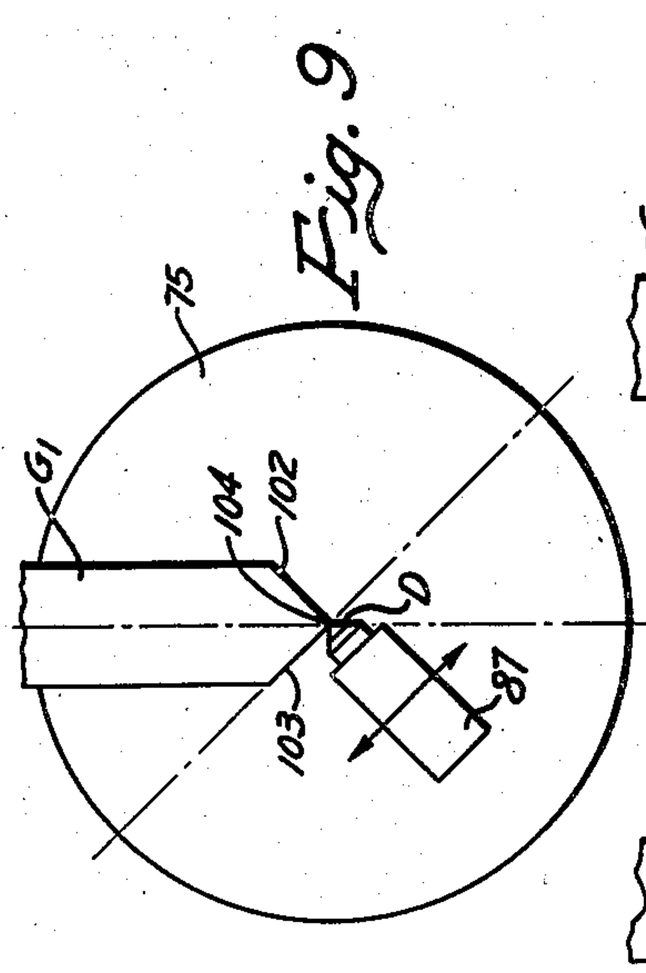

Fig. 9

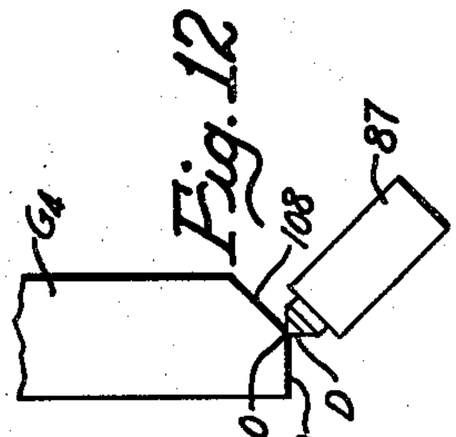

Fig. 12

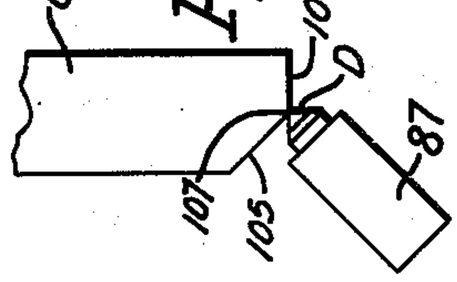

Fig. 11

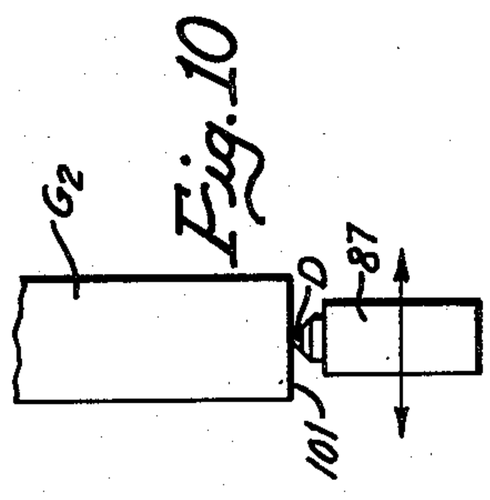

Fig. 10

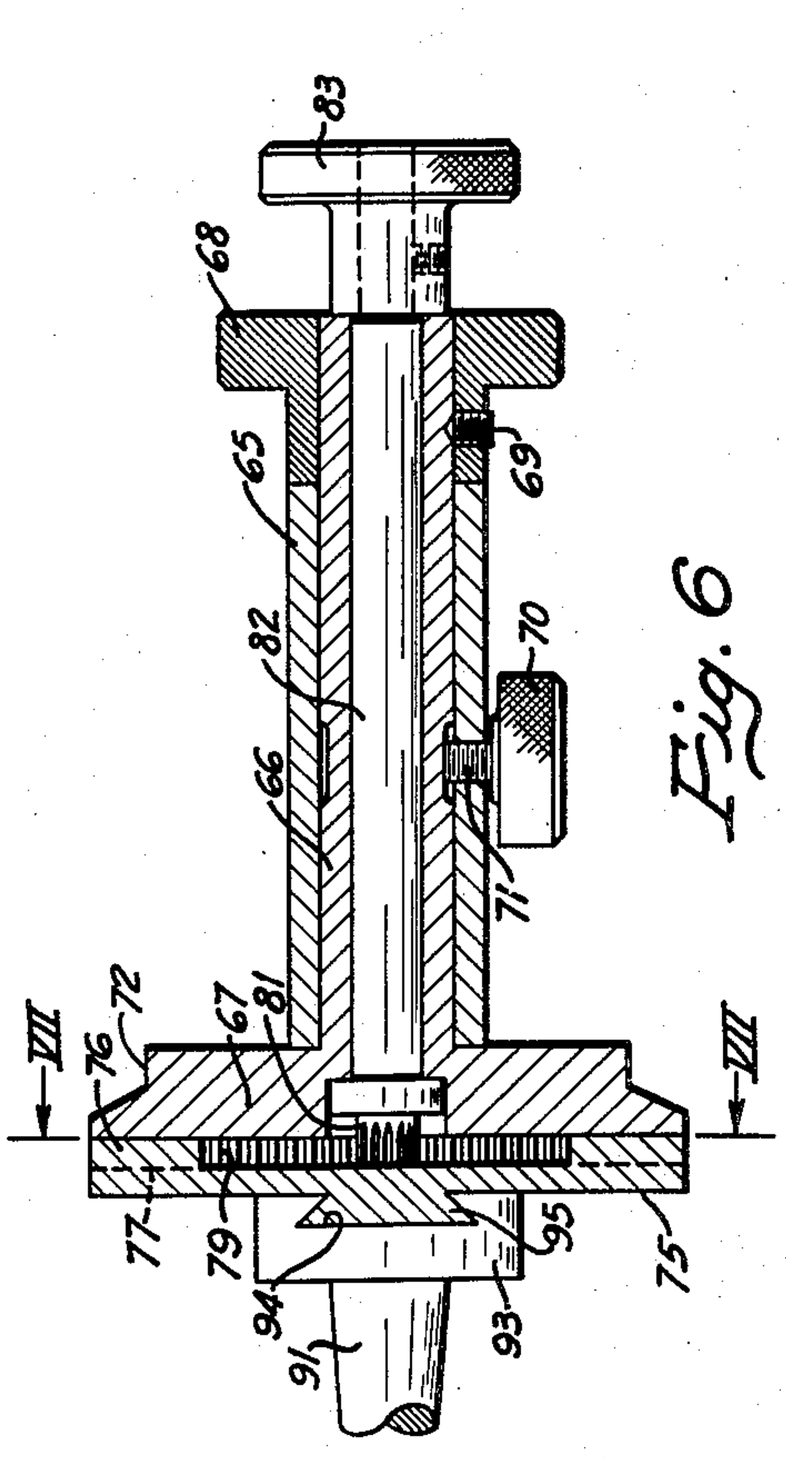

Fig. 6

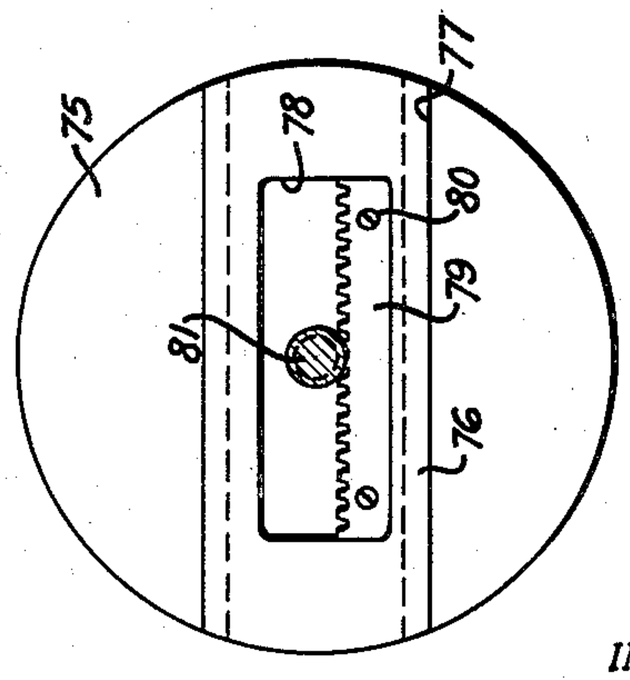

Fig. 7

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METHOD AND APPARATUS FOR GRINDING NAIL CUTTER DIES

Filed April 28, 1955 5 Sheets-Sheet 5

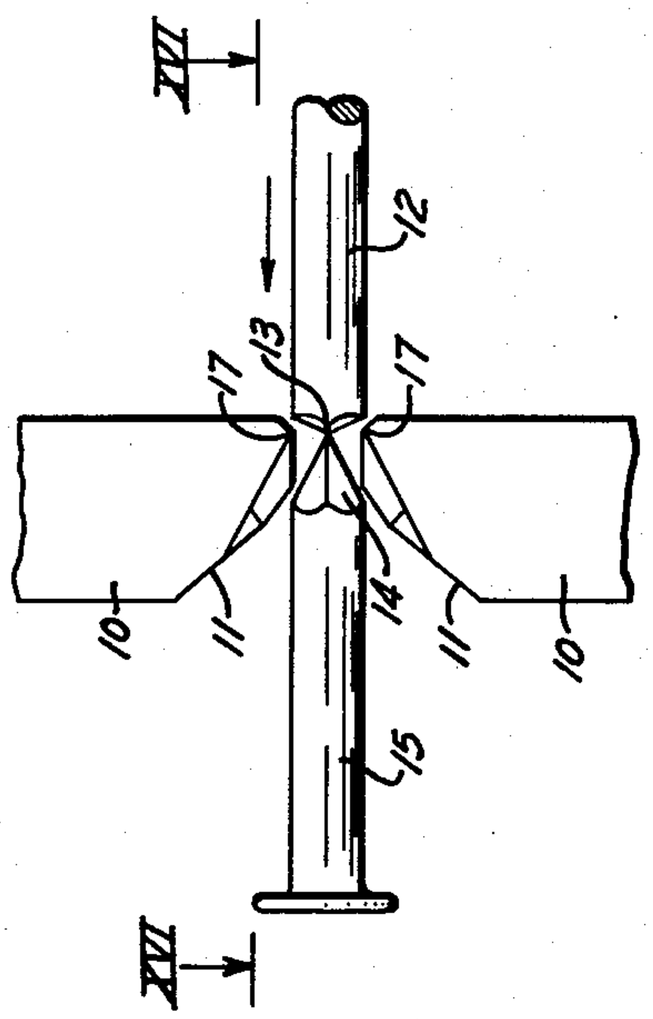

Fig. 15

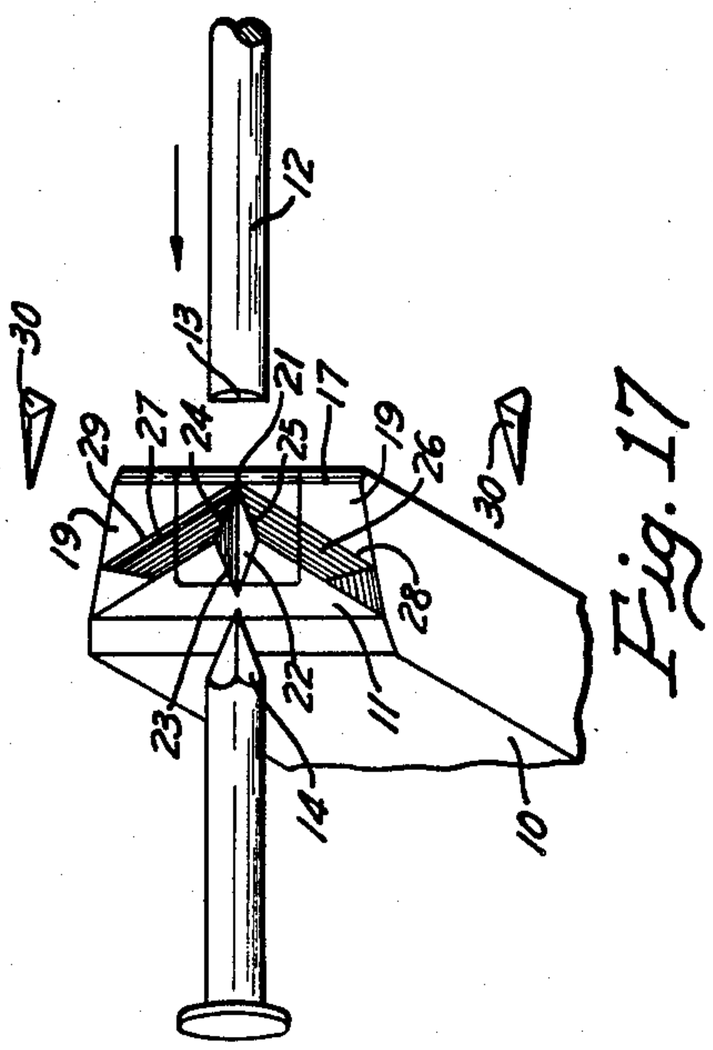

Fig. 17

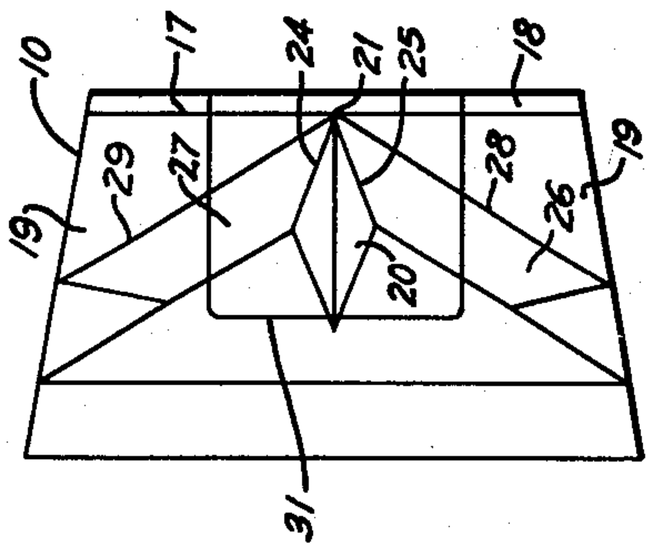

Fig. 14

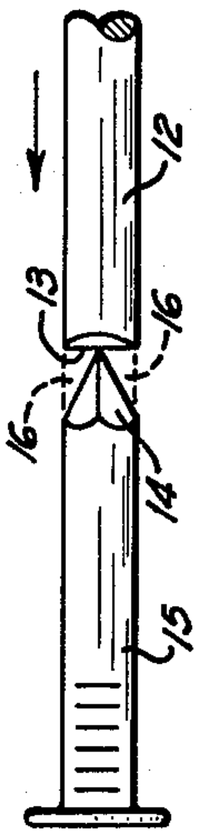

Fig. 16

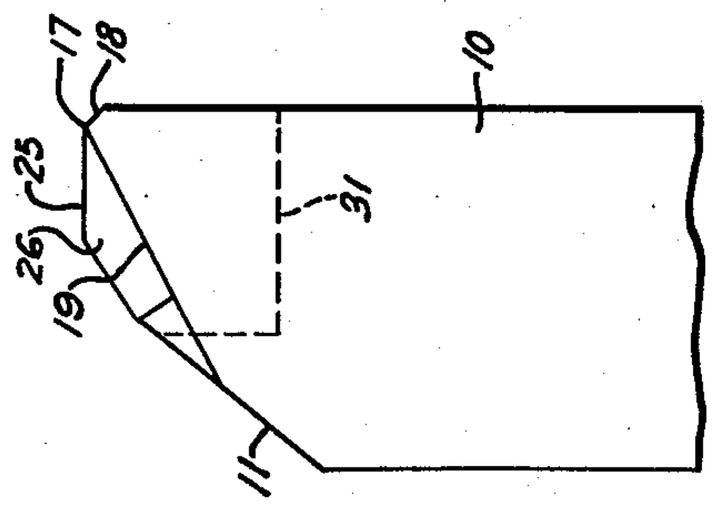

Fig. 13

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METHOD AND APPARATUS FOR GRINDING NAIL CUTTER DIES

Albert L. Stoeckel, Euclid, Ohio, assignor to United States Steel Corporation, a corporation of New Jersey

Application April 28, 1955, Serial No. 504,459

12 Claims. (Cl. 51—92)

This invention relates, as indicated, to a method of and an apparatus for grinding nail cutter dies and, more particularly, is directed to the problem of forming the wire cutting edges and shaping surfaces on the dies in accurately predetermined positions with reference to a point having a centrally located position relative to the side surfaces of the die body to facilitate mounting of the dies in a nail cutting machine in automatically aligned positions.

Conventional nail machines are commonly provided with two cutting dies which are mounted in opposed relation and reciprocated in an endwise direction relative to each other to sever the wire from which the nails are being formed and to point the nail. The point forming surfaces of the die have a configuration according to the shape of the nail to be formed, the most common shapes being diamond points of varying degrees, duck bill and needle points. It is of course necessary that the two dies be aligned accurately relative to each other in order to obtain an accurately shaped nail point which is free of burrs. In the older and more common type of nail cutting machine, provisions were made for adjusting the position of the dies laterally relative to their path of reciprocating movement in order to obtain the desired alignment of the die cutting and shaping surfaces. This adjustment was necessary since the die cutting surfaces were ground manually and were not uniformly arranged relative to the body of the die.

With the development of modern high speed cutting machines, a more accurate alignment of the cutting dies relative to each other is required in order to obtain a satisfactory die life. To this end, the provisions for adjusting the dies in a lateral direction relative to their path of reciprocating movement were eliminated. Instead of such adjusting provisions, the die bodies are now provided with accurately machined side surfaces which enable their mounting in a nail machine in a predetermined position with their die cutting surfaces accurately located relative to their side surfaces. In this manner, the die cutting and forming surfaces on a pair of opposed dies are automatically aligned relative to each other upon being inserted in the machine provided of course that such surfaces are accurately formed relative to the sides of the dies. This of course requires more accurate machining of the die cutting surfaces and renders the older conventional die grinding procedures obsolete since they are inherently incapable of providing the desired accuracy. Expensive machining operations by skilled machinists have been required for this purpose.

To obtain the increased life inherent in dies having tungsten carbide tips on which the cutting surfaces are formed, the accuracy of the grinding operation is rendered even more critical. The tungsten carbide is more brittle than ordinary tool steel and chipping may be expected if the cutting surfaces on the dies are not properly and accurately aligned. While the grinding apparatus of this invention is particularly directed to the grinding of tools having tungsten carbide tips, it will be understood that

it is applicable to the grinding of dies formed entirely of tool steel.

One of the principal objects of this invention is to provide an apparatus for grinding nail cutting dies with extreme accuracy and which eliminates the expensive machining operations heretofore required and can be operated by unskilled personnel.

A further object of the invention is to provide a nail cutter die grinding apparatus having a grinding wheel and a traverse table with a die holder and a grinding wheel dressing fixture at opposite ends thereof. A still further object of the invention is to provide the grinding wheel dressing fixture and die holder just referred to respecitvely with adjustable supports for varying their relative positions with respect to a common line extending therebetween and parallel to the path of movement of a traverse carriage on which they are mounted.

Still another object of the invention is to provide the die holder just referred to with an adjustable support for holding the die in a position in which the intersection of its wire shearing edges and point cutting edges falls on the common line extending between the holder and the grinding wheel dressing fixture, and which provides for universal adjustment of the position of the die about said point of intersection.

Still another object of the invention is to provide the grinding wheel dressing fixture just referred to with a diamond cutting point having an adjustable support for centering the point on the common line extending between the fixture and the die holder and for rotating the dressing tool about such point.

Other objects and advantages of the invention will be apparent from the following description.

In the drawings, there is shown a preferred embodiment of the invention. In this showing:

Figure 1 is a side elevational view of a grinding apparatus constructed in accordance with the principles of this invention and in which the grinding wheel, its drive and support are shown diagrammatically;

Figure 2 is a plan view of the traverse carriage shown in Figure 1 in which the position of the grinding wheel relative to the die holder and dressing fixture on the carriage is illustrated diagrammatically;

Figure 3 is an end elevational view of the carriage shown in Figure 2 looking in a direction from the left of Figure 2;

Figure 4 is a sectional view taken substantially along the line IV—IV of Figure 1;

Figure 5 is a diagrammatic view showing the relative positions of the critical axes about which the adjusting movement of the components of the apparatus of this invention takes place;

Figure 6 is a sectional view taken along the line VI—VI of Figure 1;

Figure 7 is an elevational view looking in the direction of the line VII—VII of Figure 6;

Figure 8 is a view taken along the line VIII—VIII of Figure 1 showing one position of the grinding wheel dressing fixture for dressing the surface of one of the grinding wheels used in the apparatus of this invention;

Figure 9 is a view similar to Figure 8 but with parts thereof omitted and which shows another position of the dressing fixture for dressing a different surface of the grinding wheel shown in Figure 8;

Figures 10 through 12 are schematic views, respectively taken in the same direction as Figure 9, showing other positions of the dressing fixture for dressing other grinding wheels used in the apparatus of the invention;

Figure 13 is a side elevational view of a nail cutter die;

Figure 14 is a plan view of the die shown in Figure 13;

Figure 15 is a fragmentary and diagrammatic view illustrating the manner in which a pair of dies are mount-

ed in opposed relation in a nail machine for cutting and pointing wire in the formation of a nail;

Figure 16 is a view of the wire and nail shown in Figure 15 looking in the direction of the line XVI—XVI; and

Figure 17 is a perspective view showing the arrangement of the die cutting surfaces relative to the wire and the nail being formed.

The die grinder of this invention comprises a base **1** having a grinder table **2** on which a traverse carriage **3** is mounted for reciprocating movement as viewed in Figure 1. The support for the carriage **3** on the table **2** includes a trackway (not shown) for guiding the traversing movement of the carriage **3** rectilinearly with respect to the table **2**. The base **1** in accordance with conventional practice has a hydraulic or other suitable form of drive for imparting reciprocating movement to the carriage **3** and a manual drive for adjusting its position on the table **2**. A die holder and grinding wheel dresser fixture respectively designated as a whole by the numerals **4** and **5** are bolted to the carriage **3** for a purpose to be described. The grinder includes as shown diagrammatically in broken lines a support and drive **6** for a shaft **7** on which grinding wheels G of different forms are removably mounted in a manner to be described, the axis of the shaft **7** being positioned above and extending transversely of the path of rectilinear movement of the carriage 3. The shaft **7** has a mounting (not shown) by which its vertical position may be adjusted, a handwheel **8** being provided for adjusting its position.

The arrangement of the grinding wheels G on the shaft **7**, the die holder **4** and dresser fixture **5** relative to each other and their manner of operation are critical with respect to the wire cutting and point shaping surfaces to be ground on the die. Before description of these parts and their operation, reference will be first made to the structure of a conventional die and to the manner in which such dies are used in a nail machine to cut wire and form a nail point. In the showings of Figures 5 and 13 through 17, the numeral **10** designates a nail cutter die having side surfaces which are tapered and accurately machined for mounting in a predetermined position in a nail machine for reciprocating movement thereby. The die **10** has conventional wire cutting and nail pointing surfaces on an end **11** thereof which must be accurately positioned relative to their side surfaces.

Figure 15 illustrates the manner in which a pair of dies **10** are mounted in opposed relation in a nail machine for reciprocating movement with respect to the direction of travel of the wire from which nails are cut and formed. In this showing, the wire **12** travels in the direction indicated by the arrow and the dies **10** are mounted with their ends **11** adjacent each other and are reciprocated toward and away from each other. As the surfaces **11** move to their innermost position the wire **12** is sheared at **13** and a point **14** is formed on the end of a nail **15**. The point **14** has a diamond shape which is formed by a combined cutting and swaging operation. In formation of the point **14**, portions of the wire, generally referred to as whiskers, are removed from the area **16** inwardly of the dotted lines in Figures 15 and 16.

The wire cutting and point shaping surfaces on each die end **11** have a configuration as shown in Figures 13, 14 and 17. Each end **11** has a wire shearing edge **17** extending transversely of the path of wire movement and defined by oppositely inclined surfaces **18** and **19**. A diamond-shaped groove **20** extends inwardly from the shearing edge **17** with its point **21** positioned exactly centrally of the wire cutting edge **17**. The side surfaces **22** and **23** of the groove **20** are shaping surfaces for the nail point **14** and the outer edges **24** and **25** of such surfaces are cutting edges at the same level as the shearing edge **17**. The cutting edges **24** and **25** converge and intersect at the point **21**. Surfaces **26** and **27** taper angularly away from the edges **24** and **25** and intersect

with the surface **19** along lines designated respectively by the numerals **28** and **29**. The surfaces **26** and **27** together with the surface **19** form whisker chutes along which whiskers **30** (see Figure 17) cut from the wire in the areas **16** by the edges **24** and **25** move outwardly. From the showings of Figures 15 and 17, it will be apparent that the wire **12** is sheared at **13** by the die shearing edges **17** and the nail point **14** is cut by the cutting edges **24** and **25** and shaped by the surfaces **22** and **23** upon movement of the dies to their innermost position relative to each other, it being noted that the cutting edges **17** and **24** and **25** on the two dies do not touch at this innermost position but are spaced a few thousandths of an inch apart.

It will be noted that the wire shearing edge **17**, nail point cutting edges **24** and **25**, and whisker chute lines **28** and **29** have a common point of intersection at the point **21** which corresponds to the point of the nail. These edges and the surfaces defining such edges must be positioned relative to the sides of the die body **10** with extreme accuracy if the die cutting edges and shaping surfaces on the dies **10** are to be accurately aligned when the dies are mounted in a nail machine as shown diagrammatically in Figure 15.

A plurality of grinding wheels are required to form the shaping surfaces and cutting edges on the die end **11**. The different grinding wheels and their peripheral grinding contours are shown in Figures 8 through 12 wherein the grinding wheels are designated respectively by the letters **G1**, **G2**, **G3** and **G4**. The wheel **G2** in Figure 10 is a dressing wheel which is used to form the surface **18** and the cutting edge **17**. The wheel **G1** shown in Figures 8 and 9 is required to cut the diamond-shaped groove **20** and its side surfaces **22** and **23** and to locate the point **21**. The wheel **G3** shown in Figure 11 is used to grind the whisker chute surfaces **26** and **19** and form their line of intersection **28**. The wheel **G4** shown in Figure 12 is used to grind the whisker chute surfaces **27** and **19** and their line of intersection **29**. The action of the wheels **G3** and **G4** in grinding the surfaces **19** cooperates with the grinding action of the wheel **G2** to form the wire shearing edge **17**. In addition, the grinding action of the wheels **G3** and **G4** cooperates with the grinding action of the wheel **G1** in forming the point cutting edges **24** and **25** of the diamond-shaped groove **20**. In order to accurately locate the die surfaces and the cutting edges defined thereby, the grinding surfaces on the wheels **G1**, **G2**, **G3** and **G4** must be dressed with extreme accuracy and the die body **10** must be supported in an accurately predetermined position relative to the path of movement of the grinding wheel over the end thereof during a grinding operation. In a manner to be described, these requirements are answered by the die holder **4** and grinding wheel dresser fixture **5** of this invention.

According to one of the objects of the invention, it will be recalled that the fixture **5** and die holder **4** have adjustable provisions for varying their relative positions with respect to a common line extending therebetween and parallel to the path of movement of the traverse carriage **3** on which they are mounted. This common line is designated CL in the diagrammatic showing of Figure 5. The line CL intersects with the die point **21** of the die **10** which is held by the holder **4** in a manner to be described. The holder **4**, and also in a manner to be described, has provisions for adjusting the angular position of the die **10** about a vertical axis V and a horizontal axis H which also intersect with the line CL at the point **21** and this angular adjustment is effected in such manner that the point **21** does not move from the common point of intersection of the lines V, H and CL regardless of the angular position to which the die **10** is moved. The line CL is tangential to a point centrally of the periphery of the grinding wheel G. Also in a manner to be described, the dressing fixture **5** includes a diamond dressing point D the tip of which is centered

on the line CL in such manner that it may have its angular position adjusted about the line CL. The manner in which the die holder 4 and the dressing fixture 5 answer these requirements will be apparent from the following description of their construction and operation.

Figures 1 through 6 furnish a detailed illustration of the construction of the holder 4 and grinding wheel dresser fixture 5. As best shown in Figures 1 and 2, the holder 4 and fixture 5 have a common base 32 which is rigidly clamped to the traverse carriage 3 by clamps 33 at the ends thereof. The base 32 is of course clamped in a position aligned with the rectilinear path over which the carriage 3 moves and in such manner that the die point 21 and diamond dressing point D move along the line CL when their positions are adjusted properly as will be explained hereinafter.

As shown in Figures 1 through 4, the holder 4 comprises an L-shaped bracket 40 the horizontal arm of which has a depending journal 41 rotatably supported in a bearing 42 secured to the base 32 to mount the bracket 40 for movement about the vertical axis V. The journal 41 has an axially extending opening in which a bolt 43 is positioned for actuating a clamping member 44 to hold the bracket 40 against angular movement in the bearing 42 from any selected position of angular adjustment. Rings 45 and 46 respectively secured to the journal 41 and bearing 42 have indicia for indicating the angular position of the bracket 40 relative to the base 32.

The vertical arm of the bracket 40 has a horizontal opening 47 in which a journal 48 at the end of a die holder arm 49 is rotatably received. The bearing support provided by the opening 47 for the journal 48 mounts the arm 49 for rotational movement about the horizontal axis H. A clamping plate 50 is mounted on a shaft 51 which has threaded engagement in the end of the journal 48. A manually operable knob 52 is secured to the outer end of the shaft 51 for rotating it to move the clamping member 50 to a position clamping the journal 48 against rotational movement from any selected position of angular adjustment. A ring 60 mounted on the bracket 40 concentrically of its opening 47 and a ring 61 secured to the journal 48 for rotation therewith bear indicia for indicating the relative angular position of the holder arm 49 with respect to the horizontal axis H.

The outer end of the arm 49 has an opening 53 in which a die 10 to be ground is received. A clamping member 54 is mounted in a slot 55 (see Figure 3) in the outer end of the arm 49 for clamping the die 10 against a gauge plate 56 at the inner edge of the opening 53, the clamping plate being actuated by a knurled knob 57 on a shaft 58 having its inner end threaded in the arm 49 whereby rotation of the shaft 53 is effective to impart clamping movement to the clamp 54. The back of the opening 53 is defined by a gauge plate 59 (see Figure 2) which has bearing engagement with the back side of the die body 10. When the die body 10 is clamped in position as shown in Figures 2 and 4 with its side surfaces firmly engaged with the gauge plates 56 and 59, the point 21 will be located at the point of intersection of the axes V and H. While the holder arm 49 may be rotated about the axes V and H, the die point 21 will not move away from the point of intersection of the axes V and H. In this manner, the holder 4 mounts the die 10 for universal movement about the point of intersection of the axes V and H.

As best shown in Figures 1, 2, 6 and 7, the grinding wheel dressing fixture 5 comprises a hollow casting 65 which is bolted to a bracket 34 projecting upwardly from the base 32 in a position with its axis substantially coinciding with the center line CL. As best shown in Figure 6, the casting 65 furnishes a rotational support for a hollow shaft 66 having an adjusting head 67 at one end thereof. Rotation of the shaft 66 and head 67 is effected by a knurled knob 68 secured to the shaft 66 by a set screw 69. A knurled knob 70 operates a set screw 71 for locking the shaft 66 against rotational movement with respect to the hollow casting 65. A surface 72 on the head 67 bears indicia cooperating with indicia on a stationary member 73 secured to the casting 65 for indicating the angular position of the head 67.

A circular plate 75 has a tongue 76 mounting it in a tongue groove 77 in the face of the head 67 for movement along a diameter of the head 67. As shown in Figure 7, the tongue 76 has an opening 78 in which a gear rack 79 is secured to the plate 75 by screws 80. A pinion 81 has meshing engagement with the gear rack 79 and is effective upon rotation thereof to move the tongue 76 in its mounting slot 77. The pinion 81, as shown in Figure 6 is operated by a shaft 82 extending axially of the hollow shaft 66 and which has a knurled operating knob 83 at its outer end.

The diamond dressing point D is mounted on the end of a shaft 85 which is received in an opening 86 in a mounting block 87, set screws 88 and 89 being provided for adjusting the position of the shaft 85 in the opening 86. The opening 86 is preferably angularly inclined as shown in Figure 1 so that the shaft 85 may be rotated from time to time to change the surface of the point D which engages with the grinding wheel being dressed thereby. The block 87 has a mounting rod 90 which is received in a holder 91, a set screw 92 being provided for preventing turning movement of the rod 90 in the holder 91. The holder 91 is secured to a mounting member or hub 93 which has a tongue groove 94 (see Figure 2) by which it is mounted on a tongue 95 on the outer end of the plate 75. The tongue 95 and tongue 76 are normal relative to each other so that the two tongue and slot connections 95 and 76 provide for universal adjustment of the position of the dresser block 87 with respect to the rotatable head 67. A set screw 96 is provided for locking the hub 93 against movement along its mounting tongue 95.

The fixture 5 is conditioned for operation by initial adjustment of the position of the rotatable head 67 so that the tongue 76 extends horizontally and the tongue 95 extends vertically as shown in Figures 1 and 2. The mounting hub 93 is then adjusted to a vertical position with the tip of the diamond dressing point D located on the line CL. A die 10 to be ground is then mounted in the holder arm 49 in a position as shown in Figures 1, 2 and 5 with the point 21 also positioned along the line CL. These adjustments place the holder 4 and dressing fixture 5 in condition for grinding the end 11 of a die 10 to produce the die surfaces and cutting edges shown in Figures 13, 14 and 17, and their operation for this purpose will now be described. In this description, the position of the die 10 will be described with reference to the planes of the surfaces to be formed by the action of the grinding wheels G1, G2, G3 and G4.

The first operational step is the grinding of the surface 18 to form the wire severing edge 17. For this purpose, the grinding wheel G2 is mounted on the shaft 7 which is lowered to a position in which the lower edge of the wheel G2 engages with the diamond point D as shown in Figure 10. The grinding wheel C2 is then rotated and the knob 83 is operated to move the block 87 and point D back and forth across the periphery of the grinding wheel G2. This operation forms a grinding surface 101 on the periphery of the wheel G2 which is tangential at its lower edge to the line CL. The die mounting arm 49 is then rotated in a counter-clockwise direction about the horizontal axis H as viewed in Figure 5 without changing the position of the bracket 40 about the vertical axis V and to a position in which the surface 18 to be formed will lie in a horizontal plane. The carriage 3 is then moved to the right as viewed in Figure 1 to move the

grinding wheel G2 over the edge of the die and form the surface 18 and cutting edge 17.

The next operational step is to form the diamond-shaped groove 20. For this purpose, the grinding wheel G2 is removed from the shaft 7 and is replaced by the grinding wheel G1 as shown in Figures 8 and 9. With the grinding wheel G1 in position, the knob 68 is operated to rotate the head 67 through an angle of 45°. This operation places the block 87 and diamond point D in the position shown in Figure 8. The grinding wheel G1 is then rotated and the knob 83 is operated to move the block 87 and dressing point D as indicated by the arrows in Figure 8 to dress the surface 102. Upon completion of the dressing of the surface 102, the knob 68 is rotated to shift the angular position of the block 87 and diamond point D to the relative angular position shown in Figure 9, the latter position being spaced an angle of 90° from the position shown in Figure 8. The knob 83 is then rotated to move the block 87 and dressing point D in the direction indicated by the arrows in Figure 9 to dress the grinding surface 103. The grinding wheel surfaces 102 and 103, interest at 104 and form a circle which is tangential to the line CL. The arm 49 is then rotated about its horizontal axis H in a clockwise direction to a position in which the bottom of the groove 20 to be formed falls along the line CL. The carriage 3 is then moved to the right to move the die 10 into grinding engagement with the grinding wheel G1 and form the die groove 20 including its side surfaces 22 and 23.

The next step in the operation is the formation of the whisker chutes by the grinding of the die surfaces 26, 29 and 19 and this involves the use of the grinding wheels G3 and G4 as shown in Figures 11 and 12. The grinding wheel G3 is dressed by manipulation of the diamond point D and holder 87 as explained in connection with Figure 9 to dress the surface 105. The point D and holder 87 are then manipulated as explained in connection with Figure 10 to form the surface 106. The grinding wheel surfaces 105 and 106 intersect at 107 to form a circle which is tangential to the center line CL at the bottom of the wheel. The grinding wheel surface 105 is used to grind the die surface 26 and the grinding wheel surface 106 is used to grind the bottom portion of the die surface 19 as viewed in Figure 17. The die 10 is positioned for this grinding operation by rotation of the bracket 40 to the left as viewed in Figure 2 to a position as shown in dotted lines in which the line 28 of intersection between the surfaces 26 and 19 falls on the center line CL. The die holder arm 49 is then rotated to position the surface 19 to be formed by the grinding surface 106 in a horizontal plane. Upon movement of the carriage 3 to the right as viewed in Figure 1, the grinding wheel surface 106 will form the portion of the surface 19 along the line 28 and the grinding wheel surface 105 will grind the die surface 26 to complete one of the whisker chutes, the circle at 107 moving over the line 28 during this operation. The grinding action of the surface 105 in this operation completes the point cutting edge 25 and the grinding action of the surface 106 completes the lower half of the wire shearing edge 17 as viewed in Figure 17.

The grinding wheel G4 is then placed on the shaft 7 and the diamond point D and its holder 87 are manipulated as described in connection with Figure 8 to form the grinding wheel surface 108. Thereafter, the point D and its holder 87 are manipulated as explained in connection with Figure 10 to form the grinding wheel surface 109. The grinding wheel surfaces 108 and 109 intersect at 110 and define a circle which is tangential to the line CL. The bracket 40 is then rotated to the right as viewed in Figure 2 to its second position shown in dotted lines. This places the line of intersection 29 of the surface 19 with the die surface 27 along the center line CL. The die holder arm 49 is then rotated to place the upper portion of the surface 19 as viewed in Figure 17 in a horizontal plane. Upon movement of the carriage 3 to the right, the grinding surface 109 will grind the surface 19 along the line 29 and the grinding wheel surface 108 will grind the die surface 27, and the circle at 110 defined by the intersection of the surfaces 108 and 109 will move over the line 29. This operation completes the whisker chute at the top of the die as viewed in Figure 17. In addition, this operation completes the upper half of the wire severing edge 17 as viewed in Figure 17 and the formation of the point cutting edge 25.

From the foregoing, it will be apparent that the apparatus of this invention is effective to dress the different grinding wheels G required for the fabrication of a nail cutting die and that its mounting on the traverse carriage 3 facilitates accurate dressing of the grinding wheels G with respect to the common line CL. The holder 4, with particular reference to the manner in which it mounts the die with the point 21 on the line CL and provides for universal movement of the die about this point through its rotation about the vertical and horizontal axes V and H, enables holding of the die in proper position with the die surfaces lying in planes tangential to the peripheral grinding surfaces on the grinding wheels G. In this respect, attention is particularly directed to the fact that the position of the die in the holder 4 is adjusted in such manner that the line of intersection between the surfaces being ground is positioned on the line CL during traversing movement of the carriage 3 to move the die into grinding engagement with the grinding wheel. For example, when the wheel G1 is used to grind the diamond-shaped groove 20, the line of intersection between the surfaces 22 and 23 is positioned on the line CL with the said die surfaces 22 and 23 in planes which are tangential to the peripheral surfaces 102 and 103 on the grinding wheel G1. In a similar manner, when the grinding wheel G3 is used to form the surfaces 26 and 19, the line of intersection 28 between such surfaces is positioned on the line CL and with the die surfaces 26 and 19 lying respectively in planes tangential to the grinding wheel surfaces 105 and 106. Similar operations are performed by the remaining grinding wheels and in such manner that each grinding wheel is effective to grind a pair of die surfaces respectively lying on opposite sides of the line CL which of course passes through the center die point 21.

The above describes the various operations required to produce the die surfaces on an end 11 of a single die 10. However, it will be appreciated that each grinding operation may be applied to a plurality of dies before the next grinding operation is undertaken. In such case, the same grinding operation would be applied to all of the dies before dressing and mounting of the grinding wheel G required for the next operation. The accurate mounting of the dies 10 in the holder 4 enables their emplacement in a properly centered position for subsequent grinding operations.

It is preferred that the dressing fixture 5 be mounted on the carriage 3 with the holder 4 since this facilitates accurate dressing of the grinding wheels G with respect to the common line CL. However, and respecting the actual grinding operation, it will be understood that the invention includes the use of wheels G which have been dressed by an apparatus which is not mounted on the carriage 3.

The foregoing describes the grinding wheels G and the surfaces thereon required for the fabrication of a die for cutting nails with a diamond point 14. By changing of the angular relation and size of the grinding surfaces, nail cutting dies for diamond nail points of different sizes and degrees may be formed. However, it will be understood that the principles of this invention are not limited to the fabrication of dies for cutting diamond points and that such principles are applicable equally well to

the fabrication of nail cutting dies for other nail points such as needle points and duck bill points.

It will be recalled that the method and apparatus of this invention is particularly adapted to the formation of nail cutting dies in which the cutting and shaping surfaces are formed on a tungsten carbide insert. In this respect, the body bounded by the lines **31** in Figures 13 and 14 represents a tungsten carbide insert, the remaining portion of the die being formed of tool steel. While, in this showing, the die cutting edges and surfaces extend beyond the boundary of the insert and into the body of the surrounding tool steel, it will be understood that the tool steel outwardly of the insert defined by the lines **31** may be recessed so that the die cutting edges and surfaces ground thereon will be located entirely on the tungsten carbide insert. By such recessing the body of the die, an advantage is obtained with respect to grinding wheel operation since the grinding surfaces thereon will not become clogged or covered with the softer particles of tool steel in which the insert is held.

While one embodiment of my invention has been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. A method of grinding nail cutting dies to form thereon die-surfaces arranged in a plurality of angularly inclined pairs respectively having a common line of intersection therebetween and with the lines of intersection formed by said surfaces converging on a common point which comprises mounting a die to be ground on a carriage supported for movement along a rectilinear path so that said point traverses a line parallel to said path upon movement of the carriage, shaping the periphery of a grinding wheel in axial directions with respect to a circle positioned centrally of its periphery to provide a pair of grinding surfaces diverging from said circle at an angle relative to each other corresponding to the angular inclination of the pair of die-surfaces to be ground thereby, rotating said grinding wheel about an axis extending transversely of said rectilinear path of carriage movement and with said circle tangential to said parallel line, adjusting the position of the die on said carriage so that the common line of intersection between the said last mentioned pair of die-surfaces to be ground by said grinding surfaces falls on said parallel line, and moving the carriage along said rectilinear path to move the die thereon into grinding engagement with said wheel to form said last mentioned pair of die-surfaces and their common line of intersection.

2. An apparatus for grinding nail cutting dies having wire cutting edges and shaping surfaces which intersect at a common point comprising a grinder having a carriage mounted for traversing movement along a rectilinear path, a grinding wheel having a peripheral grinding surface and an axis of rotation positioned above and extending in a direction transversely of said path of carriage movement, a holder for a die to be ground, means mounting said holder on said carriage for movement therewith including means for rotatably adjusting its position about horizontal and vertical axes which intersect with each other on a line tangential to said peripheral grinding surface, and means providing an opening extending transversely of said horizontal axis for receiving and mounting a die on said holder with its said common point positioned at the intersection of said axes.

3. An apparatus for grinding nail cutting dies having wire cutting edges and shaping surfaces which intersect at a common point comprising a grinder having a carriage mounted for traversing movement along a rectilinear path, a grinding wheel having a peripheral grinding surface and an axis of rotation positioned above and extending in a direction transversely of said path of carriage movement, a bracket mounted on said carriage for movement therewith and for rotational movement about a first axis

normal to said path, a die-holder mounted on said bracket for rotational movement about a second axis parallel to said path, said first and second axes having an intersection in all rotational positions of said bracket which traverses a line parallel to said path and tangential to said peripheral grinding surface upon traversing movement of said carriage, and means providing an opening extending transversely of said horizontal axis for receiving and mounting a die on said holder with its said common point positioned at the said intersection of said first and second axes.

4. The invention defined in claim 3 characterized by said peripheral grinding wheel surface having portions on opposite sides of said parallel line which bear an angular relation relative to each other corresponding to the angular relation of the die-surfaces to be ground thereby, and said bracket and die-holder being adjusted to positions in which the said die-surfaces to be ground are arranged in planes respectively tangential to said grinding wheel portions.

5. The invention defined in claim 4 characterized further by said grinding surface portions being inclined in an axial direction relative to each other and defining a circle along their line of intersection which is tangential to said parallel line, and said bracket and die-holder being adjusted to positions in which the line of intersection of the surfaces to be ground by said grinding wheel portions falls on said parallel line.

6. An apparatus for grinding nail cutting dies having wire cutting edges and shaping surfaces which intersect at a common point comprising a grinder having a carriage mounted for traversing movement along a rectilinear path, a grinding wheel having a peripheral grinding surface and an axis of rotation positioned above and extending in a direction transversely of said path of carriage movement, a holder for a die to be ground, means mounting said holder on said carriage for movement therewith including means for rotatably adjusting its position about horizontal and vertical axes which intersect with each other on a line parallel to said path and tangential to said peripheral grinding surface, means for mounting a die on said holder with its said common point positioned at the intersection of said axes, and a grinding wheel dressing fixture mounted on said carriage including a tool for dressing engagement with said peripheral grinding surface, and means mounting said tool for traversing movement over a path which is normal to said parallel line at its point of tangency with said peripheral surface.

7. An apparatus as defined in claim 6 characterized by the provision of means for adjusting the angular position of said tool traversing path relative to said parallel line.

8. An apparatus as claimed in claim 6 characterized by said tool mounting means comprising a head mounted for rotation about said line, a holder for said tool mounted on said head for movement back and forth over a diameter thereof and which when in a centered position relative thereto mounts the tool in dressing engagement with said peripheral surface at its point of tangency with said line, and means for rotating said head to adjust its angular position relative to said carriage.

9. An apparatus for grinding nail cutting dies having wire cutting edges and shaping surfaces which intersect at a common point comprising a grinder having a carriage mounted for traversing movement along a rectilinear path, a grinding wheel having a peripheral grinding surface and an axis of rotation positioned above and extending in a direction normal to said traverse path of carriage movement, a die-holder mounted on said carriage for movement therewith including means for supporting a die to be ground with its said common point located along a line parallel to said path and tangential to said peripheral grinding surface, a grinding wheel dressing fixture on said carriage and including a head rotatable to selected angular positions about said parallel line as an axis, a

dressing tool mounted for traversing movement along a diameter of said head and which when centered on said diameter engages with said peripheral grinding surface at its point of tangency with said parallel line, and means for adjusting the position of the die on said holder about vertical and horizontal axes which intersect with said parallel line at a point coinciding with the said common point on said die.

10. In an apparatus for grinding nail cutting dies, the combination with a grinding machine having a carriage mounted for traversing movement along a rectilinear path and a grinding wheel mounted for rotation about an axis extending transversely of said path, of a support for holding a die with a selected point on its end in a predetermined position relative thereto, and means mounting said support on said carriage for movement therewith and in a position such that said point traverses a line parallel to said path and tangential to the periphery of said grinding wheel, said mounting means including means for moving said support relatively to said carriage to adjust the position of a die held thereby universally about said point.

11. The invention defined in claim 10 characterized by said last mentioned means comprising means mounting said support for independent rotation about a pair of axes normal to each other and intersecting at said point, one

of said axes being normal to said rectilinear path of carriage movement.

12. The invention defined in claim 10 characterized by said mounting means comprising a bracket connected with said carriage for movement therewith and for rotation about a first axis normal to said path and passing through said selected point, and said die holder being supported in said bracket for rotation about a second axis normal to and intersecting with said first axis at said common point.

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