June 12, 1956 J. S. MacKINNON ET AL 2,749,981

MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

Filed July 16, 1954 11 Sheets-Sheet 1

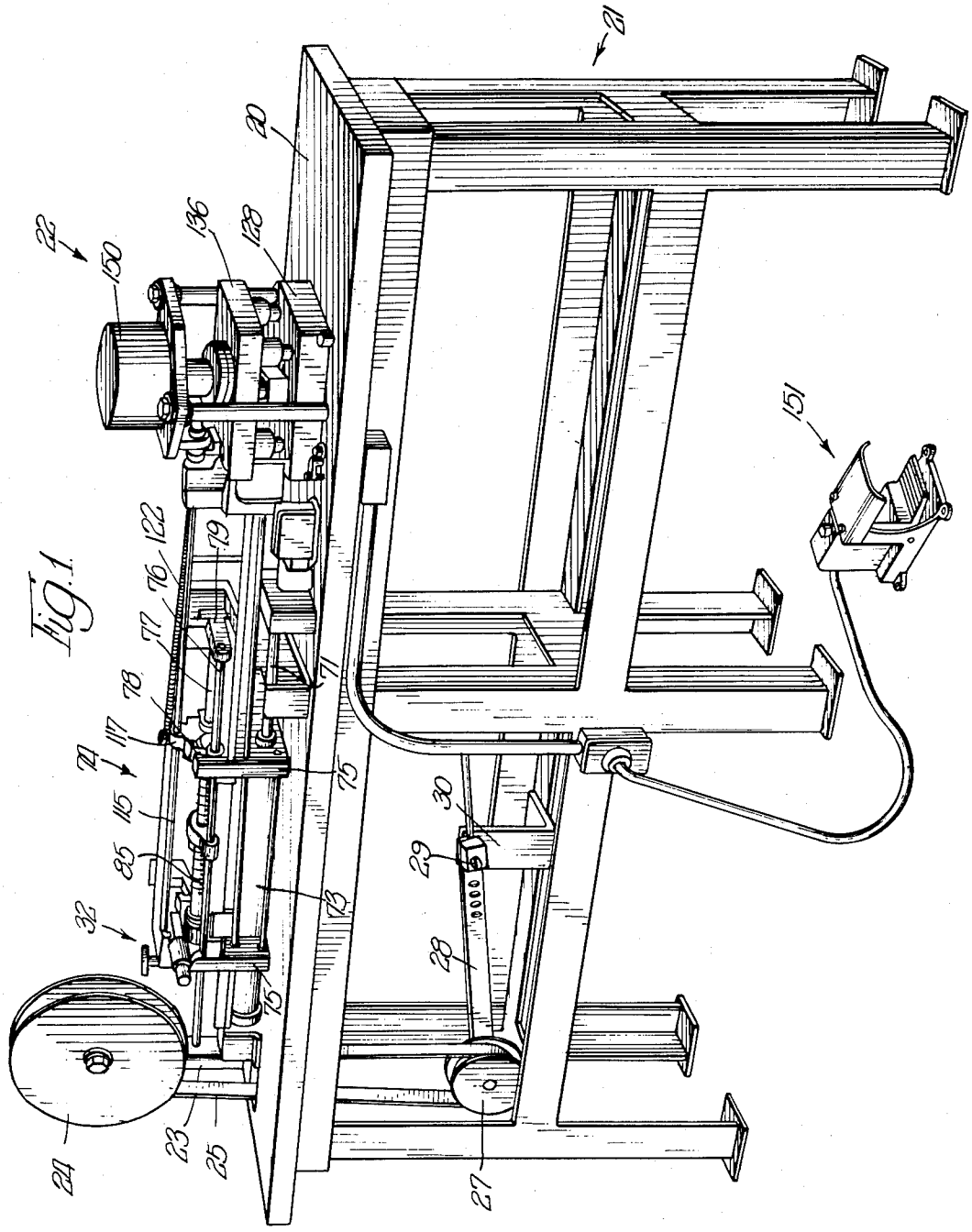


Fig. 1.

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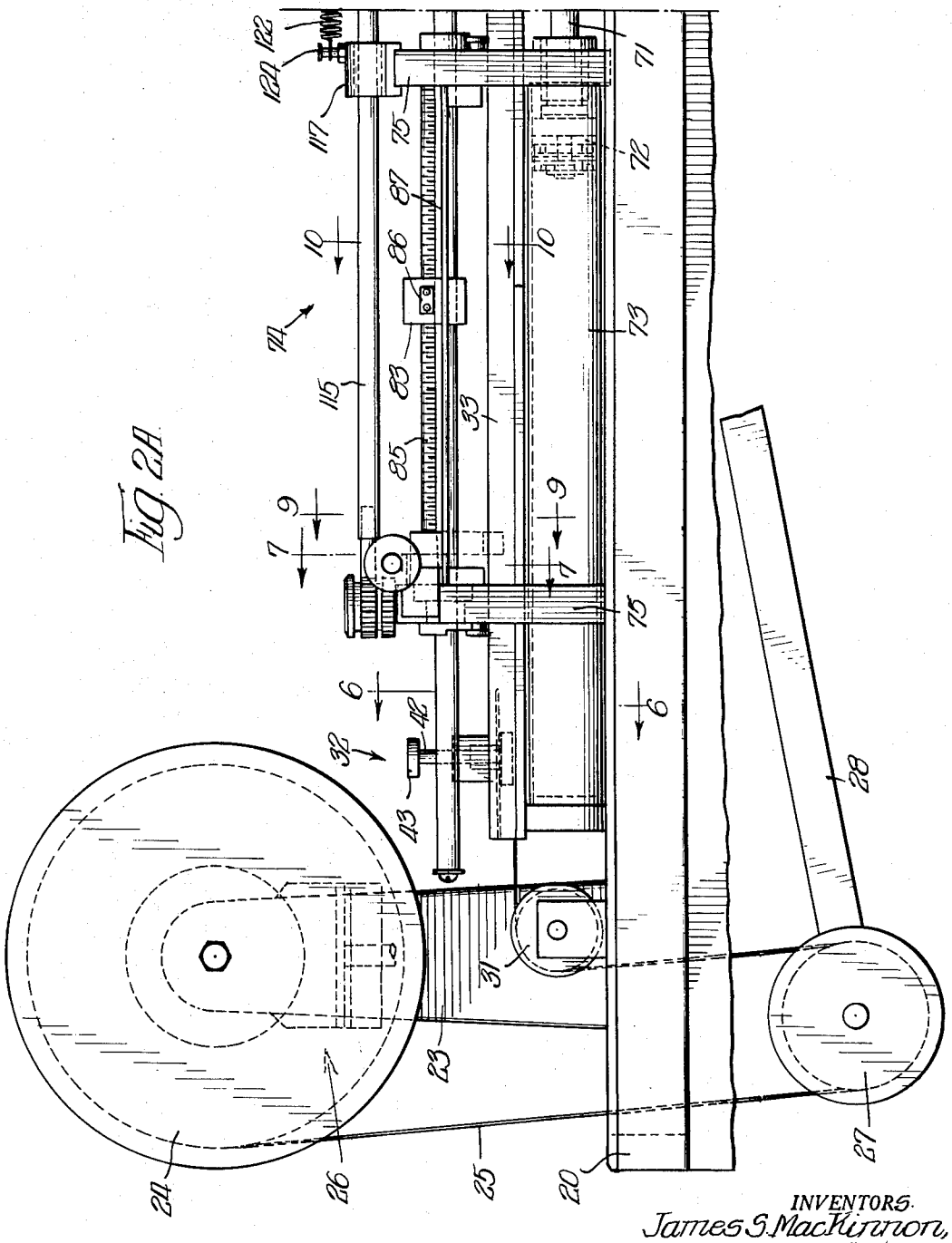


Fig. 2A

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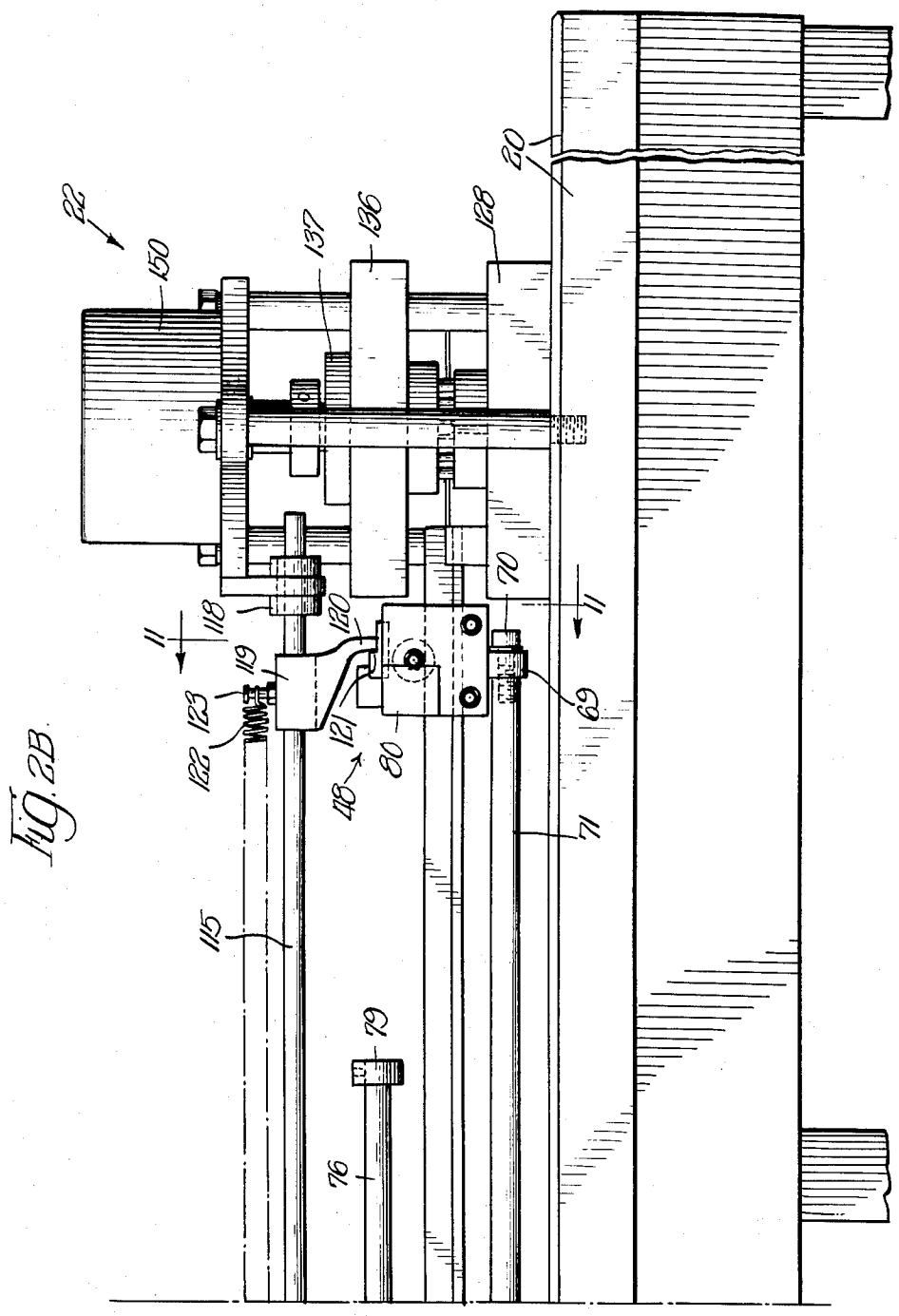


Fig. 2B

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MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

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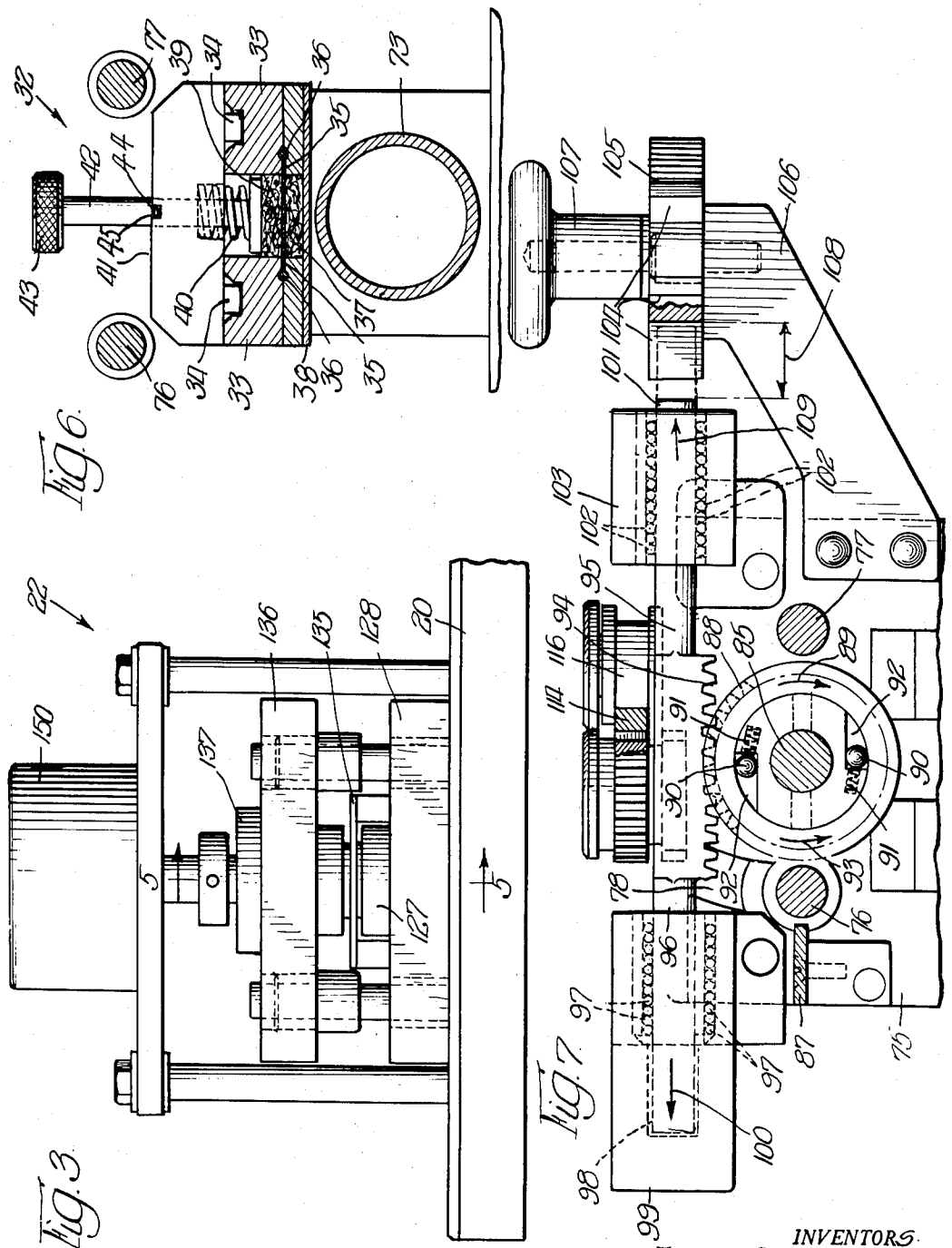


Fig. 6.

Fig. 3.

Fig. 7.

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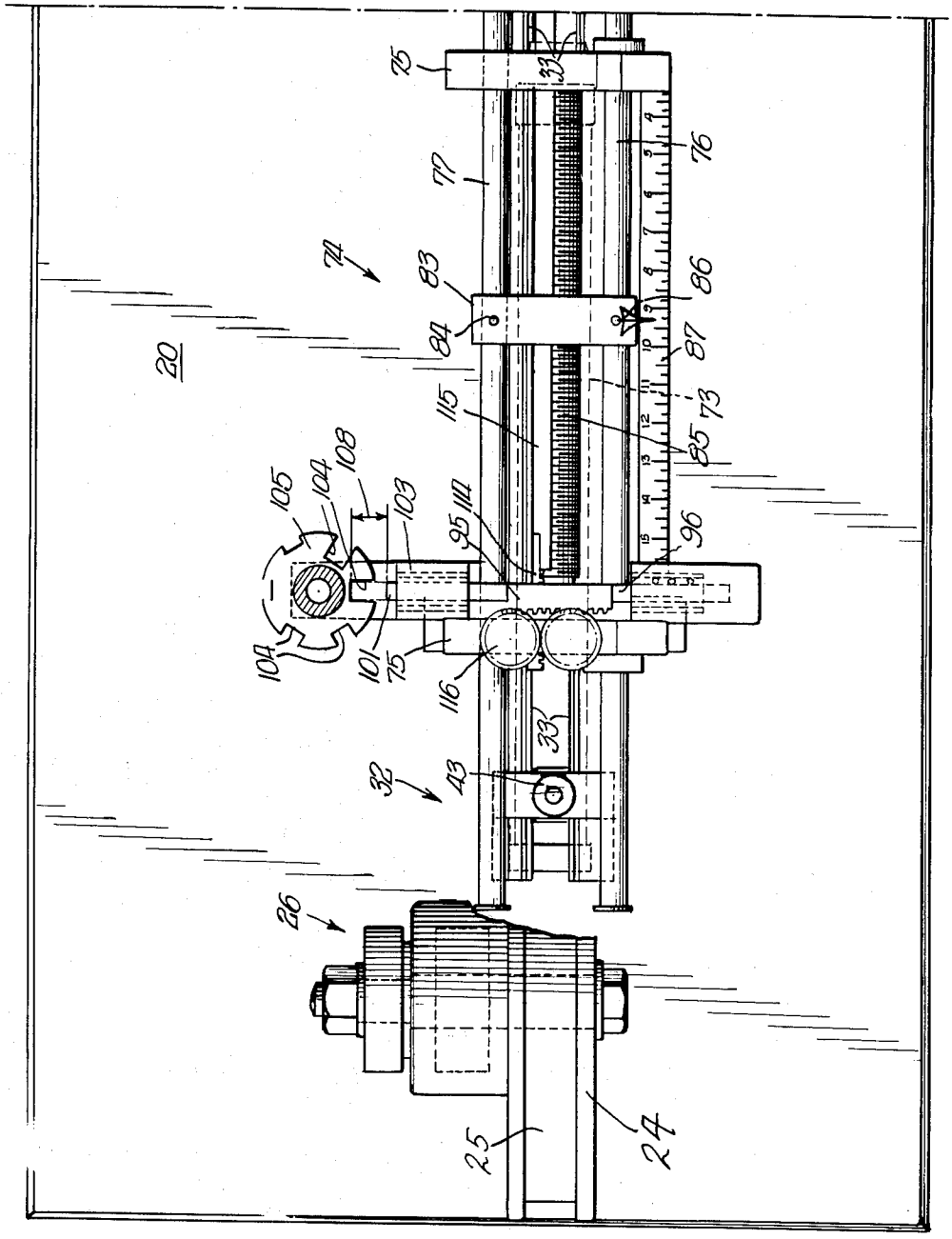


Fig. 4A

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Filed July 16, 1954

11 Sheets-Sheet 6

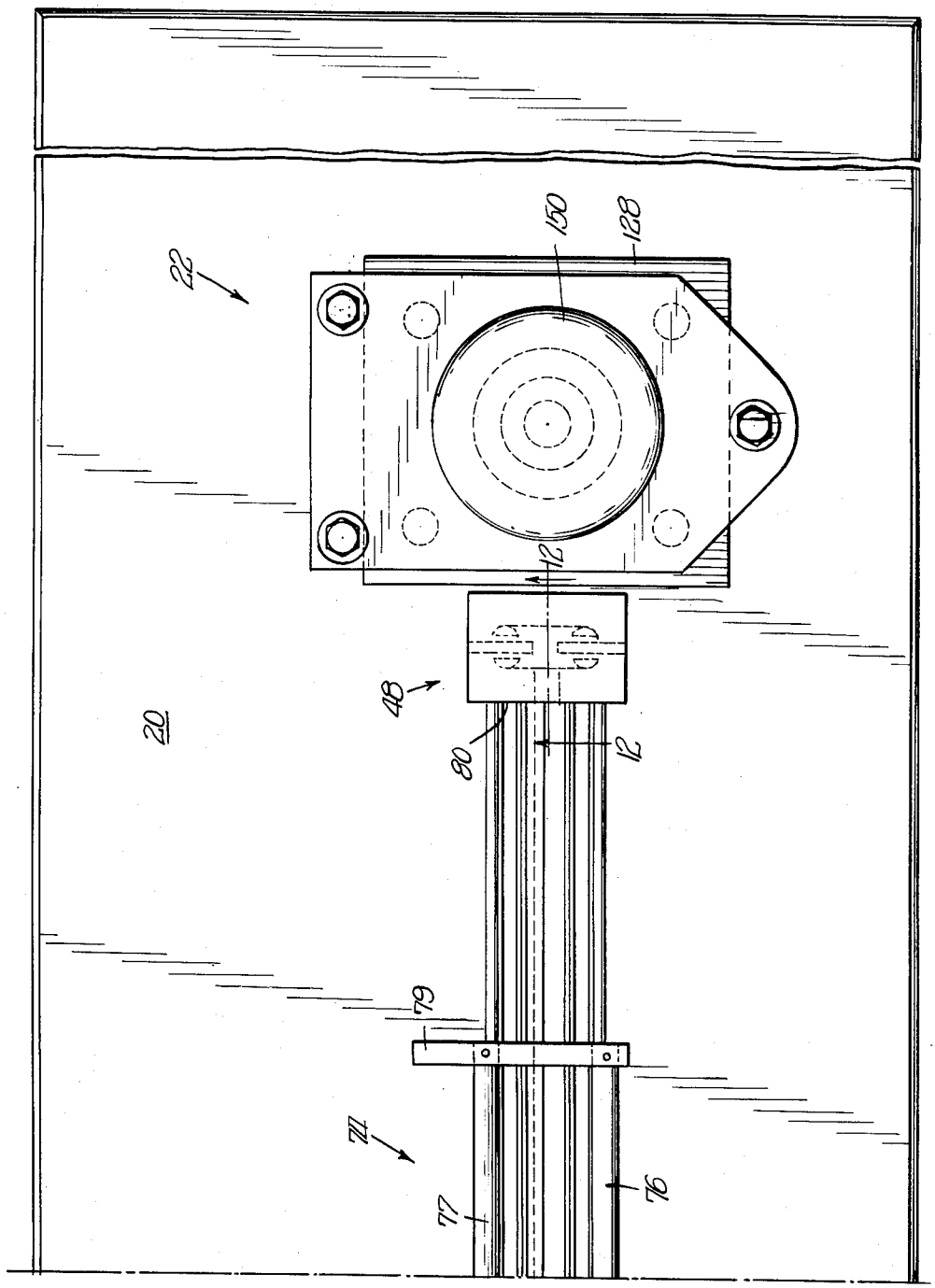


Fig. 4B.

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MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

Filed July 16, 1954 11 Sheets-Sheet 7

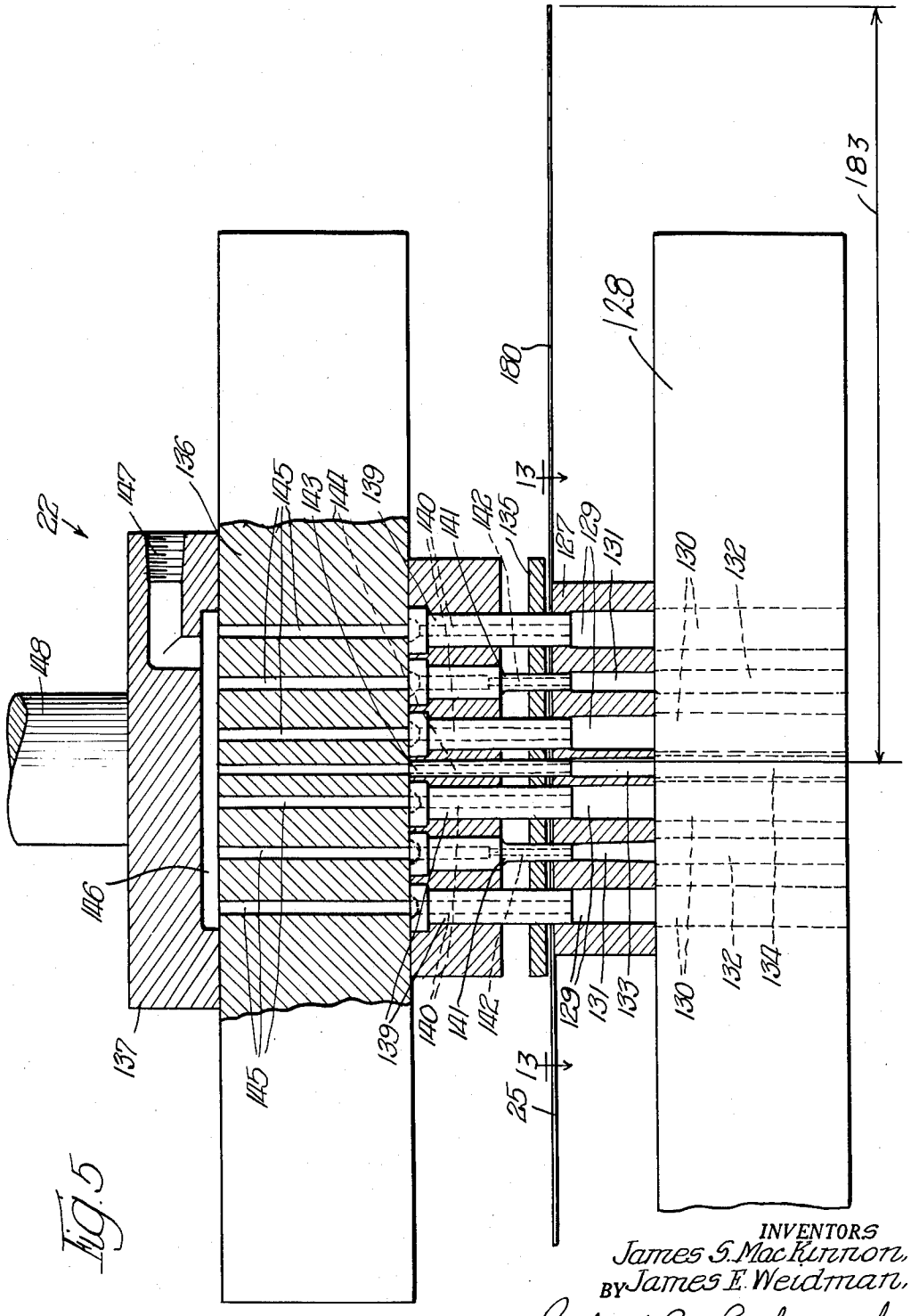


Fig. 5

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MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

Filed July 16, 1954 11 Sheets-Sheet 8

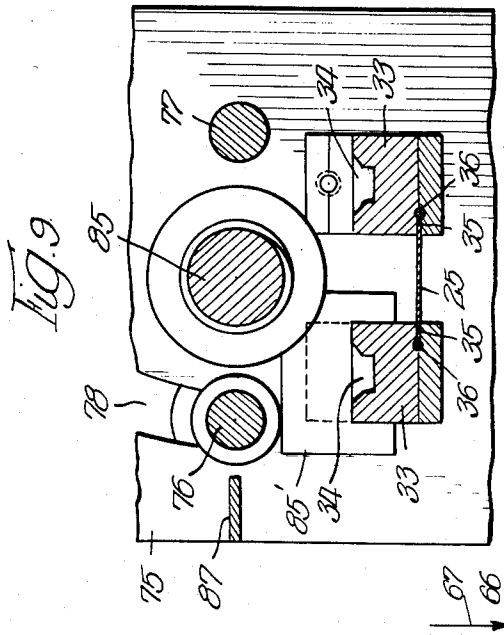


Fig. 9

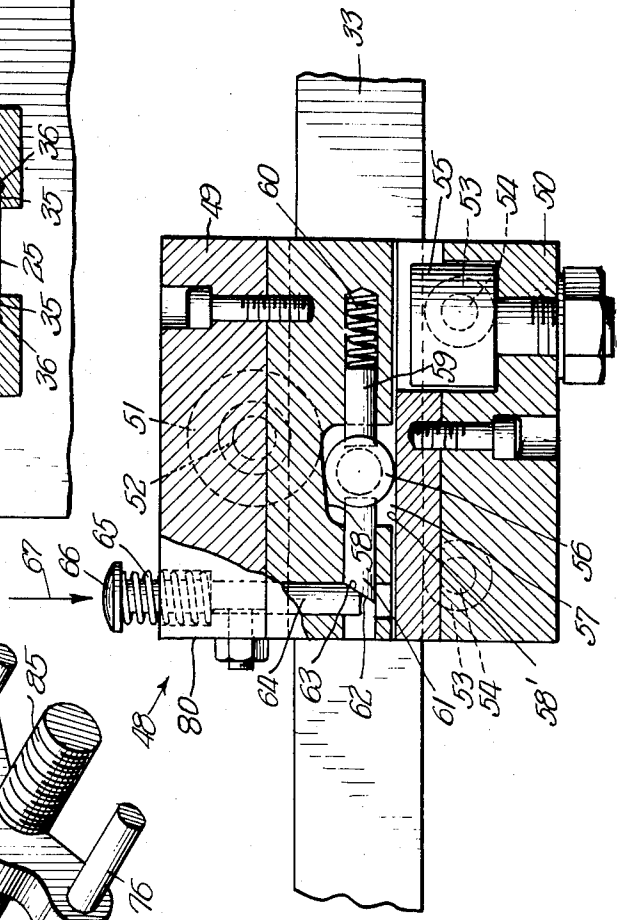


Fig. 12.

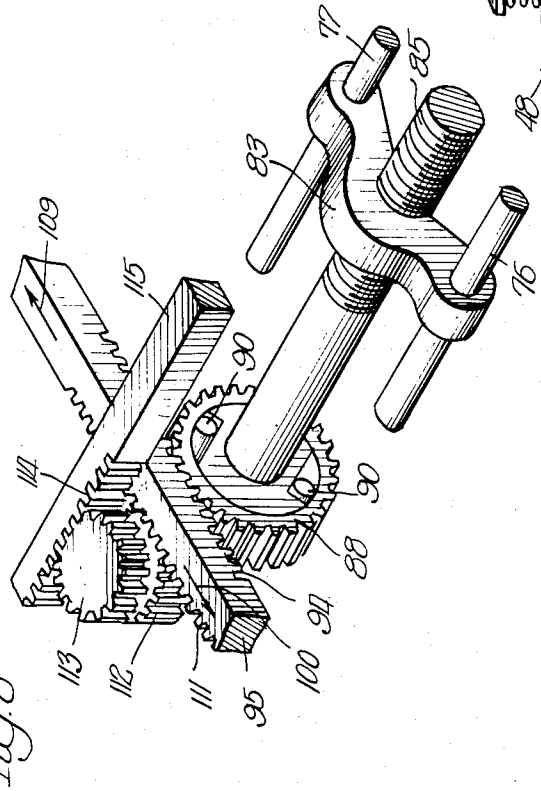


Fig. 8

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Filed July 16, 1954 11 Sheets-Sheet 9

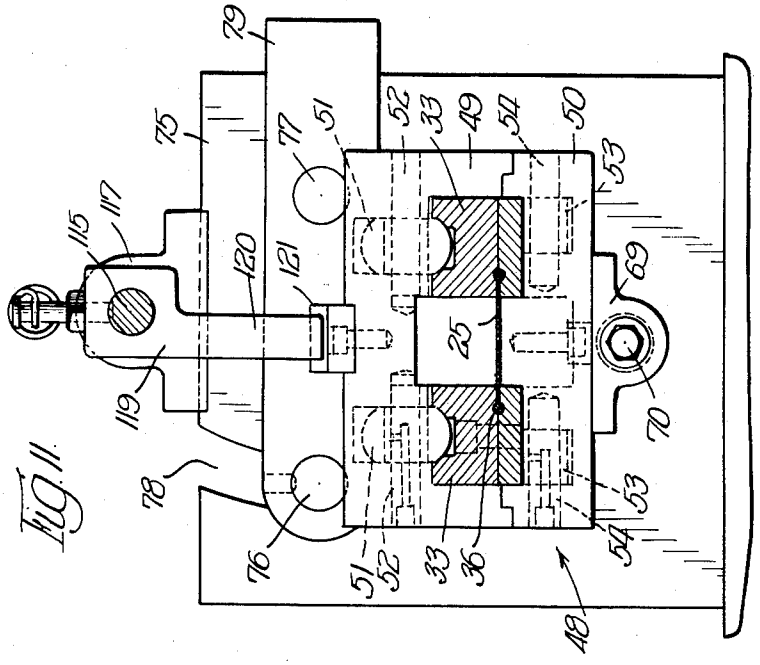


Fig. 11.

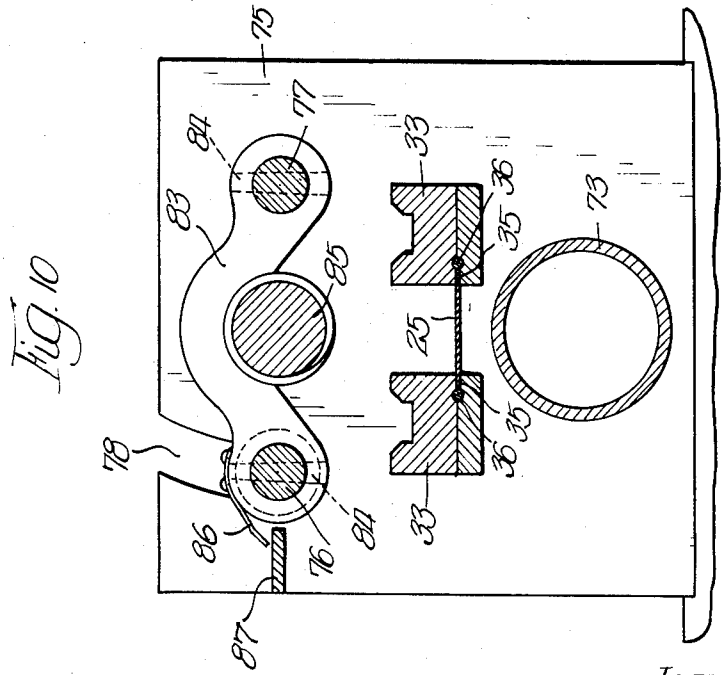


Fig. 10

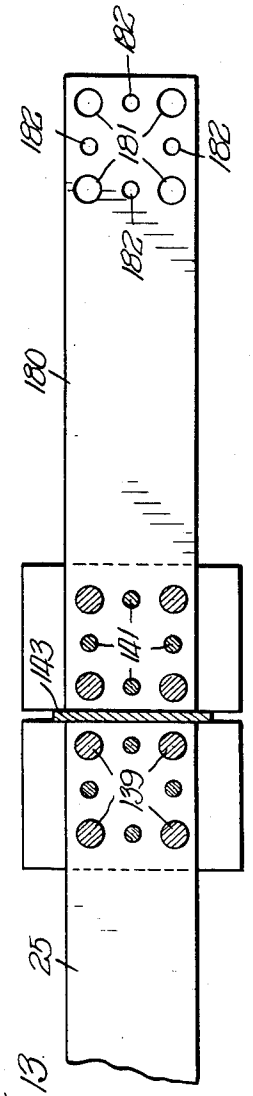


Fig. 13

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MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

Filed July 16, 1954 11 Sheets-Sheet 10

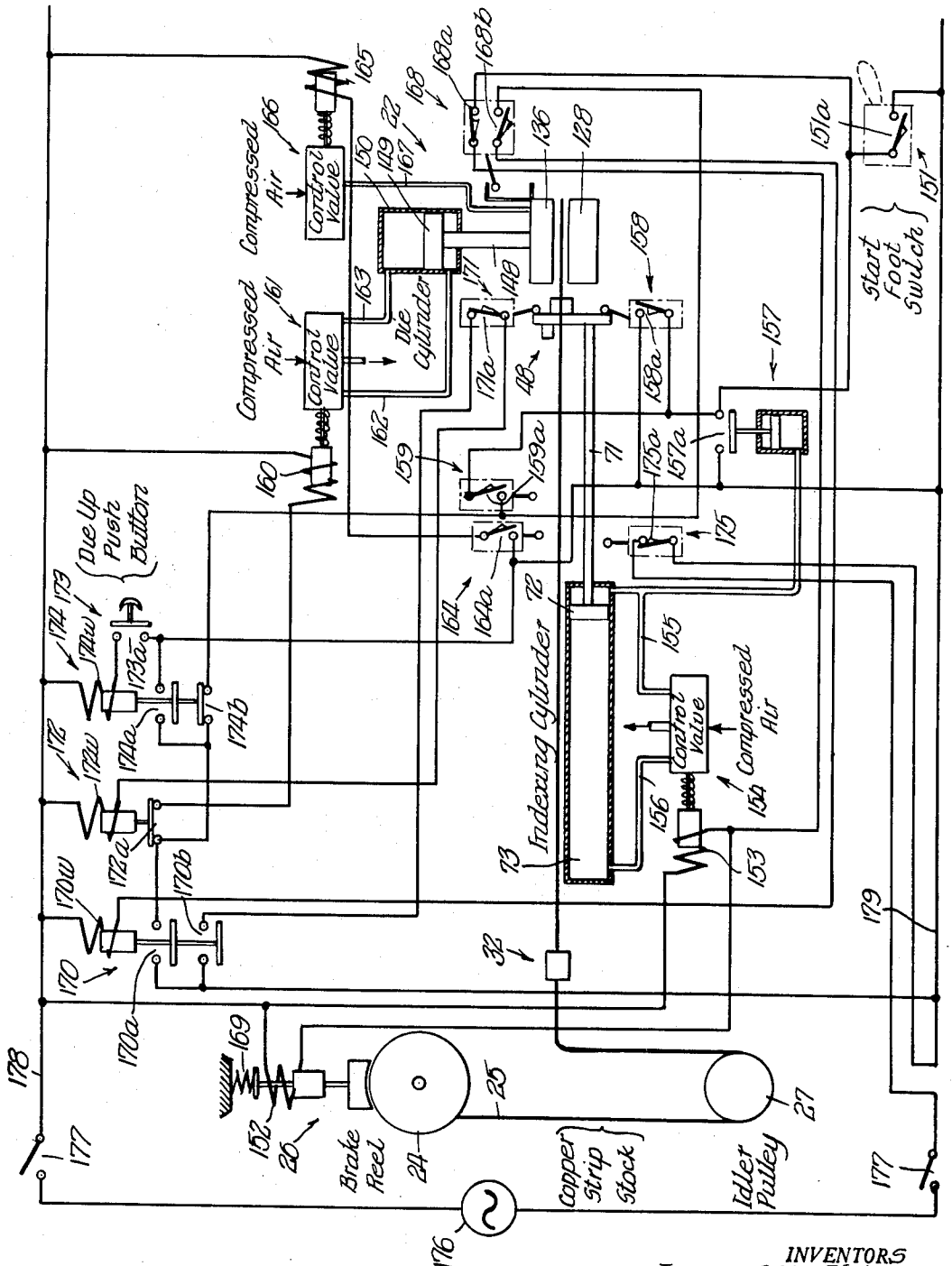


Fig. 11

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MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

Filed July 16, 1954 11 Sheets-Sheet 11

Fig. 15

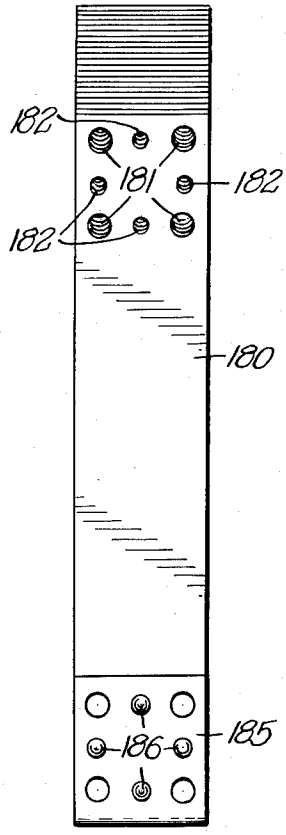


Fig. 17

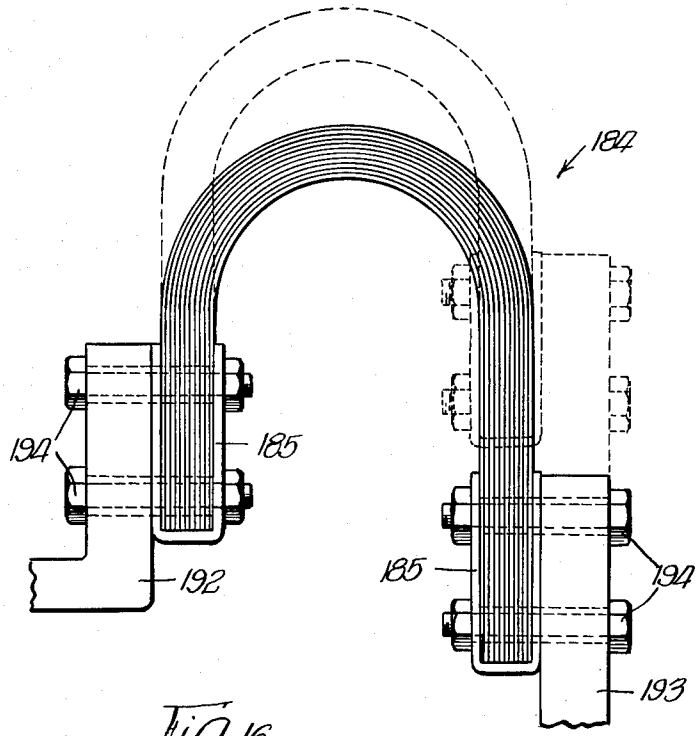
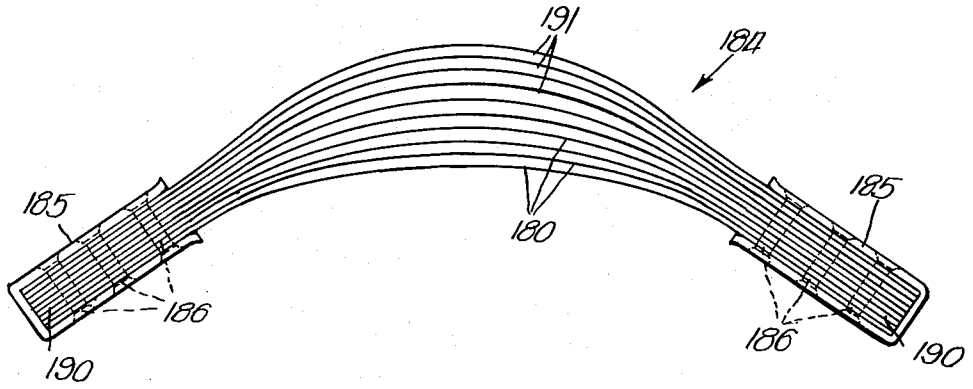


Fig. 16



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United States Patent Office 2,749,981 Patented June 12, 1956

2,749,981

MACHINE FOR AUTOMATICALLY CUTTING OFF STRIPS OF UNIFORMLY INCREASING LENGTHS FROM STRIP STOCK OF INDEFINITE LENGTH

James S. MacKinnon, Detroit, and James E. Weidman, Royal Oak, Mich., assignors, by mesne assignments, to William H. Martin, Grosse Pointe, Mich.

Application July 16, 1954, Serial No. 443,856

19 Claims. (Cl. 164—12)

This invention relates, generally, to the construction of automatically operating machines and it had particular relation to such machines particularly adapted for cutting off and perforating the ends of metallic strips or leaves to be assembled for making shunts as described in application Serial No. 436,565, filed June 14, 1954.

As described in the application referred to, shunts for carrying several thousands of amperes between relatively movable conductors are fabricated using a large number, for example seventy-five, of strips or leaves of relatively thin sheet copper with each succeeding strip or leaf being slightly longer than the preceding one. This arrangement is employed in order to fashion the shunt in a U-shape and have the ends of the strips or leaves in coplanar relation at right angles to the length of the respective arm or branch of the U-shape. Two sets of openings are provided at each end of each strip or leaf, one set to receive rivets for holding the surfaces of the end portions in flatwise engagement to function as a conductor of solid cross-section, and the other set to receive bolts for clamping the ends of the shunt to the respective conductors.

Among the objects of this invention are: To provide for automatically cutting off strips of uniformly increasing lengths from strip stock of indefinite lengths; to perforate the ends of the strip stock on opposite sides of the cut; to feed strip stock to a die punch in successively increased lengths; to change the length of feed for the next strip as result of completion of the feed for the preceding strip; to vary the increment in length of the feeding stroke; to remove the strip stock from a reel in a stepwise fashion; to prevent reverse movement of the strip stock after it has been unwound from the reel and to clean the surface thereof; to initiate the cutting and perforating actions only after the strip stock has been fed in increased lengths to the die punch; and to initiate the feeding action of the strip stock only after the die punch has been opened.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof as shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention reference can be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a perspective view of an automatic machine incorporating the features of this invention;

Figures 2A and 2B, taken together, show a side elevation of the table and the machine mounted thereon;

Figure 3 is a view, in end elevation, of the mechanism shown in Figures 2A and 2B;

Figures 4A and 4B, taken together, show a top plan

view of the machine illustrated in Figures 2A and 2B;

Figure 5 is a view, partly in side elevation and partly in section, taken generally along the line 5—5 of Figure 3;

Figure 6 is a detailed sectional view, at an enlarged scale, taken generally along the line 6—6 of Figure 2A;

Figure 7 is a detailed view, at an enlarged scale, taken generally along the line 7—7 of Figure 2A;

Figure 8 is a perspective view, at an enlarged scale, of a portion of the stroke gauge means;

Figure 9 is a detailed sectional view, at an enlarged scale, taken generally along the line 9—9 of Figure 2A;

Figure 10 is a sectional view, at an enlarged scale, taken generally along the line 10—10 of Figure 2A;

Figure 11 is a detailed sectional view, at an enlarged scale, taken generally along the line 11—11 of Figure 2B;

Figure 12 is a detailed sectional view, at an enlarged scale, taken generally along the line 12—12 of Figure 4B;

Figure 13 is a horizontal sectional view taken generally along the line 13—13 of Figure 5 showing the perforations in one end of one leaf and how the perforations are made in the other end of the leaf and in the end of the strip which has not, as yet, been severed by the cut-off punch;

Figure 14 illustrates diagrammatically the pneumatic and electrical circuits that can be employed in practicing this invention;

Figure 15 shows a shunt in partially assembled condition;

Figure 16 is a view in side elevation of an assembled shunt and showing only a few of the large number of strips or leaves actually used to make up the same; and

Figure 17 is a view, in side elevation, of a completed shunt connected between stationary and movable conductors and showing how the same is employed for flexibly interconnecting them while providing for the conduction of a large amount of current therebetween.

Referring now particularly to Figures 1, 2A–2B, 3 and 4A–4B of the drawings, it will be observed that the reference character **20** designates a table which, for illustrative purposes, it is pointed out may be 6′ long and 2′ wide. Where particular dimensions, as here, are referred to it will be understood that the references are for illustrative purposes only and that other dimensions can be employed without departing from the spirit and scope of this invention. The table **20** is mounted on a suitable support frame, shown generally at **21**, so that the table **20** can be at convenient height for a workman. At the right hand end of the table **20**, as viewed in most of these figures, there is a die punch, shown generally at **22**, which is arranged to be operated by compressed air in a manner to be described hereinafter. At the other end of the table **20** there is an upstanding support **23** on which a reel **24** is rotatably mounted. The reel **24** is arranged to have copper strip stock **25** of indefinite length wound thereon. The copper strip stock may have a thickness of .005 inch and a width of 1⅜ inches for the manufacture of a particular line of shunts. Other thicknesses and widths of material can be used for making shunts of different current carrying capacities.

The copper strip stock is arranged to be withdrawn from the reel **24** in a stepwise fashion. An electromagnetically operated brake mechanism **26** is arranged to control the rotation of the reel **24** in a manner to be described. The copper strip stock **25** as withdrawn from the reel **24** extends over an idler pulley **27** which is carried at the outer end of an arm **28** that is pivotally mounted at **29** on a bracket **30** which is carried by the support frame **21** as shown in Figure 1. The weight of the idler pulley **27** and arm **28** is such as to withdraw the copper strip stock **25** from the reel **24** when the brake mechanism **26** is released.

The copper strip stock 25 after it passes the idler pulley 27 extends around a guide pulley 31 and then passes through pressure pad means, shown generally at 32 in Figure 6 of the drawings, located between a pair of parallel spaced stock feed ways 33 having top grooves 34 for a purpose to be described presently and guide grooves 35 for receiving the edges of the strip stock 25. Hard drill rods 36 extend along the inner edges of the guide grooves 35 to reduce wear.

The pressure pad means 32, Figure 6, performs a dual purpose. It acts to prevent reverse movement of the copper strip stock 25 so that, when the brake mechanism 26 is released, the weight of the idler pulley 27 and arm 28 is sufficient to unreel another length of the stock 25. Also it serves to clean and polish the upper and lower surfaces of the strip stock 25. The pressure pad means 32 includes a lower pressure pad 37 which is felt covered and is carried by a cross member 38 underneath the stock feed ways 33. Above the lower pressure pad 37 and arranged to engage the upper surface of the strip stock 25 is a felt covered plunger 39 which is urged downwardly against the strip stock 25 by a coil compression spring 40. It will be observed that the spring 40 reacts between the upper side of the felt covered plunger 39 and the underside of an abutment 41. The spring 40 is positioned around a rod 42 the lower end of which is secured to the plunger 39. A knob 43 at the upper end of the rod 42 facilitates lifting of the same to permit the threading of the strip stock 25 between the lower pressure pad 37 and the plunger 39. In order to hold the rod 42 and the plunger 39 in the upper position a pin 44 extends transversely of the rod 42 and interfits with a slot 45. In the position shown in Figure 6, the spring 40 urges the plunger 39 into engagement with the upper side of the strip stock 25. When the rod 42 is withdrawn and turned through approximately 90°, the pin 44 rides on the upper surface of the abutment 41 and holds the plunger 39 in spaced relation to the lower pressure pad 37.

It will be understood that the copper strip 25 extends the full length of the stock feed ways 33 and its edges are located in the guide grooves 35. In order to move the strip stock 25 thus positioned to the die punch 22 a stock pusher head, shown generally at 48, in Figures 11 and 12 is employed. Provision is made for reciprocating the stock pusher head 48 and it is arranged to grip the strip stock 25 when it moves toward the die punch 22 and to release the strip stock and move freely with respect thereto when it is withdrawn from the die punch 22.

The stock pusher head 48 includes upper and lower blocks 49 and 50 that are suitably secured together so that they operate as a unit. They are apertured to receive therethrough the stock feed ways 33 and are arranged to be reciprocated therealong and to be guided accurately with respect thereto. For this purpose a pair of spherical rollers 51 are mounted on pins 52 in the upper block 49 and they are arranged to roll along top grooves 34 in the stock feed ways 33. The lower block 50 is provided with two pairs of rollers 53 that are mounted on pins 54. The rollers 53 are arranged to engage the undersides of the stock feed ways 33 and cooperate with the spherical rollers 51 in guiding the stock pusher head 48 along the stock feed ways 33. A cam follower 55, carried by the lower block 50, is positioned between the stock feed ways 33 and acts to prevent lateral movement of the stock pusher head 48.

With a view to gripping the strip stock 25 when the stock pusher head 48 is moved forwardly toward the die punch a roller 56 is transversely mounted within a cavity 57 in the upper block 49. The cavity 57 has an inclined surface 58 which cooperates with the roller 56 when the stock pusher head 48 is moved forwardly to grip the strip stock 25 between the under side of the roller 56 and a flat upper surface 58' on the lower block 50. In order to insure that the strip stock 25 is gripped between the roller 56 and the surface 58' at the instant that the stock pusher head 48 starts to move forwardly there is provided a plunger 59 biased by a spring 60 which urges the roller 56 into engagement with the inclined surface 58. While the stock pusher head 48 is being moved rearwardly, the roller 56 moves upwardly along the inclined surface 58 and compresses the spring 60 so that the net result is that the strip stock 25 is not gripped while the stock pusher head 48 is being moved rearwardly.

In order to facilitate threading of the strip stock 25 through the stock pusher head 48 there is provided a plunger 61 on the opposite side of the roller 56 from the plunger 59 and it has an inclined face 62 that cooperates with an inclined face 63 on the lower end of a vertical plunger 64 which is biased upwardly by a coil compression spring 65. At the upper end of the vertical plunger 64 there is a button head 66 which can be depressed in the direction indicated by the arrow 67 for effecting movement of the plunger 61 to operate the roller 56 along the inclined surface 58 against the biasing action of the spring 60 to permit the strip stock 25 to be inserted for initiating the operation of the machine. The spring 65 holds the vertical plunger 64 in the inoperative position.

On the underside of the lower block 50, as shown in Figure 11, there is provided a flange 69 which is secured by a bolt 70, Figures 2A–2B, to a connecting rod 71 at the other end of which is a piston 72 which is slidable in an indexing cylinder 73. The piston 72 and indexing cylinder 73 comprise variable stroke means for operating the stock pusher head 48 through different distances depending upon the distance that the stock pusher head 48 is permitted to be retracted in a manner to be described.

The extent that the stock pusher head 48 is permitted to be retracted is controlled by stroke gauge means shown generally at 74 in Figures 2A–2B and 4A–4B of the drawings. The stroke gauge means 74 includes a pair of support brackets 75 that are fixedly mounted on the table 20. It will be observed in Figure 2A that the indexing cylinder 73 terminates on one of the support brackets 75 and that it extends through the other support bracket. The stroke gauge means 74 also includes guide rods 76 and 77 which are movable endwise with respect to the support brackets 75. The guide rod 77 is rockably mounted in the support brackets 75, as shown more clearly in Figure 9, while the guide rod 76 is arranged to swing about the longitudinal axis of the guide rod 77 in slots 78 in the support bracket 75. At the forward ends of the guide rods 76 and 77 there is a stop plate 79, Figure 2B, which cooperates with an end surface 80 of the upper block 49 of the stock pusher head 48 to limit the extent that it is retracted by the piston 72 in the indexing cylinder 73. Provision is made for retracting the stop plate 79 in a stepwise fashion so as to increase the extent that the stock pusher head 48 is retracted for each successive stroke. For this purpose a half nut 83, Figures 8 and 10 of the drawings, extends between the guide rods 76 and 77 and its ends are secured thereto by tapered pins 84. The combination of the half nut 83 and the stop plate 79 with the guide rods 76 and 77 forms a rigid generally rectangular frame structure which is movable endwise through the support brackets 75. The half nut 83 is arranged to cooperate with a lead screw 85 and to be moved therealong on its rotation. A drag 85', Figure 9, cooperates with the lead screw 85 to prevent over travel thereof. It will be understood that the lead screw 85 is rotatable in the support brackets 75 and that it does not move along its longitudinal axis. Rather, on rotation of the lead screw 85, the half nut 83 is retracted together with the guide rods 76 and 77 and, as a result, the stop plate 79 is retracted through a corresponding extent. A pointer 86, Figure 10, is carried by the half nut 83 and it is arranged to move relative to a scale 87, Figure 4A,

to facilitate the initial setting up of the machine for operation.

The manner in which the lead screw **85** is rotated in a stepwise fashion will be clear from a consideration of Figures 7 and 8 of the drawings. It will be recalled that the lead screw **85** is rotatably mounted in the support brackets **75**. At the rear end of the lead screw **85** there is provided a pinion **88** which is freely rotatable in the direction indicated by the arrow **89**. In order to place the pinion **88** in driving connection with the lead screw **85** rollers **90** are biased by springs **91** in slots **92** into engagement with the inner surface of the pinion **88**. It will be understood that the rollers **90**, springs **91** and slots **92** provide a roller clutch connection between the pinion **88** and the lead screw **85**. When the pinion **88** is rotated in the direction indicated by the arrow **93**, the rollers **90** are picked out and wedge between the pinion **88** and the slots **92** with the result that the lead screw **85** is rotated through an extent determined by the extent that the pinion **88** rotates in the direction indicated by the arrow **93**.

Provision is made for rotating the pinion **88** through a predetermined arc for a given setting of the machine corresponding to the desired increment in length of the strip or leaf to be cut off, this being reflected by the distance that the stop plate **79** is retracted for each movement of the pinion **88**.

Provision is made for rotating the pinion **88** in the direction indicated by the arrow **93** during the last portion of the forward stroke of the stock pusher head **48**. This is accomplished through the agency of a rack **94** which engages the teeth of the pinion **88** and forms a part of a rack bar **95** that is movable transversely of and above the lead screw **85** as shown more clearly in Figure 7. One end **96** of the rack bar **95** is guided by rollers **97** in a socket **98** that is formed in a stop **99** carried by one of the support brackets **75**. The rack bar **95** is moved in the direction indicated by the arrow **100** during the last portion of the forward stroke of the stock pusher head **48** against the stop **99** and it is during this movement that the rack bar **95** is moved in the direction indicated by the arrow **100**. Since the stop **99** is fixed the forward movement of the stock pusher head **48** likewise is fixed and it always moves toward the die punch **22** to a predetermined position. The movement of the stock pusher head **48** away from the die punch **22** is increased for each stroke by the retraction of the stop plate **79** as a result of the stepwise rotation of the lead screw **85**.

The outer end **101** of the rack bar **95** is guided by rollers **102** in a guide **103** that is carried by the support bracket **75** on which the stop **99** is mounted. As shown more clearly in Figure 4A of the drawings the other end **101** of the rack bar **95** is arranged to interfit with a radial slot **104** which is one of several radial slots in an adjustable stop member or index mechanism gauge **105** that is rotatably mounted on an arm **106** that is carried by the support bracket **75** on which the stop **99** is mounted. An operating knob **107**, Figure 7, is attached to the adjustable stop member or means **105** for rotating it to present the desired radial slot for cooperation with the other end **101** of the rack bar **95**. It will be understood that the extent that the rack bar **95** is moved or its stroke indicated at **108** depends upon the depth of the particular slot that cooperates with this other end **101**. The rack bar **95** is moved in the direction indicated by the arrow **109** into the particular radial slot in registry therewith. By employing slots of different depths, different extents of movement **108** or strokes of the rack bar **95** are obtainable and corresponding differences result in the extent of rotation of the pinion **88** in both a forward and a reverse direction.

The rack bar **95** is moved in the directions indicated by the arrows **100** and **109**, Figure 8, by means of a rack **111** provided thereon which engages the teeth of a pinion **112** which is rotatable conjointly about a vertical axis with a pinion **113**. It will be understood that the pinions **112** and **113** are rotatably mounted on the support bracket **75** shown in Figure 7 of the drawings. Cooperating with the pinion **113** is a rack **114** located on one end of an indexing rod **115**. The rack **114** is held in engagement with the pinion **113** by means of a guide roller **116** which is rotatably mounted on the support bracket **75** shown in Figure 7. The indexing rod **115** extends above the support bracket **75** as shown in Figures 2A and 11 and is slidable in a bushing mount **117** intermediate its ends and slidably mounted at its forward end on a bushing mount **118** that is carried by the die punch **22**, Figure 2B. On the forward end of the indexing rod **115** there is rigidly mounted a trip **119** which has a depending pawl **120** that is arranged to engage shoulder **121** on the stock pusher head **48**. It is this engagement during the final forward stroke of the stock pusher **48** that is effective to rotate the pinion **88** in the direction indicated by the arrow **93**, Figure 7, the forward motion being arrested on engagement of the end **96** of the rack bar **95** with the stop **99**.

The indexing rod **115** is retrieved when the stock pusher head **48** is retracted by a coil tension spring **122**. It will be observed in Figures 2A and 2B of the drawings that the spring **122** is secured to a pin **123** on the trip **119** at one end and that its other end is secured to a pin **124** on the bushing mount **117**.

In Figure 5 of the drawings the details of construction of the die punch **22** are shown more clearly. The strip stock **25** is moved or fed by the stock pusher head **48** across a stationary die punch **127** that is mounted on a die plate **128** which is carried by the table **20**, Figure 1. The stationary die punch **127** is provided with eight large diameter openings **129** and directly therebelow eight large diameter openings **130** are provided in the die plate **128** through which the slugs punched from the strip stock **25** can be ejected. The stationary die punch **127** also is provided with eight small diameter openings **131** and eight corresponding small diameter openings **132** are provided in the die plate **128**. As will appear hereinafter the eight large diameter openings are provided for forming openings of corresponding size in the strip stock **25** for receiving clamping bolts while the eight small openings are provided for receiving rivets to hold the strips in the assembled shunt in aligned relation and in contact engagement with each other so as to function as a conductor of solid cross section. The stationary die punch **127** also is provided with a slotted opening **133** and a correspondingly shaped opening **134** is provided in the die plate **128**. This opening **133** is provided for receiving the slug which is punched from the strip stock **25** when a strip is cut off therefrom.

Immediately above the stationary die punch **127** is a stationary stripper plate **135** and above it is a movable guide block **136** which carries a head **137**. The guide block **136** and head **137** are arranged to be reciprocated vertically in a manner to be described.

Depending from the head **137** and movable therewith are eight large diameter punches **139** which are arranged to project through corresponding openings in the stripper plate **135** and to enter the corresponding large diameter openings **129** in the stationary die punch **127**. In so doing the punches **139** remove slugs from the strip stock **25** having diameters corresponding to the diameters of the punches. Air passageways **140** extend through the punches **139** so that air can be blown therethrough for removing slugs at the lower ends of the punches **139**. The head **137** also carries eight small diameter punches **141** which are provided with air passages **142**. It will be observed that the small diameter punches **141** are movable through the stripper plate **135** and into the small diameter openings **131** in the stationary die punch **127**. The small diameter punches **141** serve to remove corre-

spondingly sized slugs from the strip stock 25 and air blown through the passageways 142 acts to remove these slugs from the lower ends of the punch 141 and to blast them out through the openings 132 in the die plate 128.

Between the two sets of large diameter punches 129 and small diameter punches 141 is a rectangular cut off punch 143 that also is carried by the head 137 and has a passageway 144 therethrough. The rectangular cut off punch 143 is employed to sever a narrow portion of the strip stock 25 in order to facilitate a clean cut from the remainder of the strip stock. The passageway 144 is provided to permit the flow of air through the punch 143 for removing the slug cut off by the punch 143. The stripper plate 135 is provided with a rectangular opening to receive the punch 143. Likewise the stationary die punch 127 is provided with a slotted opening 133 for receiving this punch and a registering opening 134 is provided in the die plate 128 to permit the ejection of the slug under the air blast through the passageway 144.

As shown in Figure 5 passageways 145 are formed in the guide block 136 for connection with the passageways 140, 142 and 144 in the various punches. These passageways 145 communicate with a common cavity 146 which has an air inlet 147 to which a suitable source of compressed air is connected, as will be described hereinafter, for blasting the slugs from the several punches at a predetermined time in the cycle of operation of the machine.

As pointed out the guide block 136 and the head 137 carrying the several punches are arranged to be reciprocated vertically. For this purpose a connecting rod 148, Figure 14, is connected to the guide block 136 through the head 137, Figure 5. At its upper end the connecting rod 148 has a piston 149 which is movable in a die cylinder 150. It will be pointed out hereinafter how air pressure is applied to the ends of the die cylinder 150 for raising or lowering the piston 149 and effecting corresponding movement of the several punches carried by the head 137 which moves conjointly with the guide block 136.

The operation of the machine is initiated by means of a start foot switch which is shown, generally, at 151 in Figures 1 and 14 of the drawings. Once the foot switch 151 has been operated, the machine will go through a complete cycle of operation even though the manual pressure on the foot switch is removed. Figure 14 shows that the start foot switch 151 is provided with normally open contacts 151*a* which are arranged to be closed when the switch is manually operated.

The closure of the contacts 151*a* completes the circuits to be described hereinafter for energizing a brake solenoid 152 for releasing the brake 26 to permit the reel 24 to rotate. Also closure of the contacts 151*a* completes an energizing circuit for an index retract solenoid 153 which controls the operation of a control valve shown generally at 154 that is arranged to supply compressed air to the opposite ends of the indexing cylinder 73 through conduits 155 and 156. When the solenoid 153 is energized, the valve 154 is operated to permit compressed air to flow through the conduit 155 and in back of the piston 72 so as to retract it and the connecting rod 71, carrying with them the stock pusher head 48. At the same time air pressure is applied to a pressure switch 157 which is provided with normally open contacts 157*a* that close to provide a holding circuit around the contacts 151*a* of the start foot switch 151. Also a holding circuit is provided by a limit switch 158 having normally open contacts 158*a* which are closed as soon as the stock pusher head 48 is moved toward the retracted position.

Near the end of the retraction stroke of the stock pusher head 48 a limit switch, shown generally at 159, and carried by the stop plate 79, is operated to close its normally open contacts 159*a* and effect the energization of a die up solenoid 160 which controls the operation of a control valve, shown generally at 161, which is arranged to cause compressed air to flow through either conduit 162 or conduit 163 for moving the piston 149 in the die cylinder 150. Another limit switch, shown generally at 164 and also mounted on the stop plate 79, is provided with normally open contacts 164*a* which are arranged to control the energization of an air blast solenoid 165 which controls the operation of a control valve, shown generally at 166. The control valve 166 is connected by a conduit 167, a portion of which is flexible, to the air inlet 147, Figure 5, in the head 137 for directing the air blast to remove the slugs from the lower ends of the punches previously referred to.

The die punch 22 is provided with a limit switch, as shown generally at 168, and it has normally closed contacts 168*a* and normally open contacts 168*b* when the die punch is closed as illustrated in Figure 14. The limit switch 168 is arranged to control the deenergization of the brake solenoid 152 and the index retract solenoid 153 in a manner to be described. The brake 26 is applied by a spring 169 when the brake solenoid 152 is deenergized. Included in the control for the solenoids 152 and 153 is a relay, shown generally at 170, and having an operating window 170*w* and normally open contacts 170*a* and 170*b*.

When the stock pusher head 48 is operated to the forward position it engages a limit switch, shown generally at 171, and closes its contacts 171*a* which in turn control the operation of a relay, shown generally at 172, having an operating winding 172*w* and normally closed contacts 172*a*. If desired the relay 172 can be provided with a set of normally open contacts to operate in conjunction with contacts on the limit switch 158 which are closed when contacts 158*a* are opened to operate a counter by energizing its solenoid for the purpose of indicating the number of strips which have been cut off for any given cycle of operations.

In order to set up the machine it is desirable to operate the piston 149 in the die cylinder 150 to the upper position. For this purpose a die up push button 173 is provided having normally open contacts 173*a*. They control the energization of a relay, shown generally at 174, having operating winding 174*w*, normally open contacts 174*a* and normally closed contacts 174*b*.

In order to shut down the machine in the event that the start foot switch 151 remains closed and the half nut 83 has been retracted to the fullest extent, a limit switch, shown generally at 175, is provided having normally closed contacts 175*a* which are arranged to be opened on retraction of the stock pusher head 48 to a predetermined extent. The opening of these contacts deenergizes the entire control system and renders the same inoperative until it is reclosed.

Any suitable source of current can be employed for energizing the control system. For example 110 or 220 volt 60 cycle source 176 can be used. Switches 177 serve to interconnect the source 176 with control conductors 178 and 179.

The operation of the machine described hereinbefore will now be set forth. It will be assumed that the source 176 is in operation and that the switches 177 have been closed. Also it will be assumed that the copper strip stock 25 has been threaded from the reel 24 over the idler pulley 27 and the guide pulley 31 along the guide grooves 35 between the lower pressure pad 37 and the felt covered plunger 39 of the pressure pad means 32. Further it will be assumed that the stock pusher head 48 is in the fully extended position with the strip stock 25 extending therethrough. The half nut 83 is shifted to desired initial position by raising the guide rod 76 so that it swings through the slot 78 in the support bracket 75 about the longitudinal axis of the guide rod 77. The half nut 83 is moved so as to position the pointer 85 with respect to the scale 86 at the desired location corresponding to the length of the first strip 180, Figures 5 and 13. It will be observed that at each end of the strip or leaf 180 four large diameter holes 181 are punched and that four small diameter holes 182 also are punched, the holes being disposed around a square and interposed. It will be under-

stood from Figures 5 and 13 that the punch **143** cuts off a rectangular slug between the strip **180** and the strip stock **25**. On opposite sides of the punch **143** four large diameter openings are punched by the eight large diameter punches **139** and at the same time four small diameter openings are punched by small diameter punches **141**. The punching and cutting off operations are performed simultaneously. It will be understood that the length of the strip **180** as indicated at **183** is determined by the extent that the stock pusher head **48** is retracted and that the extent of retraction depends upon the position of the stop plate **79**. The manner in which the different lengths of strips or leaves **180** are assembled to form a shunt will be described in detail hereinafter.

It will further be assumed that the adjustable stop member **105** or index gauge has been set to the desired position corresponding to the increment in length that each succeeding strip or leaf is to have to the preceding strip or leaf. This is accomplished by turning the stop member **105**, Figure 4A, to the desired position.

For setting up the machine the die up push button **173** is depressed to complete a circuit at contacts **173***a* for the operating winding **174***w* of the relay **174**. This circuit extends between the conductors **178** and **179** through the operating winding **174***w* and contacts **173***a*. A circuit for energizing die up solenoid **160** is completed at contacts **174***a*. This circuit can be traced from energized conductor **178** through solenoid **160**, normally closed contacts **172***a*, contacts **174***a*, to the energized conductor **179**. The control valve **161** then is operated to permit compressed air to flow through the conduit **162** and raise the piston **149**. The die up push button **173** is still held closed and the strip stock **25** is fed past the punches carried by the head **137**. On release of the die up push button **173**, the relay **174** is deenergized, contacts **174***a* are opened and the solenoid **160** is deenergized. The control valve **161** then is operated to introduce compressed air through the conduit **163** for moving the piston **149** downwardly to perforate the strip **25** and to cut off the strip or leaf **180** as indicated in Figure 13. For the first strip there will be no holes punched in the outer end and it is scrapped. The next strip which is cut off will be of the desired length and have the holes punched therein and will constitute the first strip that is to be used for making up a shunt. After the die punch **22** has been operated as described, the half nut **83** is positioned in a manner previously set forth to determine the length of the first strip. As described, the adjustable stop member **105** is positioned in accordance with the desired increment that each succeeding strip is to have in length over the preceding strip.

The operator initiates the functioning of the machine set up as previously described by operating the start foot switch **151** and closing contacts **151***a*. Solenoid **152** is energized in parallel with solenoid **153** over a circuit which can be traced from the energized conductors **178** through the solenoids, closed contacts **168***a* of the limit switch **168** and contacts **151***a* to energized conductor **179**. Energization of solenoid **152** releases the brake **26** and, since the strip stock **25** is held against reverse movement by the pressure pad means **32**, the weight of the idler pulley **27** and arm **28** is sufficient to unreel a length of the stock from the reel **24**.

The energization of the solenoid **153** operates the control valve **154** to introduce compressed air into the indexing cylinder **73** ahead of the piston **72** and it is retracted together with the piston rod **71** and the stock pusher head **48**. As previously described the application of air pressure to the conduit **155** also operates the pressure switch **157** to provide a shunt circuit at contacts **157***a* around contacts **151***a* of the start foot switch **151**. As soon as the stock pusher head **48** begins to move, limit switch **158** is operated to parallel the holding circuit at its contacts **158***a* so as to insure that the complete cycle of operations will be completed and the stock pusher head **48** returned to the fully extended position shown diagrammatically in Figure 14.

The piston **72** continues to retract until the end surface **80** on the stock pusher head **48** engages the stop plate **79**. At this time limit switches **159** and **164** are operated. At contacts **159***a* a circuit is completed for energizing the die up solenoid **160**. This circuit can be traced from the energizing conductor **178** through solenoid **160**, closed contacts **172***a*, closed contacts **174***b*, contacts **159***a*, and closed contacts **158***a* to energized conductor **179**. The control valve **161** is operated to apply compressed air through conduit **162** to the die cylinder **150** for moving the piston **149** upwardly and opening the die punch **22**.

At contact members **164***a* a circuit is completed for energizing the air blast solenoid **165**. This circuit can be traced from the energizing conductor **178** through solenoid **165**, contacts **164***a*, to energized conductor **179**. As a result control valve **166** is operated to permit compressed air to blow through the various air passageways in the punches **139** and **141** to eject the slugs which had been removed from the strip stock **25**. Also the air flows through the rectangular cut off punch **143** for the same purpose.

When the die punch **22** is in the full open position contacts **168***a* of the limit switch **168** are opened and the previously traced circuit for energizing the solenoid **152** and **153** is opened. These solenoids are deenergized, the brake is applied and the control valve **154** is operated to apply compressed air through the conduit **156** and against the piston **72** for advancing it together with the connecting rod **71** and the stock pusher head **48**.

A further result of the opening of the die punch **22** is to close contacts **168***b* of limit switch **168** for operating the relay **170**. The circuit for energizing the operating winding **170***w* can be traced from the energized conductor **178** through winding **170***w*, contacts **168***b*, contacts **159***a*, and contacts **158***a* to the energized conductor **179**. A holding circuit is completed at contacts **170***a* for the winding **174***w*. This circuit can be traced from the energized conductor **178** through winding **170***w*, contacts **168***b*, contacts **174***b*, and contacts **170***a* to energized conductor **179**.

Referring briefly to the retraction of the stock pusher head **48** from the extended position shown in Figure 2B of the drawings, during the initial movement the shoulder **121** disengages the pawl **120** and the spring **122** retrieves the indexing rod **115**. The rack **114**, Figure 8, moves therewith and rotates the pinion **113** and conjointly therewith the pinion **112** to move the rack bar **95** in the direction indicated by the arrow **109**. The extent of movement is limited by the length of the stroke **108** which is determined by the particular one of the radial notches **104** into which the end **101** of the rack bar **95** can move. Under the influence of the spring **122** the rack bar **95** moves in the direction indicated by the arrow **109** until it occupies the broken line position as shown in Figures 4A and 7 of the drawings. During this movement of the rack bar **95** the pinion **83** is rotated in the direction indicated by the arrow **89** which is in the free wheeling direction so that no rotation of the lead screw **85** takes place. The drag **85'**, Figure 9, places a sufficient load on the lead screw **85** so that there is no tendency for it to reverse its rotation.

When the stock pusher head **48** starts to move forwardly contacts **164***a* of the limit switch **164** are opened and the previously traced energizing circuit for the solenoid **165** is opened. The valve **166** is closed to shut off the flow of compressed air supplied for blowing out the slugs from the die punch **22**. Although contacts **159***a* of the limit switch **159** also open when the stock pusher head **48** starts to move forwardly, the circuit for maintaining energized the solenoid **160** is completed through contacts **170***a* of the relay **170** which now are closed.

As soon as the stock pusher head **48** begins to move forwardly, the roller **56** grips the strip stock **25** between

it and the surface 58' of the lower block 50, Figure 12, as the result of the inter-action between the inclined surface 58 and the spring biased plunger 59. Thus, at the instant that the stock pusher head 48 begins to move forwardly, it grips the strip stock 25 and pulls the same along the guide grooves 35 of the stock feed ways 33. Since the brake 26 is applied, the idler pulley 27 and the arm 28 are moved upwardly during this forward movement of the stock pusher head 48 so that, when the brake 26 is next released, a further amount of the strip stock 25 can be unwound from the reel 24.

As the stock pusher head 48 is moved forwardly, the strip stock 25 is moved through the die punch 22 to the position shown in Figure 13 of the drawings. During this forward movement of the stock pusher head 48 and particularly during the last portion of this movement the shoulder 121 engages the pawl 120 to move the trip 119 and the indexing rod 115 forwardly and to further tension the spring 122. The forward movement of the indexing rod 115 rotates the pinion 113, Figure 8, and the pinion 112 to move the rack bar 95 in the direction indicated by the arrow 100. The extent of movement of the rack bar 95 is determined, as previously described, by the length of the stroke 108. This movement continues until the end 96, Figure 7, of the rack bar 95 engages the stop 99. When this occurs, no further forward movement of the stock pusher head 48 can take place. The movement of the rack bar 95 in the direction indicated by the arrow 100, Figure 7, causes the rack 94 to rotate the pinion 88 in the direction indicated by the arrow 93. When this takes place, because of the springs 91 and the rollers 90, the lead screw 85 is rotated with the pinion 88 through a corresponding extent with the result that the half nut 83 is retracted a corresponding amount, carrying with it the guide rods 76 and 77 and the stop plate 79. The stop plate 79 then is positioned to provide the desired increment in length for the next strip to be cut off by the die punch 22 when the stock pusher head 48 is next retracted and engages the stop plate 79 and operates the limit switches 159 and 164 carried thereby.

When the stock pusher head 48 has reached its most forward position, limit switch 171 is operated to close contacts 171*a* and complete a circuit for energizing relay 172. The energizing circuit for relay 172 can be traced from energizing conductor 178 through winding 172*w*, contacts 171*a*, contacts 170*b* (now closed), to energized conductor 179. At contacts 172*a* the previously traced holding circuit for the solenoid 160 is opened and the control valve 161 is operated to apply compressed air through the conduit 163 against the upper side of the piston 149. The die punch 22 then is operated to the closed position for making the eight large and the eight small openings in the strip stock 25 and for cutting off the strip 180, Figure 13, by the cut off punch 143.

Also contacts 158*a* of the limit switch 158 are opened and, since contacts 157*a* previously were opened, the holding circuit around the contacts 151*a* of the start foot switch 151 is opened and the cycle stops unless the start foot switch 151 is held closed.

A further result of the closing of the die punch 22 is to open the previously traced holding circuit at contacts 168*b* for the operating winding 170*w* of the relay 170. This relay is deenergized and in turn the energizing circuit for the operating winding 172*w* of the relay 172 is opened at contacts 170*b* and contacts 172*a* are reclosed.

As long as the start foot switch 151 is held closed the previously described cycle of operations continues and for each strip or each retraction of the stock pusher head 48, the stop plate 79 is retracted so that the length of the next strip 180 is correspondingly greater.

In Figures 15, 16 and 17 of the drawings the manner in which a shunt, shown generally at 184, is constructed will be apparent. The strips indicated at 180 are assembled as shown in Figure 15 and an end cap 185 is positioned over one end and is held thereto by rivets 186 which extend through the small diameter holes 182. In this figure the difference in lengths, for example .0191", of each succeeding strip from the preceding strip is illustrated at the upper end. It is pointed out that the shunt 184 may be formed of a large number, for example 75, of strips 180. When an end cap 185 is applied to the other end of the assembly shown in Figure 15 the completed shunt as shown at 184 in Figure 16 is formed. When the ends are free the shunt 184 assumes the bowed position here illustrated. The rivets 186 extending through the end caps 185 hold the end portions 190 of the strips 180 in good contact engagement and under pressure so that in effect they constitute a conductor of solid cross section. Because of the difference in lengths between the successive leaves or strips 180 the intermediate portions 191 are bowed and slightly separated so that air can circulate therebetween.

Figure 17 shows how the shunt 184 can be employed for interconnecting a stationary conductor 192 and a relatively movable conductor 193. It will be observed that one face of each of the end caps 185 is positioned flatwise with respect to the conductors 192 and 193 and that bolts 194 extending therethrough and through the large diameter holes 181 serve to clamp the ends of the shunt 184 securely in good current conducting relationship to these conductors 192 and 193.

In the assembly of the strips or leaves 180 for the shunt 184 as shown in Figure 16 it will be noted that the ends of the separate strips are aligned in coplanar relation and that the plane containing their ends extends at right angles to the U-shape of the shunt 184 as it appears in Figure 17.

Since certain changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and the scope thereof, it is intended that all matter shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. Mechanism for feeding metallic strip stock of indefinite length to a die punch for cutting off predetermined lengths of the strip comprising, in combination, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock to the die punch, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, and indexing means operated for each stroke of said stock pusher head for changing the distance said stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch.

2. Mechanism for feeding metallic strip stock of indefinite length to a die punch for cutting off predetermined lengths of the strip comprising, in combination, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock to the die punch, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, and indexing means operated on movement of said stock pusher head to a predetermined position for changing the distance said stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch.

3. Mechanism for feeding metallic strip stock of indefinite length to a die punch for cutting off predetermined lengths of the strip comprising, in combination, means for guiding the strip stock to the die punch, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock along said guide means to the die punch, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, and indexing means operated for each stroke of said stock pusher head for changing the distance said

stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch.

4. Mechanism for feeding metallic strip stock of indefinite length to a die punch for cutting off predetermined lengths of the strip comprising, in combination, means for guiding the strip stock to the die punch, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock along said guide means to the die punch, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, and indexing means operated on movement of said stock pusher head toward the die punch to a predetermined position to retract said stroke gauge means for changing the distance said stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch.

5. Mechanism for feeding metallic strip stock of indefinite length to a die punch for cutting off predetermined lengths of the strip comprising, in combination, means for guiding the strip stock to the die punch, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock along said guide means to the die punch, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, indexing means, overrunning clutch means operatively interconnecting said stroke gauge means and said indexing means, means positively interconnecting said indexing means and said stock pusher head for retracting said stroke gauge means to change the distance said stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch, and means for retrieving said indexing means free of said stroke gauge means.

6. Mechanism for feeding metallic strip stock of indefinite length to a die punch for cutting off predetermined lengths of the strip comprising, in combination, means for guiding the strip stock to the die punch, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock along said guide means to the die punch, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, indexing means, overrunning clutch means operatively interconnecting said stroke gauge means and said indexing means, means positively interconnecting said indexing means and said stock pusher head for retracting said stroke gauge means to change the distance said stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch, means for retrieving said indexing means free of said stroke gauge means, and means for adjusting said indexing means to vary the distance said stroke gauge means is shifted and thereby change the increment in length between succeeding lengths of the strip stock cut off by the die punch.

7. Mechanism for feeding metallic strip stock wound on a reel to die punch for cutting off predetermined lengths of the strip comprising, in combination, means for stepwise unreeling the metallic strip stock from the reel, means for guiding the strip stock to the die punch, means preventing reverse movement of the metallic strip stock along said guide means, a stock pusher head adapted to grip the strip stock, means for moving said stock pusher head to and fro to feed the strip stock along said guide means to the die punch and to actuate said stepwise unreeling means, stroke gauge means cooperating with said stock pusher head to limit the withdrawal thereof away from the die punch, and indexing means operated for each stroke of said stock pusher head for changing the distance said stock pusher head is withdrawn and correspondingly the length of the strip stock next fed to the die punch.

8. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, a stock pusher head adapted to grip the strip stock and move it toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means operatively interconnecting said stock pusher head and said stroke gauge means for shifting the latter each time the former is operated, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

9. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising ,in combiation, a reciprocating die punch and means for operating the same, a stock pusher head adapted to grip the strip stock only when it is moved toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means operatively interconnecting said stock pusher head and said stroke gauge means for shifting the latter each time the former is operated to a predetermined position, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

10. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, means for guiding the strip stock to said die punch, a stock pusher head adapted to grip the strip stock only when it is moved along said guide means toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means operatively interconnecting said stock pusher head and said stroke gauge means for shifting the latter each time the former is operated, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the

same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

11. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, means for guiding the strip stock to said die punch, a stock pusher head adapted to grip the strip stock only when it is moved along said guide means toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means operatively interconnecting said stock pusher head and said stroke gauge means for retracting the latter each time the former is moved toward said die punch to a predetermined position, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

12. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, means for guiding the strip stock to said die punch, a stock pusher head adapted to grip the strip stock only when it is moved along said guide means toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means, overrunning clutch means operatively interconnecting said stroke gauge means and said indexing means, means positively interconnecting said indexing means and said stock pusher head for retracting said stroke gauge means each time the former is operated, means for retrieving said indexing means free of said stroke gauge means, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

13. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, means for guiding the strip stock to said die punch, a stock pusher head adapted to grip the strip stock only when it is moved along said guide means toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means, overrunning clutch means operatively interconnecting said stroke gauge means and said indexing means, means positively interconnecting said indexing means and said stock pusher head for retracting said stroke gauge means each time the former is operated, means for retrieving said indexing means free of said stroke gauge means, means for adjusting said indexing means to vary the distance said stroke gauge means is shifted and thereby change the increment in length between succeeding lengths of the strip stock cut off by the die punch, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

14. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock wound on a reel and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, means for stepwise unreeling the metallic strip stock from the reel, means for guiding the strip stock to said die punch, means preventing reverse movement of the metallic strip stock along said guide means, a stock pusher head adapted to grip the strip stock only when it is moved along said guide means toward said die punch, variable stroke reciprocating operating means for said stock pusher head and for actuating said stepwise unreeling means, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means operatively interconnecting said stock pusher head and said stroke gauge means for shifting the latter each time the former is operated, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

15. Mechanism for automatically feeding metallic strip stock and cutting off predetermined lengths thereof and perforating their juxtaposed ends comprising, in combination, a table, a die punch on said table for cutting off the strips one by one and for perforating the ends of the same, means for operating said die punch, a pair of parallel spaced stock feed ways on said table for guiding the strip stock to said die punch, a stock pusher head guided on said stock feed ways freely movable thereon away from said die punch and adapted to grip the strip stock when it is moved toward said die punch, variable stroke means for reciprocating said stock pusher head; stroke gauge means mounted on said table above said stock feed ways and cooperating with said stock pusher head to determine the extent that it is retracted from said die punch including a stop plate engageable by said stock pusher head, means carrying said stop plate and slidably mounted on said table, nut means carried by said guide means, a lead screw journaled at its ends on said table and engaging said nut means, a pinion rotatably mounted on one end of said lead screw, overrunning clutch means interposed between said lead screw and said pinion whereby the latter when rotated in one direction rotates the former and when rotated in the opposite

direction is free thereof, a rack engaging said pinion, a stop carried by said table and cooperating with one end of said rack to limit movement thereof when it rotates said pinion in said one direction, stop means cooperating with the other end of said rack to limit its stroke and thereby the degree of rotation of said lead screw and the distance said stop plate is retracted from said die punch, pinion means rotatable about a vertical axis on said table in engagement with said rack, an indexing rod slidably mounted on said table parallel to said stock feed ways and having a rack at one end engaging said pinion means and a trip at the other end having a pawl engageable by said stock pusher head for rotating said lead screw near the end of the movement thereof toward said die punch, and a spring biasing said trip for movement away from said die punch and thereby moving the first mentioned rack into engagement with said stop means; manually controllable means for operating said variable stroke means to retract said stock pusher head, means responsive to the retraction of said stock pusher head for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke means to advance said stock pusher head toward said die punch and the strip stock into position in the same to be operated upon, and means responsive to the forward movement of said stock pusher head for operating said die punch operating means to close the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

16. Mechanism for automatically feeding metallic strip stock and cutting off predetermined lengths thereof and perforating their juxtaposed ends comprising, in combination, a table, a die punch on said table for cutting off the strips one by one and for perforating the ends of the same, means for operating said die punch, a pair of parallel spaced stock feed ways on said table for guiding the strip stock from the reel to said die punch, a stock pusher head guided on said stock feed ways freely movable thereon away from said die punch and adapted to grip the strip stock when it is moved toward said die punch, variable stroke means for reciprocating said stock pusher head; stroke gauge means mounted on said table above said stock feed ways and cooperating with said stock pusher head to determine the extent that it is retracted from said die punch including a stop plate engageable by said stock pusher head, a pair of guide rods extending parallel to said stock feed ways and carrying said stop plate and slidably mounted on said table, a half nut extending between and fast on said guide rods, a lead screw between said guide rods and journaled at its ends on said table and engaging said half nut, a first pinion rotatably mounted on one end of said lead screw, overrunning clutch means interposed between said lead screw and said pinion whereby the latter when rotated in one direction rotates the former and when rotated in the opposite direction is free thereof, a rack engaging said pinion, a stop carried by said table and cooperating with one end of said rack to limit movement thereof when it rotates said pinion in said one direction, stop means cooperating with the other end of said rack to limit its stroke and thereby the degree of rotation of said lead screw and the distance said stop plate is retracted from said die punch, pinion means rotatable about a vertical axis on said table in engagement with said rack, an indexing rod slidably mounted on said table parallel to said stock feed ways and having a rack at one end engaging said pinion means and a trip at the other end having a pawl engageable by said stock pusher head for rotating said lead screw near the end of the movement thereof toward said die punch, and a spring biasing said trip for movement away from said die punch and thereby moving the first mentioned rack into engagement with said stop means; manually controllable means for operating said variable stroke means to retract said stock pusher head, means responsive to the retraction of said stock pusher head for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said variable stroke means to advance said stock pusher head toward said die punch and the strip stock into position in the same to be operated upon, and means responsive to the forward movement of said stock pusher head for operating said die punch operating means to close the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

17. Mechanism for automatically feeding metallic strip stock from a reel and cutting off predetermined lengths thereof and perforating their juxtaposed ends comprising, in combination, a table, a die punch at one end of said table for cutting off the strips one by one and for perforating the ends of the same, means for operating said die punch, means for mounting the reel at the other end of and above said table, brake means for cooperating with the reel to prevent rotation thereof, means for controlling said brake means, an idler pulley below said other end of said table and biased downwardly, a guide pulley above said other end of said table, a pair of parallel spaced stock feed ways above said table and between said die punch and said guide pulley for guiding the strip stock from the reel and looped over said idler pulley and said guide pulley to said die punch, pressure pad means at said other end of said table between said stock feed ways for preventing reverse movement of the strip stock and cleaning the surface thereof, a stock pusher head guided on said stock feed ways freely movable thereon away from said die punch and adapted to grip the strip stock when it is moved toward said die punch, variable stroke means for reciprocating said stock pusher head; stroke gauge means mounted on said table above said stock feed ways and cooperating with said stock pusher head to determine the extent that it is retracted from said die punch including a stop plate engageable by said stock pusher head, guide means carrying said stop plate and slidably mounted on said table, nut means carried by said guide rods, a lead screw journaled at its ends on said table and engaging said nut means, a pinion rotatably mounted on one end of said lead screw, overrunning clutch means interposed between said lead screw and said pinion whereby the latter when rotated in one direction rotates the former and when rotated in the opposite direction is free thereof, a rack engaging said pinion, a stop carried by said table and cooperating with one end of said rack to limit movement thereof when it rotates said pinion in said one direction, stop means cooperating with the other end of said rack to limit its stroke and thereby the degree of rotation of said lead screw and the distance said stop plate is retracted from said die punch, pinion means rotatable about a vertical axis on said table in engagement with said rack, an indexing rod slidably mounted on said table parallel to said stock feed ways and having a rack at one end engaging said pinion means and a trip at the other end having a pawl engageable by said stock pusher head for rotating said lead screw near the end of the movement thereof toward said die punch, and a spring biasing said trip for movement away from said die punch and thereby moving the first mentioned rack into engagement with said stop means; manually controllable means for operating said brake control means to release said brake means whereupon strip stock is unreeled under the biasing action applied to said idler pulley and for operating said variable stroke means to retract said stock pusher head, means responsive to the retraction of said stock pusher head for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said brake control means to apply the same and for operating said variable stroke means to advance said stock pusher head toward said die punch and the strip stock into position in the same to be operated upon, and means responsive to the forward movement of said stock pusher head for operating said die punch operating means to close the same to cut off a length of the

strip stock and perforate the ends on opposite sides of the cut.

18. Mechanism for automatically feeding metallic strip stock from a reel and cutting off predetermined lengths thereof and perforating their juxtaposed ends comprising, in combination, a table, a die punch at one end of said table for cutting off the strips one by one and for perforating the ends of the same, means for operating said die punch, means for mounting the reel at the other end of and above said table, brake means for cooperating with the reel to prevent rotation thereof, means for controlling said brake means, an idler pulley below said other end of said table and biased downwardly, a guide pulley above said other end of said table, a pair of parallel spaced stock feed ways above said table and between said die punch and said guide pulley for guiding the strip stock from the reel and looped over said idler pulley and said guide pulley to said die punch, pressure pad means at said other end of said table between said stock feed ways for preventing reverse movement of the strip stock and cleaning the surface thereof, a stock pusher head guided on said stock feed ways freely movable thereon away from said die punch and adapted to grip the strip stock when it is moved toward said die punch, variable stroke means for reciprocating said stock pusher head; stroke gauge means mounted on said table above said stock feed ways and cooperating with said stock pusher head to determine the extent that it is retracted from said die punch including a stop plate engageable by said stock pusher head, a pair of guide rods extending parallel to said stock feed ways and carrying said stop plate and slidably mounted on said table, a half nut extending between and fast on said guide rods, a lead screw between said guide rods and journaled at its ends on said table and engaging said half nut, a first pinion rotatably mounted on one end of said lead screw, roller clutch means interposed between said lead screw and said pinion whereby the latter when rotated in one direction rotates the former and when rotated in the opposite direction is free thereof, a rack engaging said pinion, a stop carried by said table and cooperating with one end of said rack to limit movement thereof when it rotates said pinion in said one direction, adjustable stop means cooperating with the other end of said rack to vary its stroke and thereby vary the degree of rotation of said lead screw and the distance said stop plate is retracted from said die punch, a second pinion and a third pinion conjointly rotatable about a vertical axis on said table with said second pinion in engagement with said rack, an indexing rod slidably mounted on said table parallel to said stock feed ways and having a rack at one end engaging said third pinion and a trip at the other end having a pawl engageable by said stock pusher head for rotating said lead screw near the end of the movement thereof toward said die punch, and a coil tension spring biasing said strip for movement away from said die punch and thereby moving the first mentioned rack into engagement with said adjustable stop means; manually controllable means for operating said brake control means to release said brake means whereupon strip stock is unreeled under the biasing action applied to said idler pulley and for operating said variable stroke means to retract said stock pusher head, means responsive to the retraction of said stock pusher head for operating said die punch operating means to open the same, means responsive to the opening of said die punch for operating said brake control means to apply the same and for operating said variable stroke means to advance said stock pusher head toward said die punch and the strip stock into position in the same to be operated upon, and means responsive to the forward movement of said stock pusher head for operating said die punch operating means to close the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

19. Mechanism for automatically feeding and cutting off predetermined lengths of metallic strip stock from a supply of indefinite length and for perforating the strip stock on opposite sides of the cut comprising, in combination, a reciprocating die punch and means for operating the same, a stock pusher head adapted to grip the strip stock and move it toward said die punch, variable stroke reciprocating operating means for said stock pusher head, stroke gauge means cooperating with said stock pusher head for limiting the distance said stock pusher head is withdrawn from said die punch, indexing means operatively interconnecting said stock pusher head and said stroke gauge means for shifting the latter each time the former is operated, means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for operating said die punch operating means to open the same, additional means responsive to the withdrawal of said stock pusher head to the extent determined by said gauge means for causing a blast of air to flow through said die punch for removing slugs punched thereby from the strip stock during the previous operation thereof, means responsive to the opening of said die punch for operating said variable stroke reciprocating operating means to move said stock pusher head forwardly toward said die punch and the strip stock into the same, and means responsive to the forward movement of said stock pusher head to a predetermined position for operating said die punch operating means for closing the same to cut off a length of the strip stock and perforate the ends on opposite sides of the cut.

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