Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

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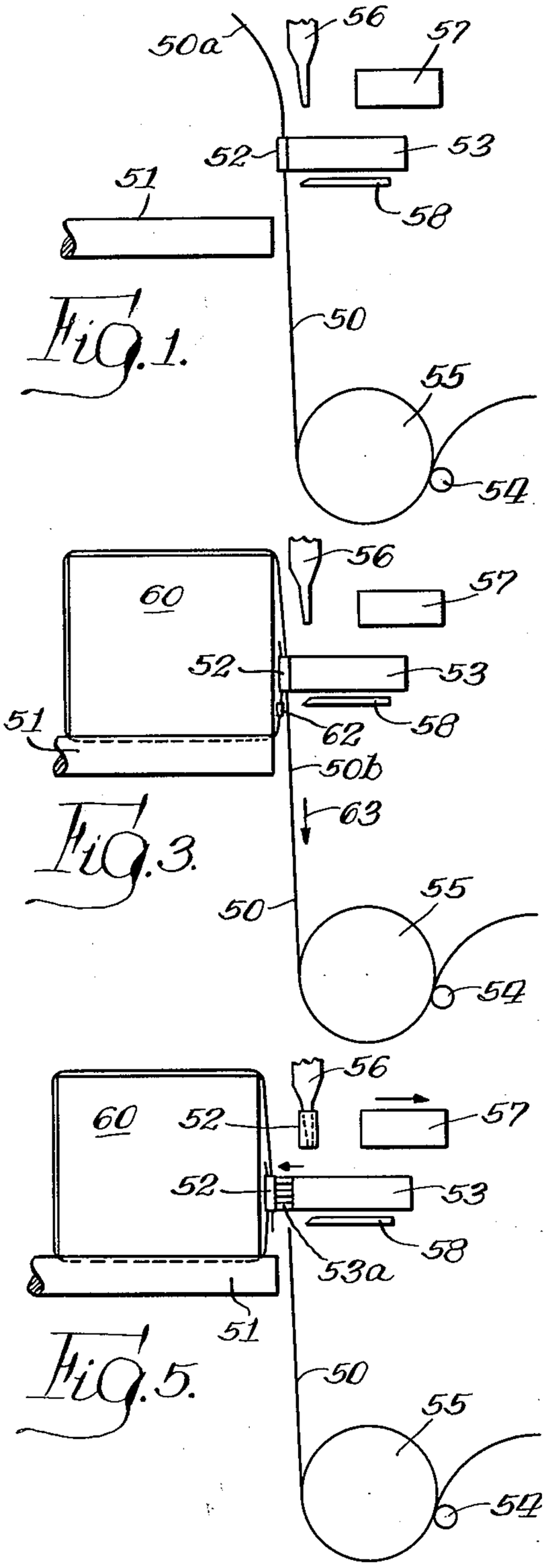

Fig. 1.

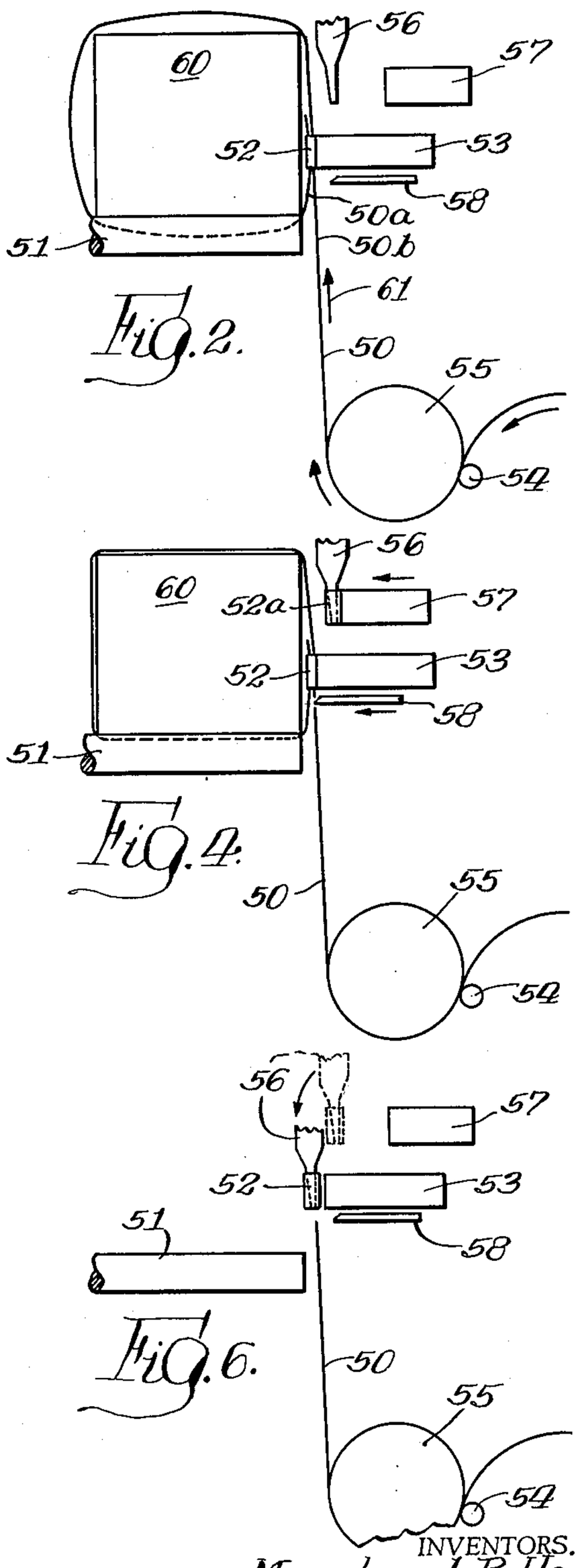

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

Filed Feb. 14, 1957 16 Sheets-Sheet 2

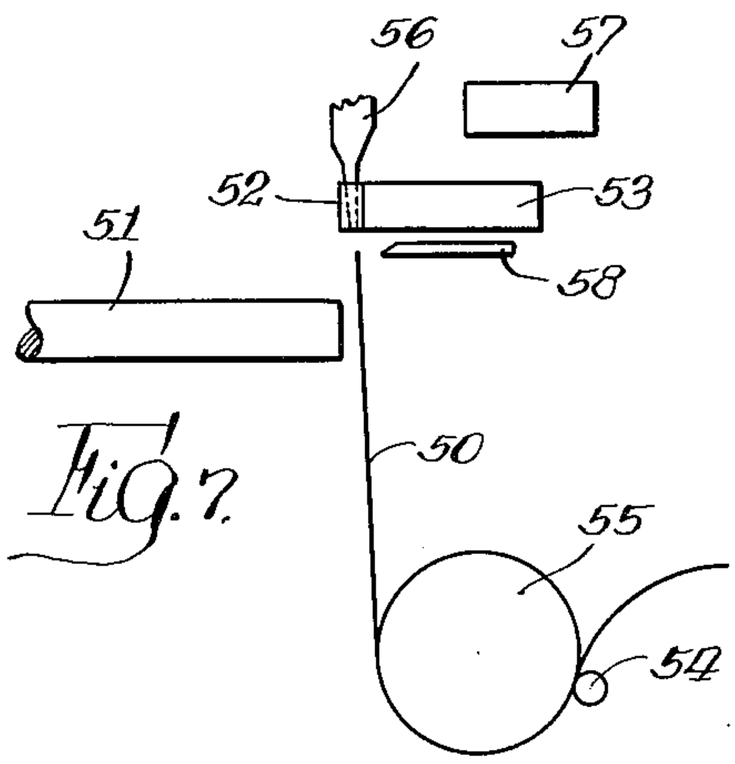


Fig. 7.

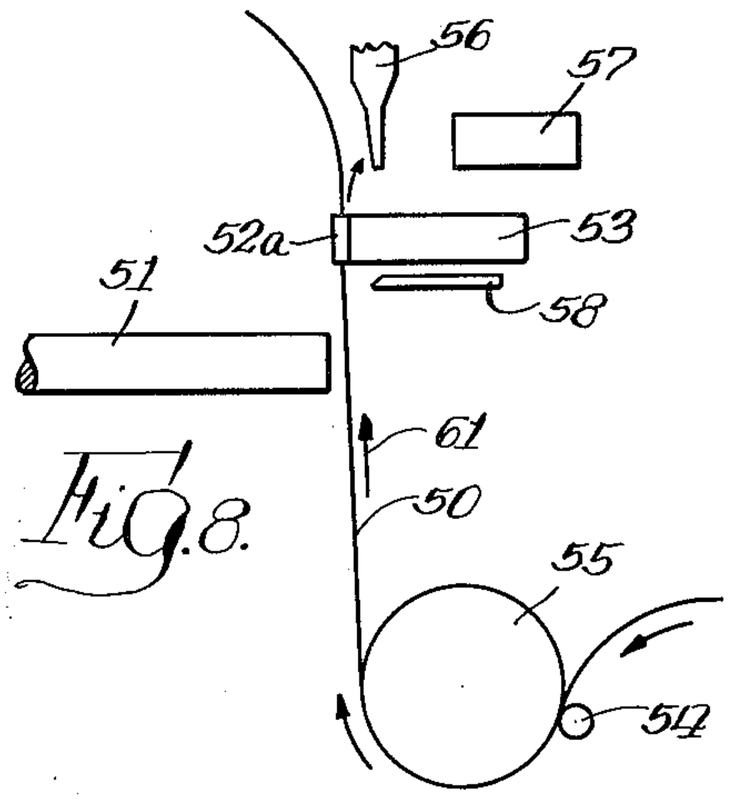


Fig. 8.

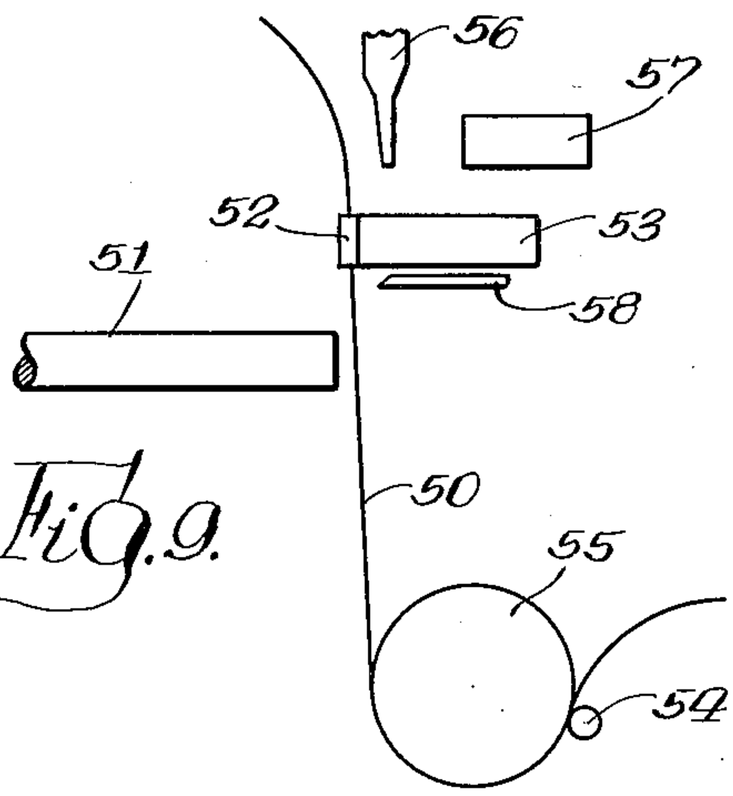
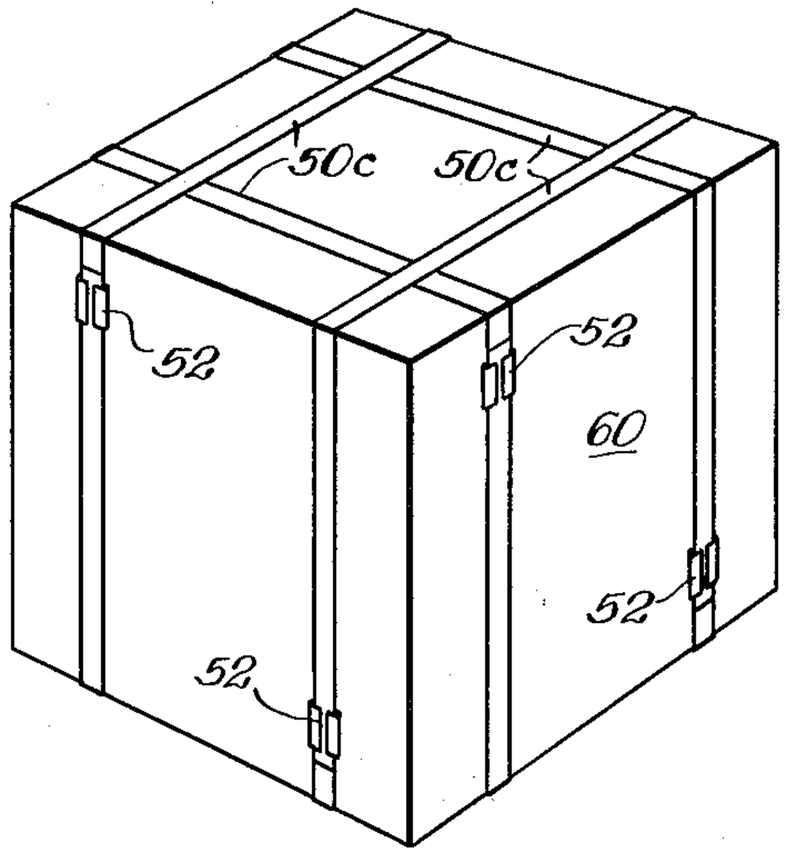


Fig. 9.

Fig. 10.



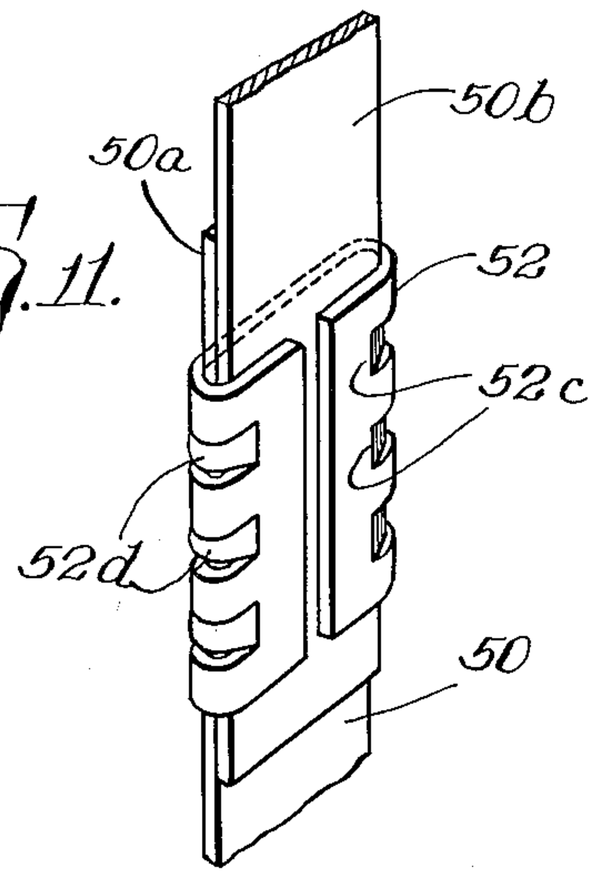


Fig. 11.

INVENTORS.
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Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

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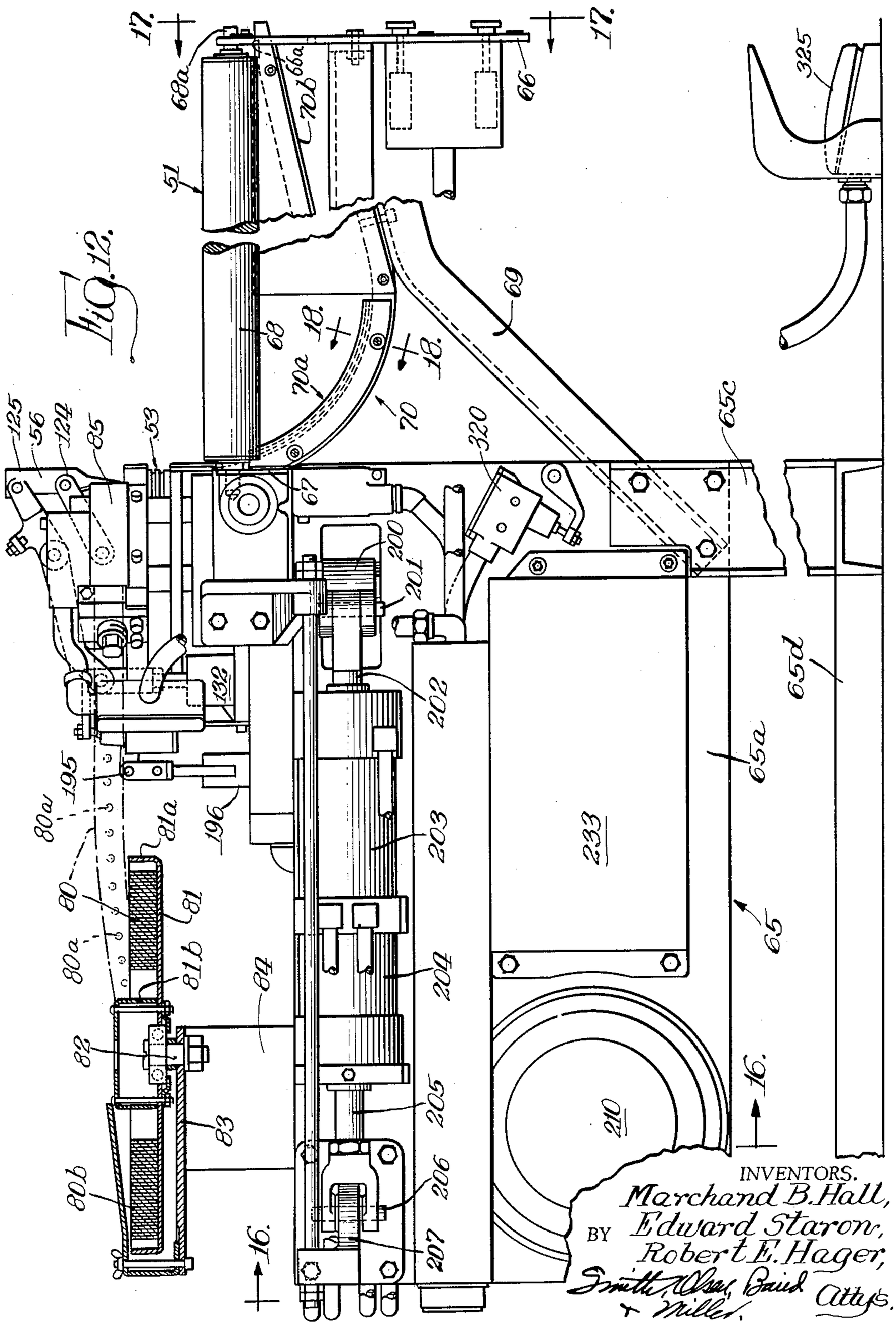

Fig. 12.

INVENTORS.
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Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

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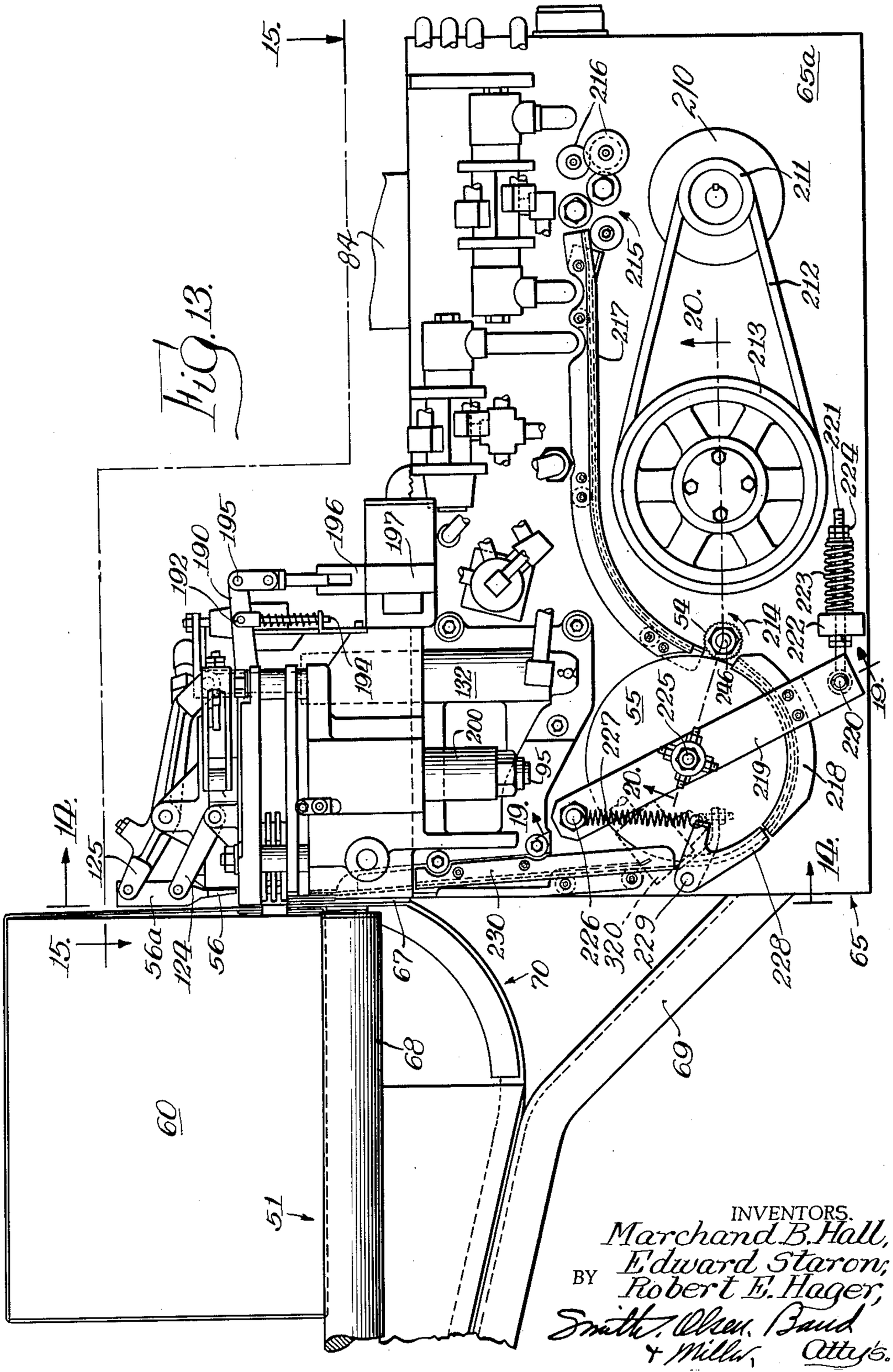
Fig. 13.



INVENTORS.
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Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

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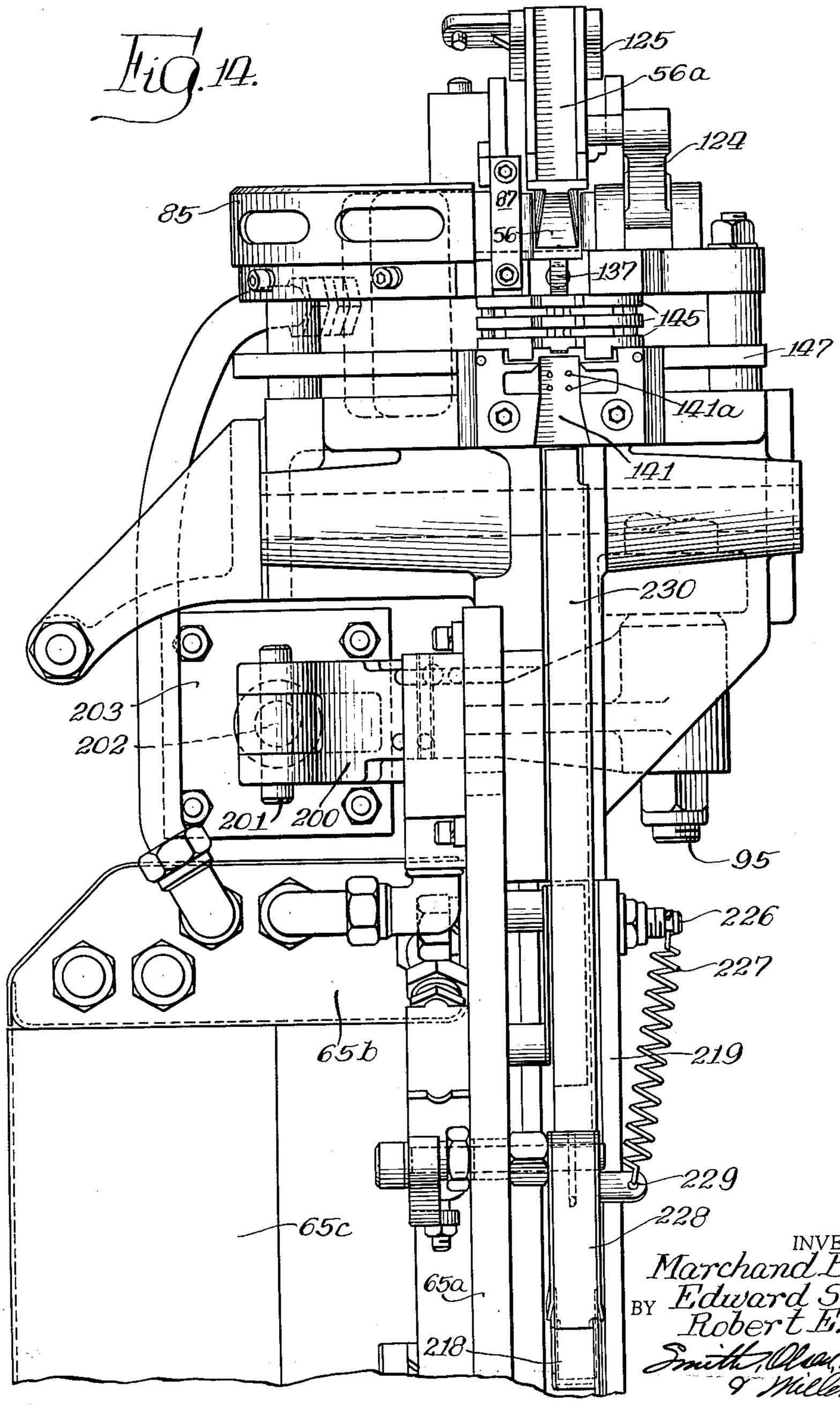
Fig. 14.



INVENTORS.
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Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

Filed Feb. 14, 1957 16 Sheets-Sheet 6

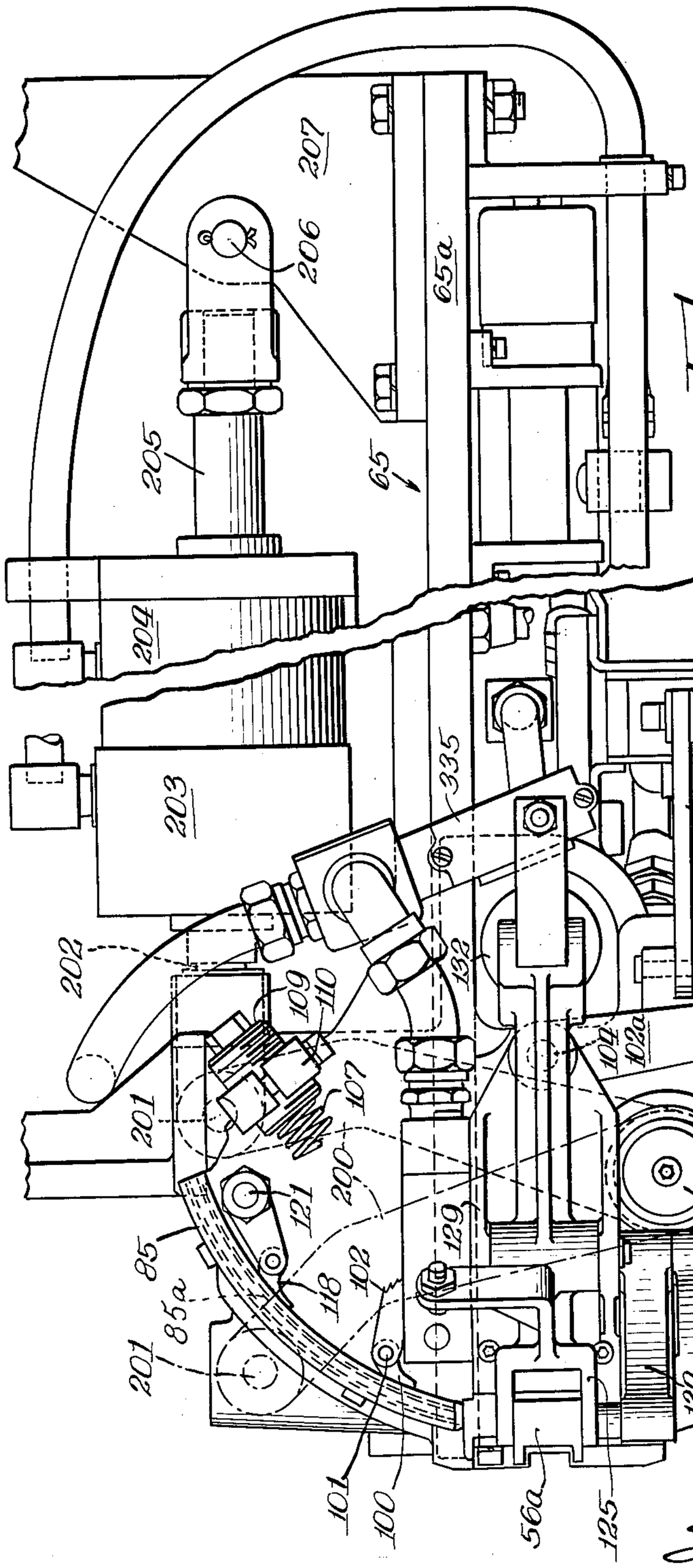

Fig. 15.

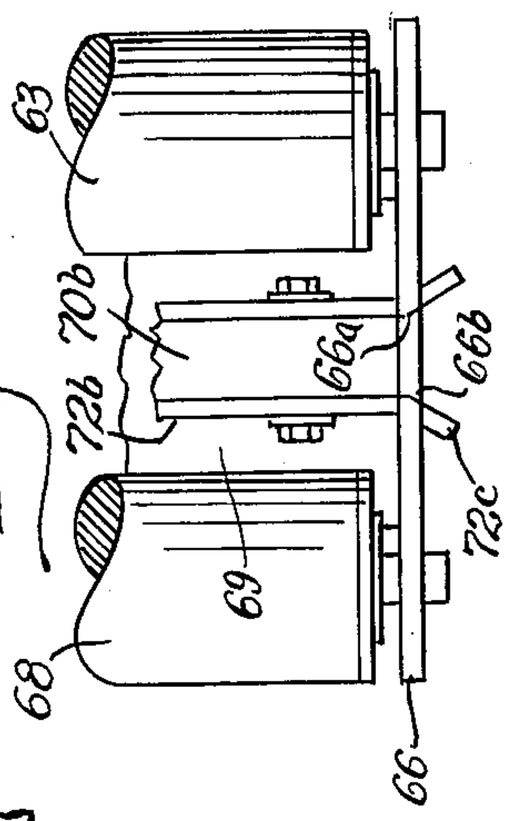

Fig. 17A

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Fig. 16.

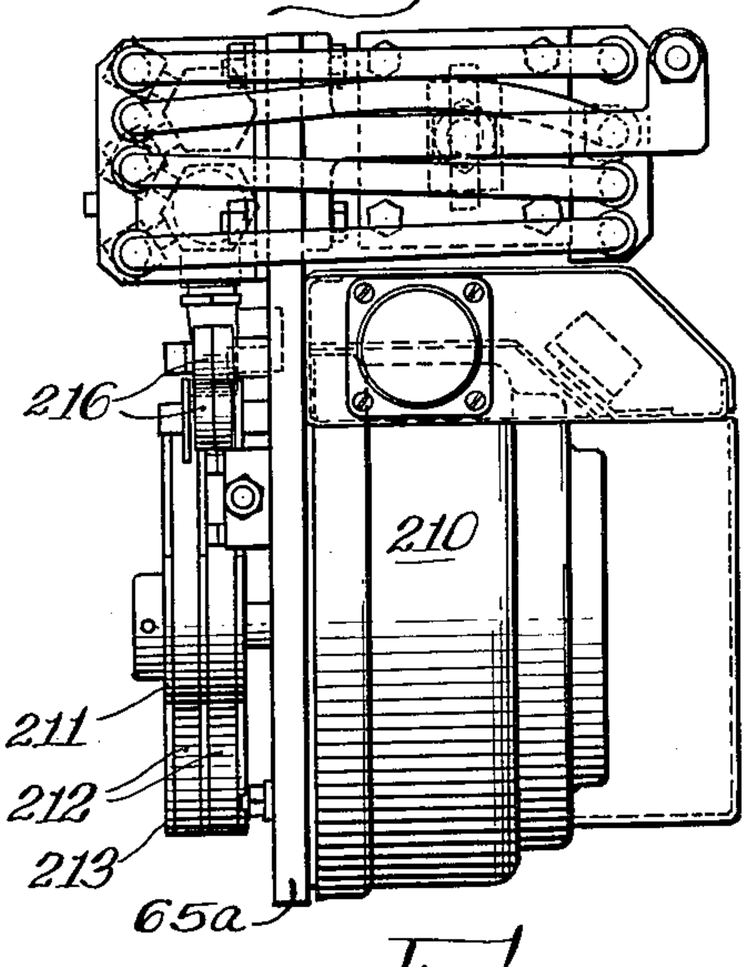


Fig. 17.

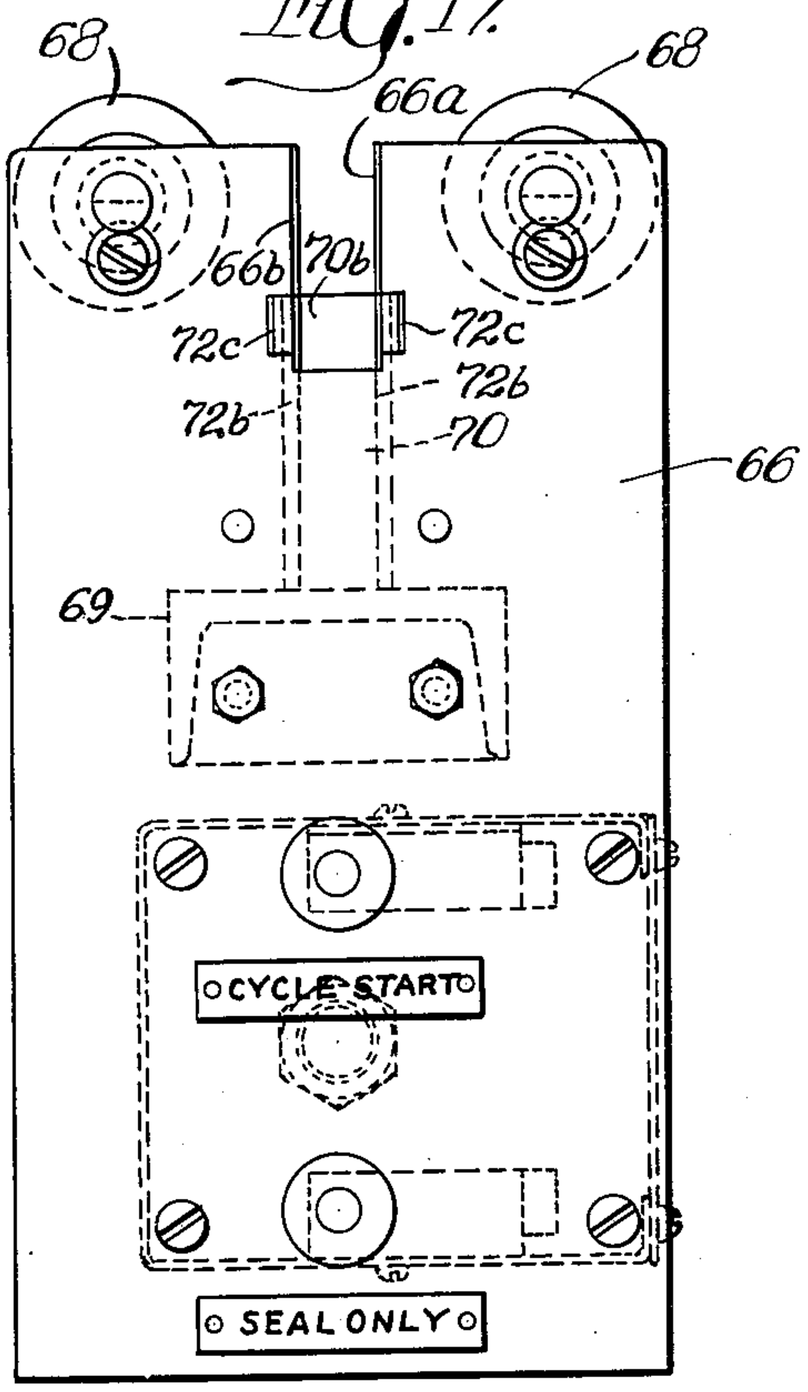


Fig. 18

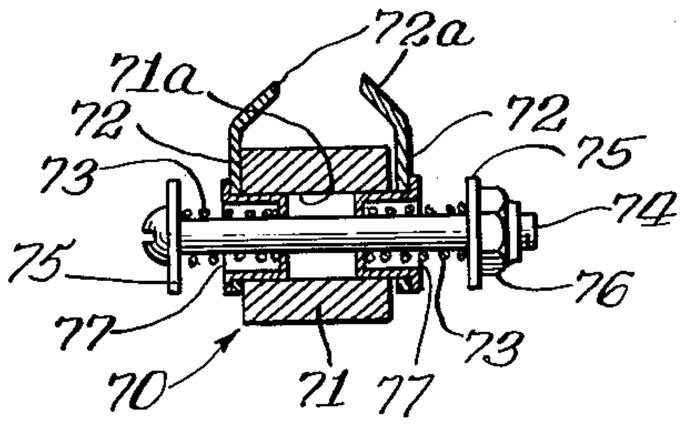
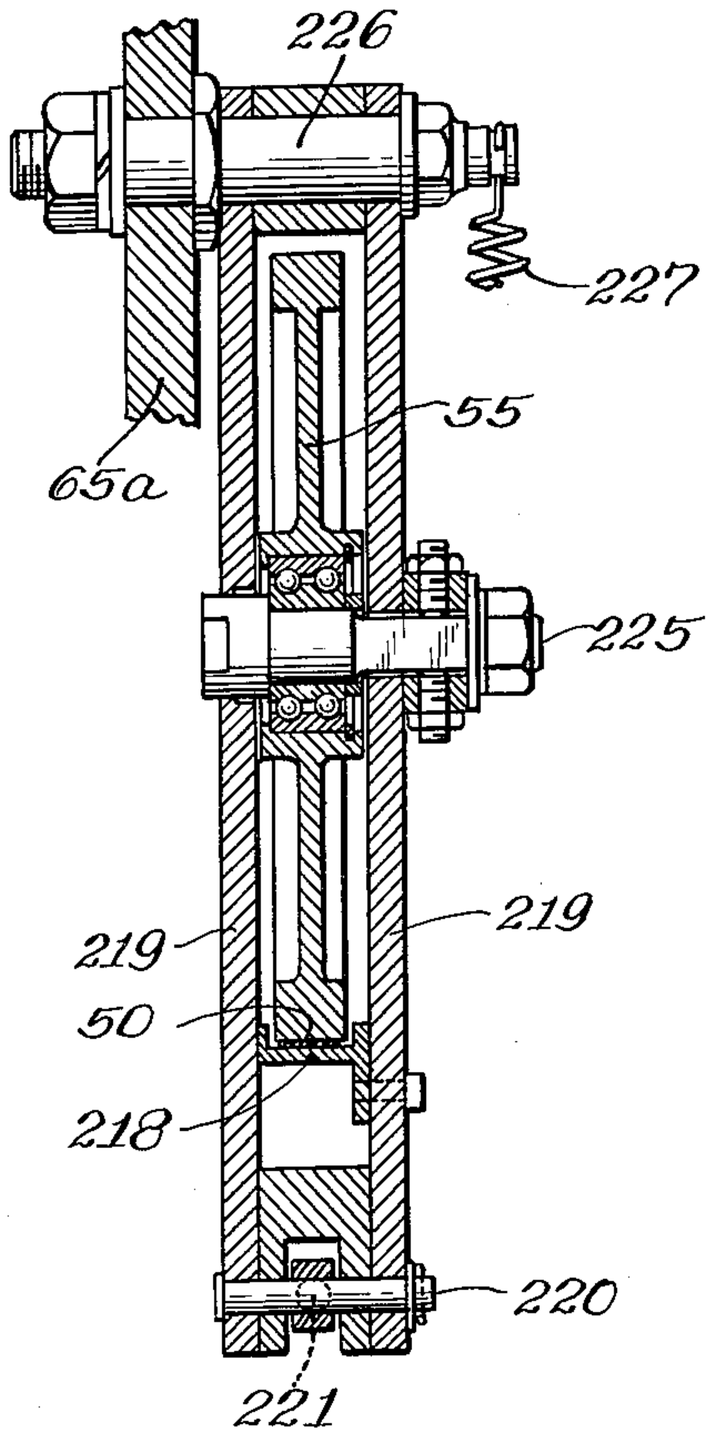


Fig. 19.



INVENTORS.
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Edward Staron,
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AUTOMATIC BOX STRAPPING MACHINE

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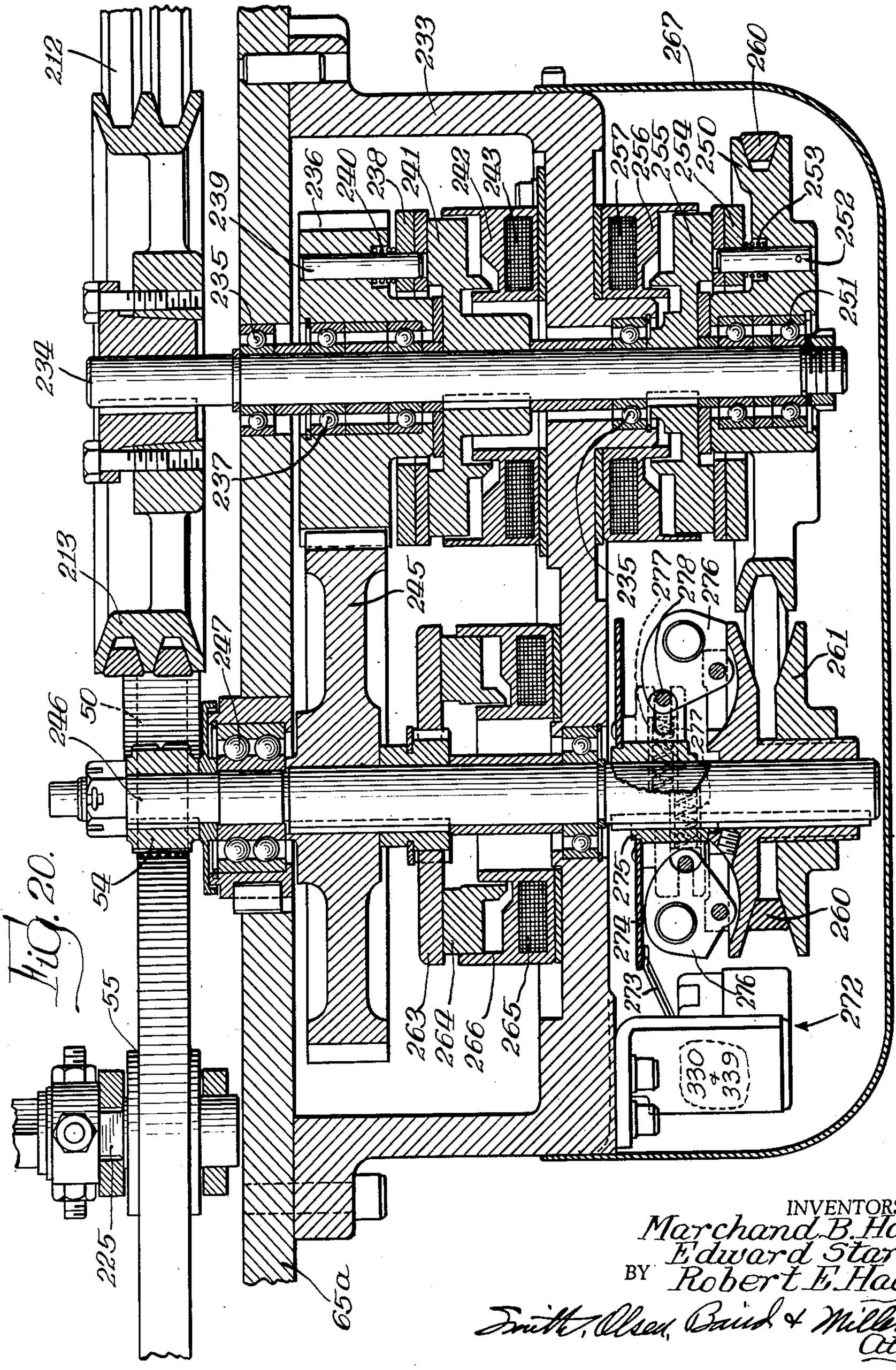

Fig. 20.

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AUTOMATIC BOX STRAPPING MACHINE

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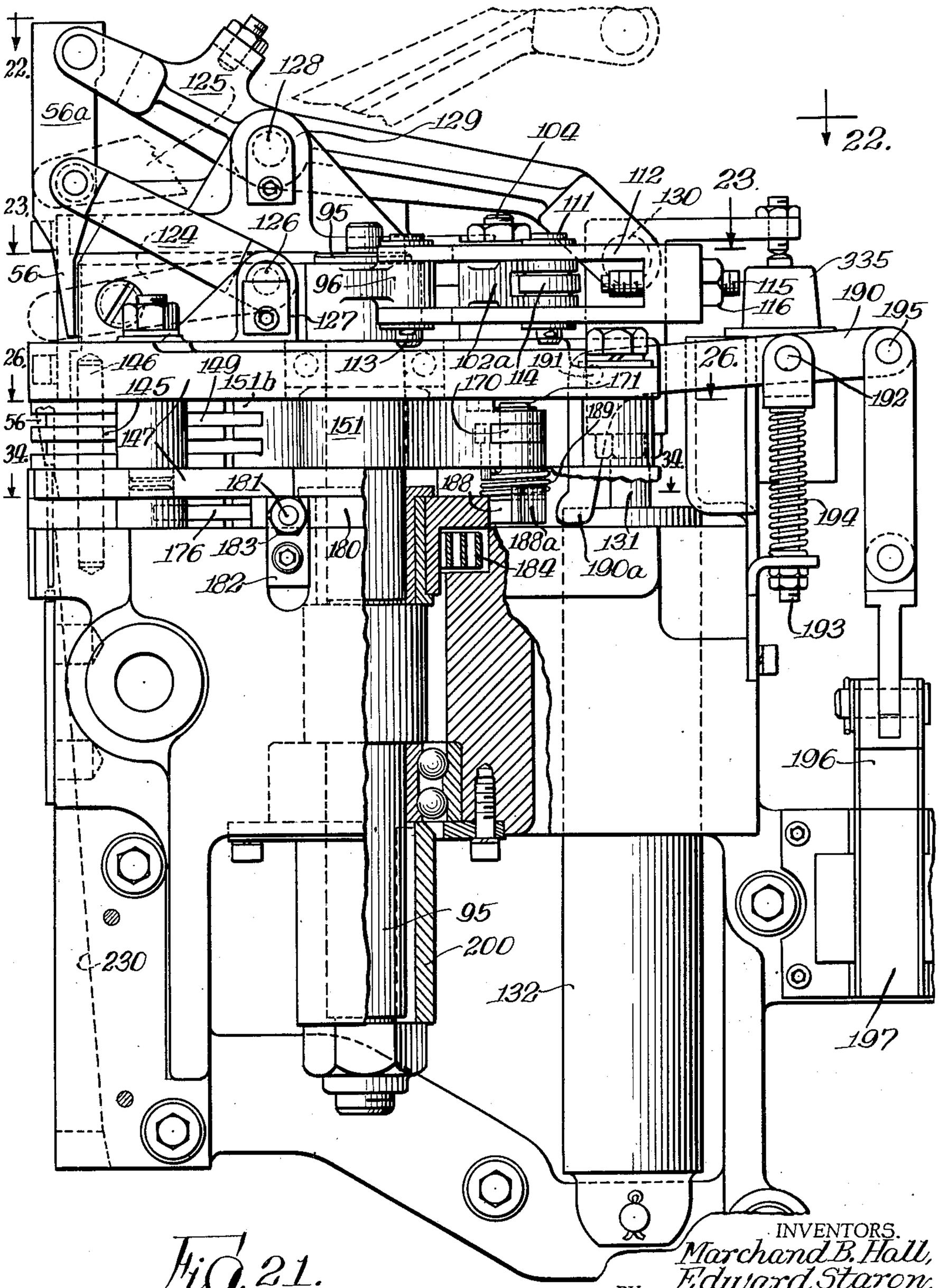

Fig. 21.

INVENTORS.
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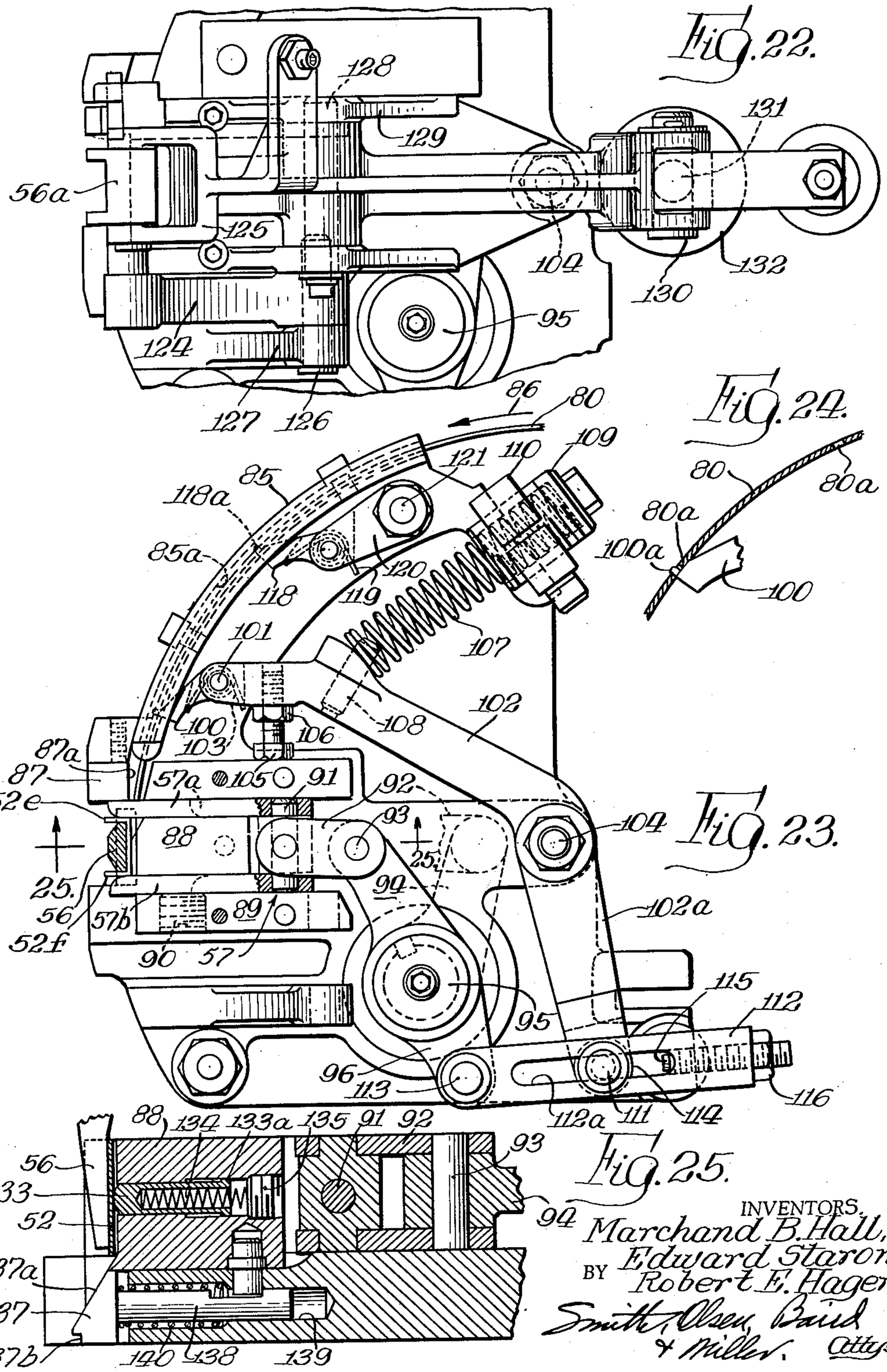

Fig. 22.

Fig. 24.

Fig. 23.

Fig. 25.

INVENTORS,
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AUTOMATIC BOX STRAPPING MACHINE

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Fig. 26.

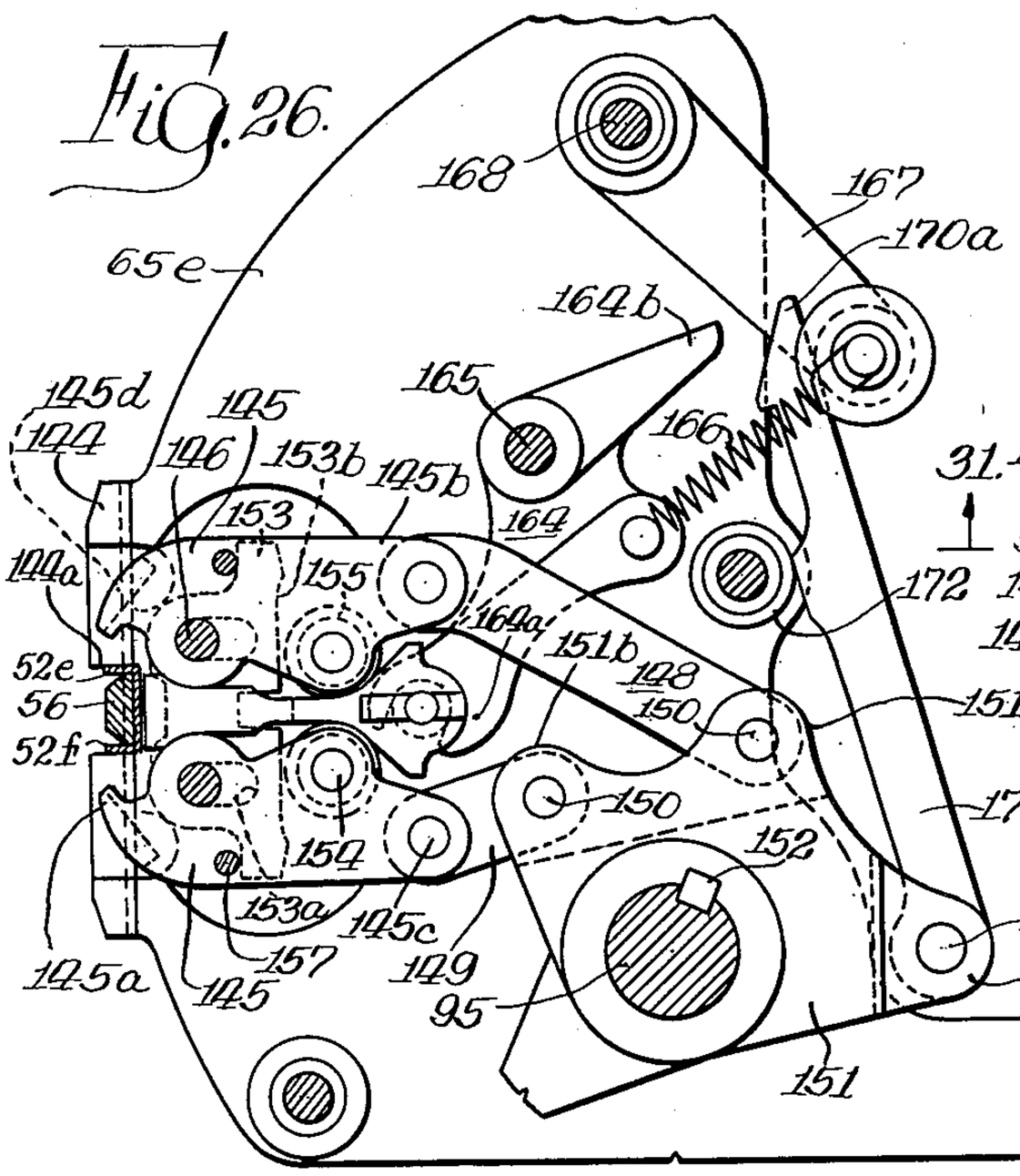


Fig. 30.

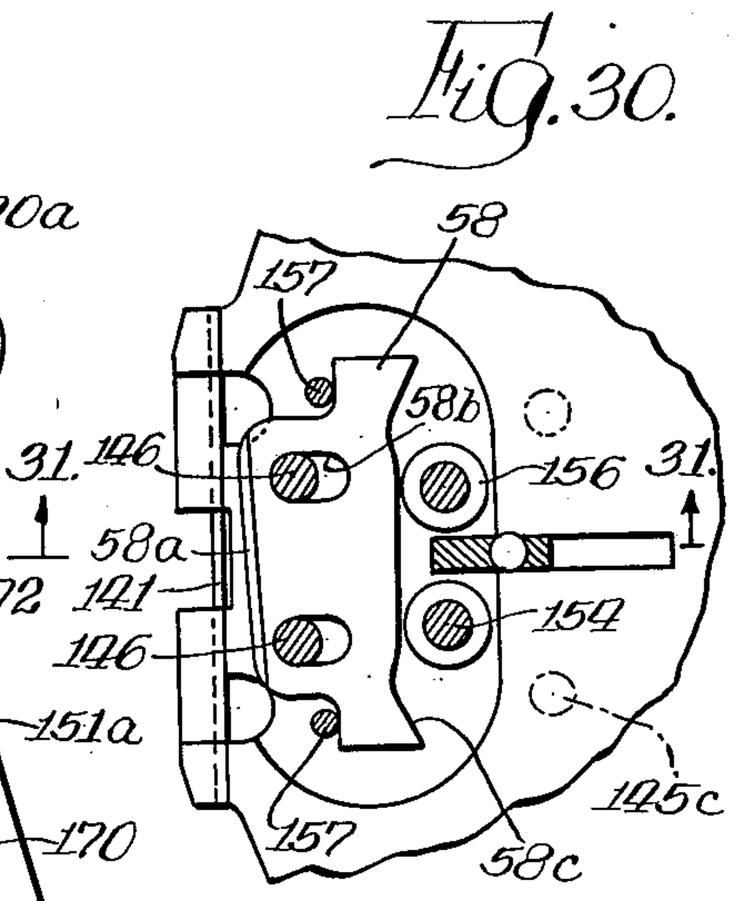


Fig. 27.

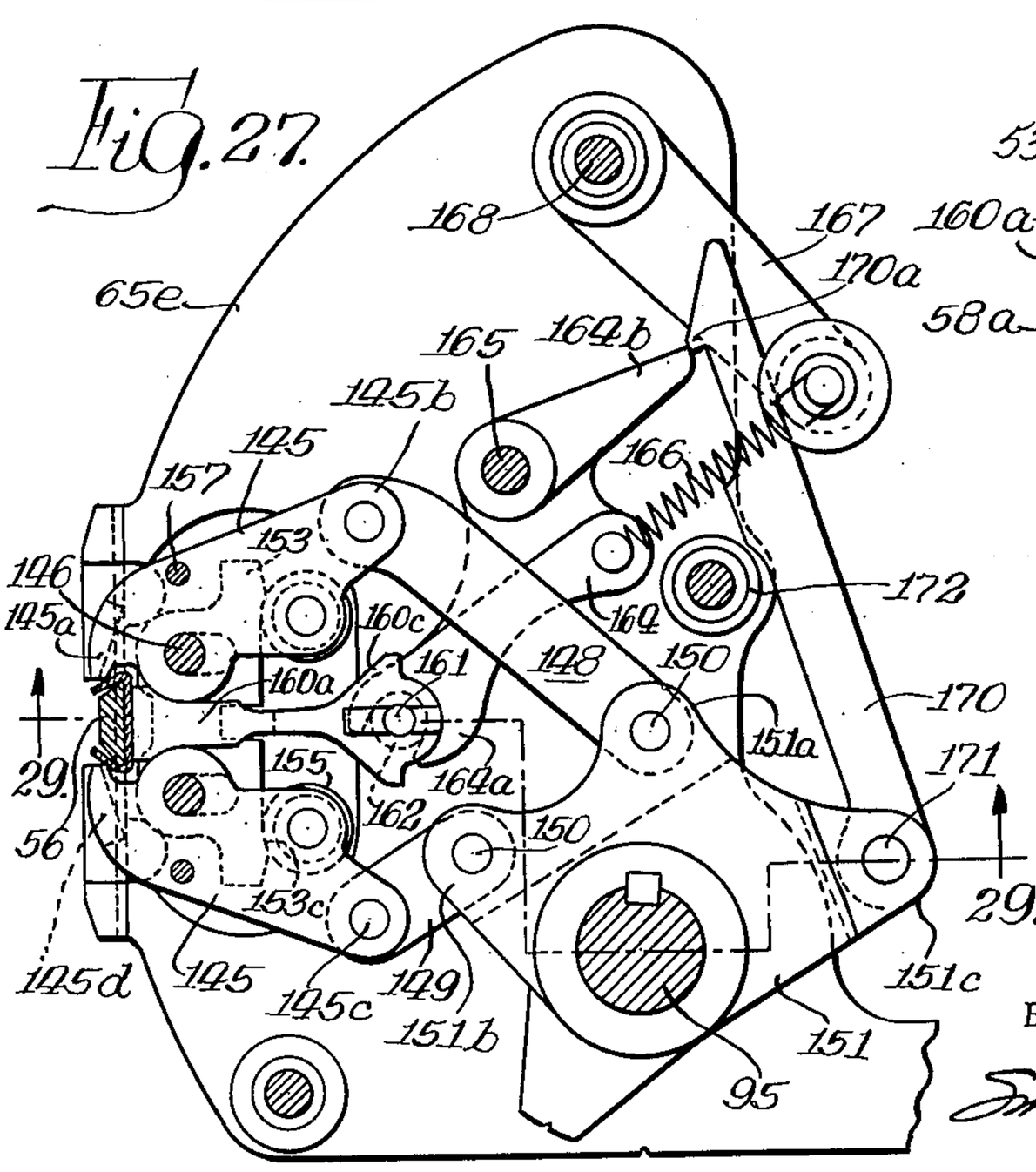
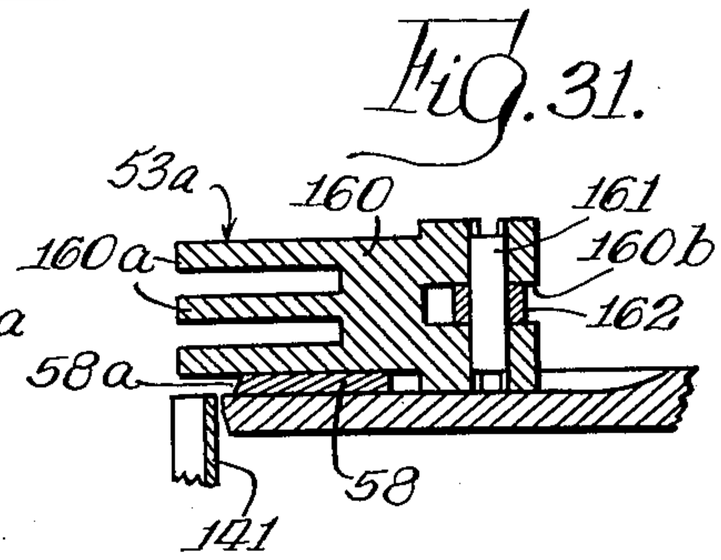


Fig. 31.



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AUTOMATIC BOX STRAPPING MACHINE

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Fig. 28.

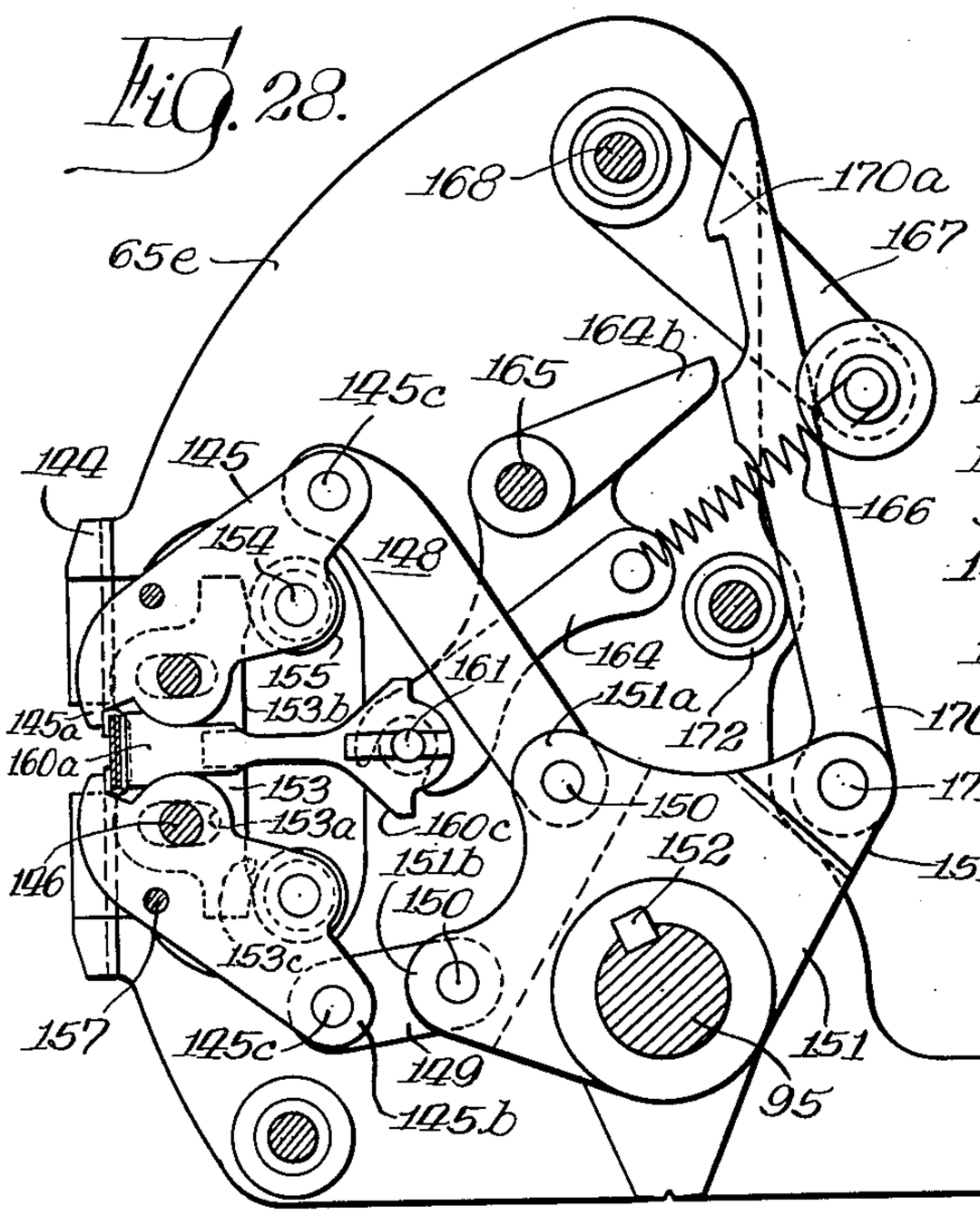


Fig. 32.

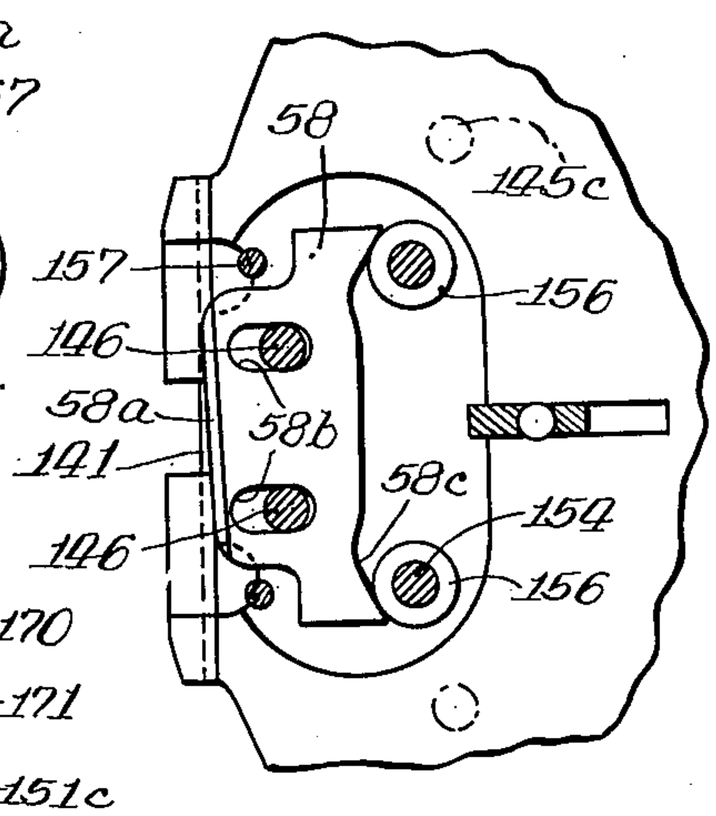


Fig. 29.

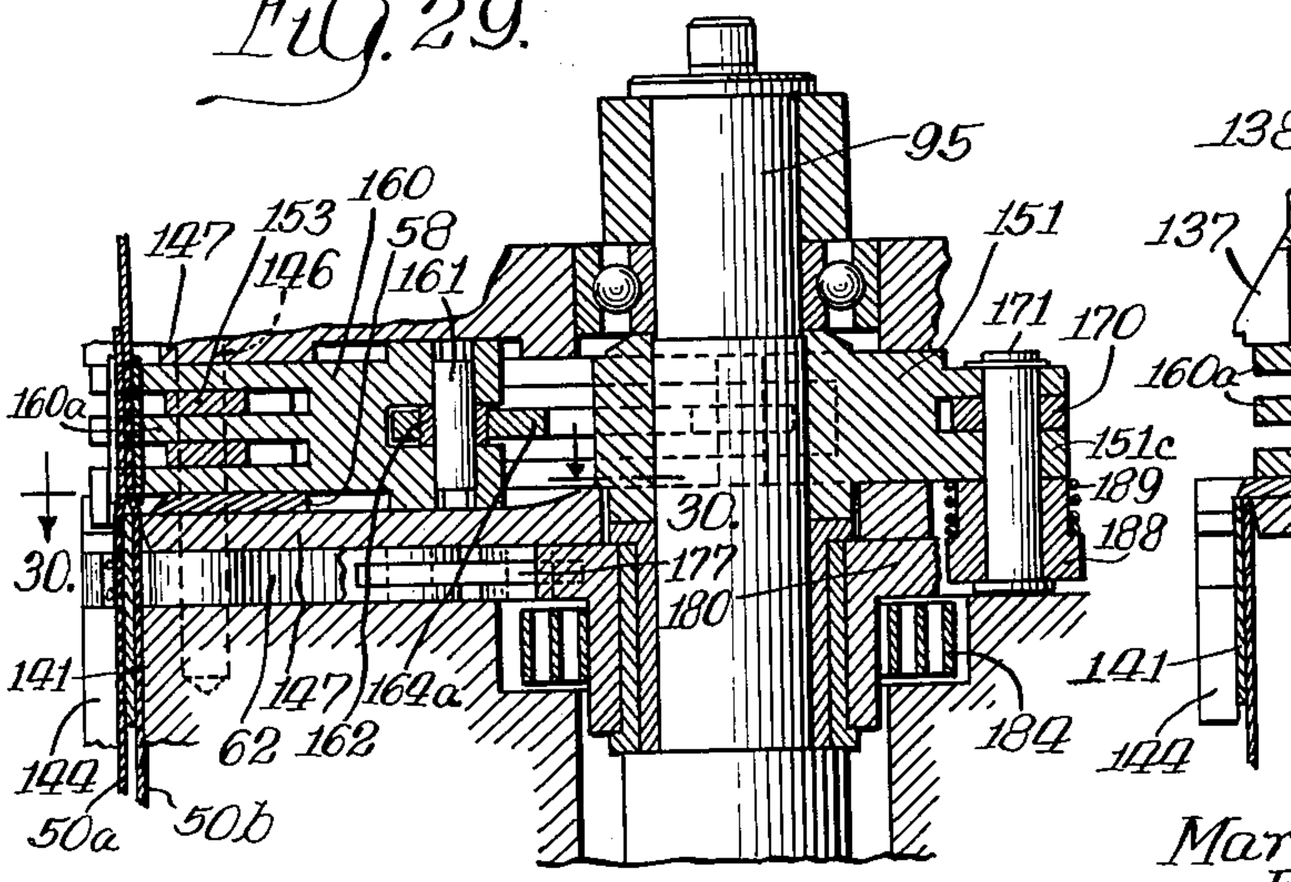
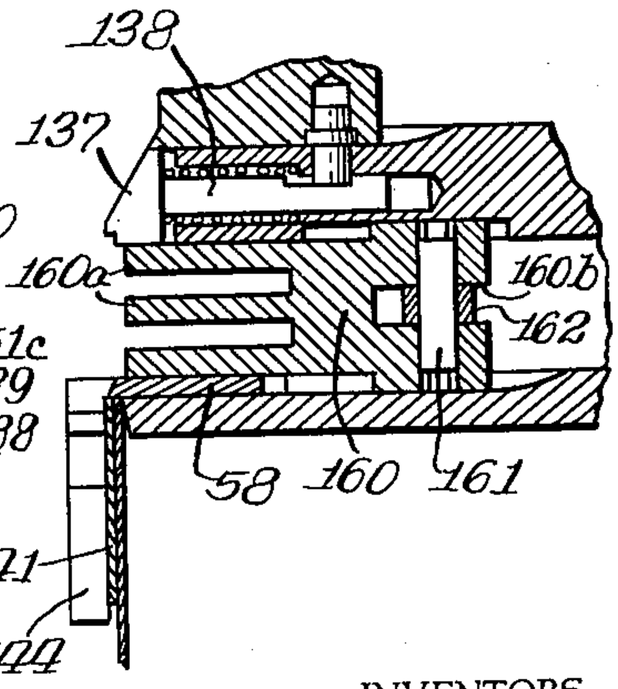


Fig. 33.



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Aug. 27, 1963 M. B. HALL ETAL 3,101,663

AUTOMATIC BOX STRAPPING MACHINE

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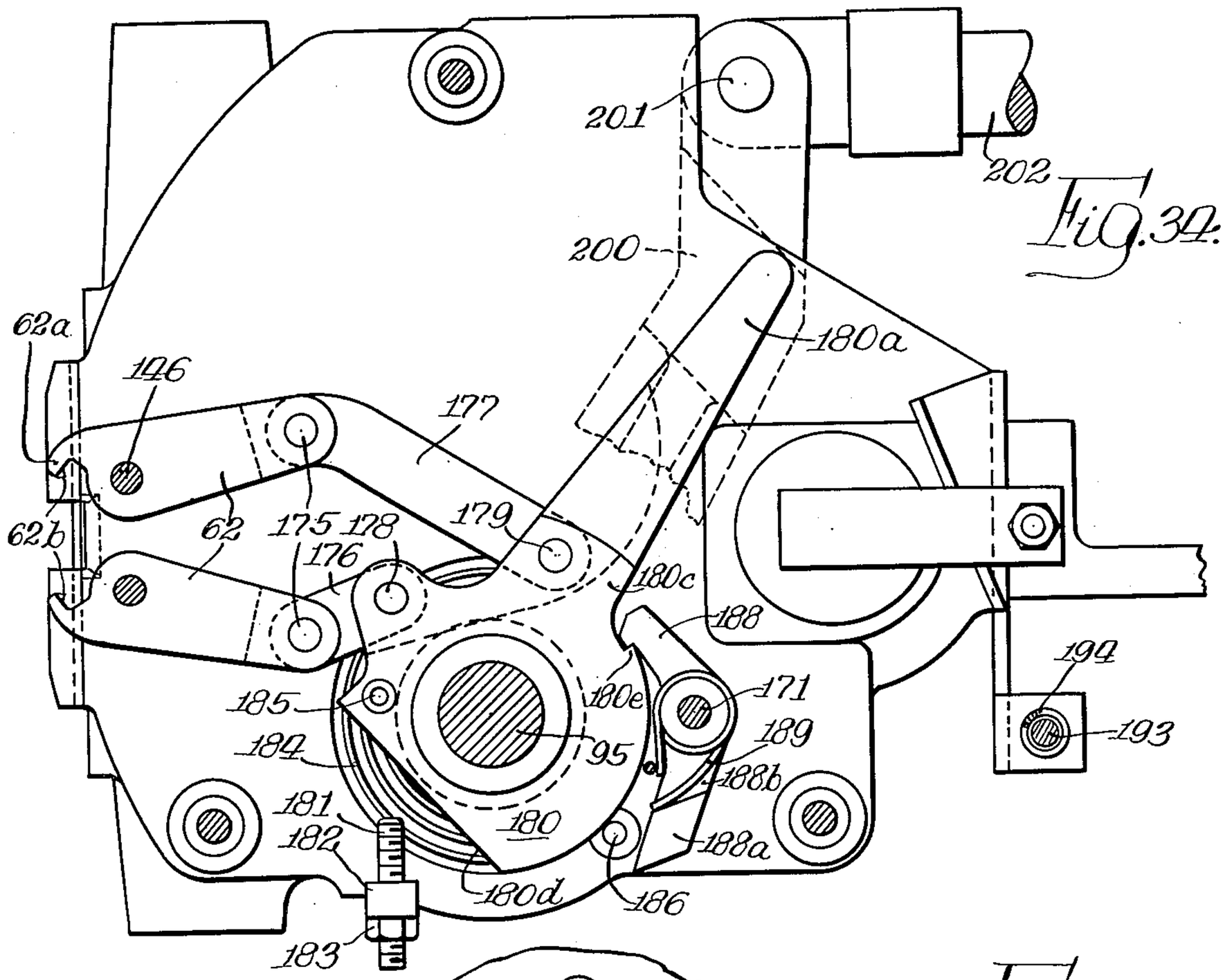

Fig. 34.

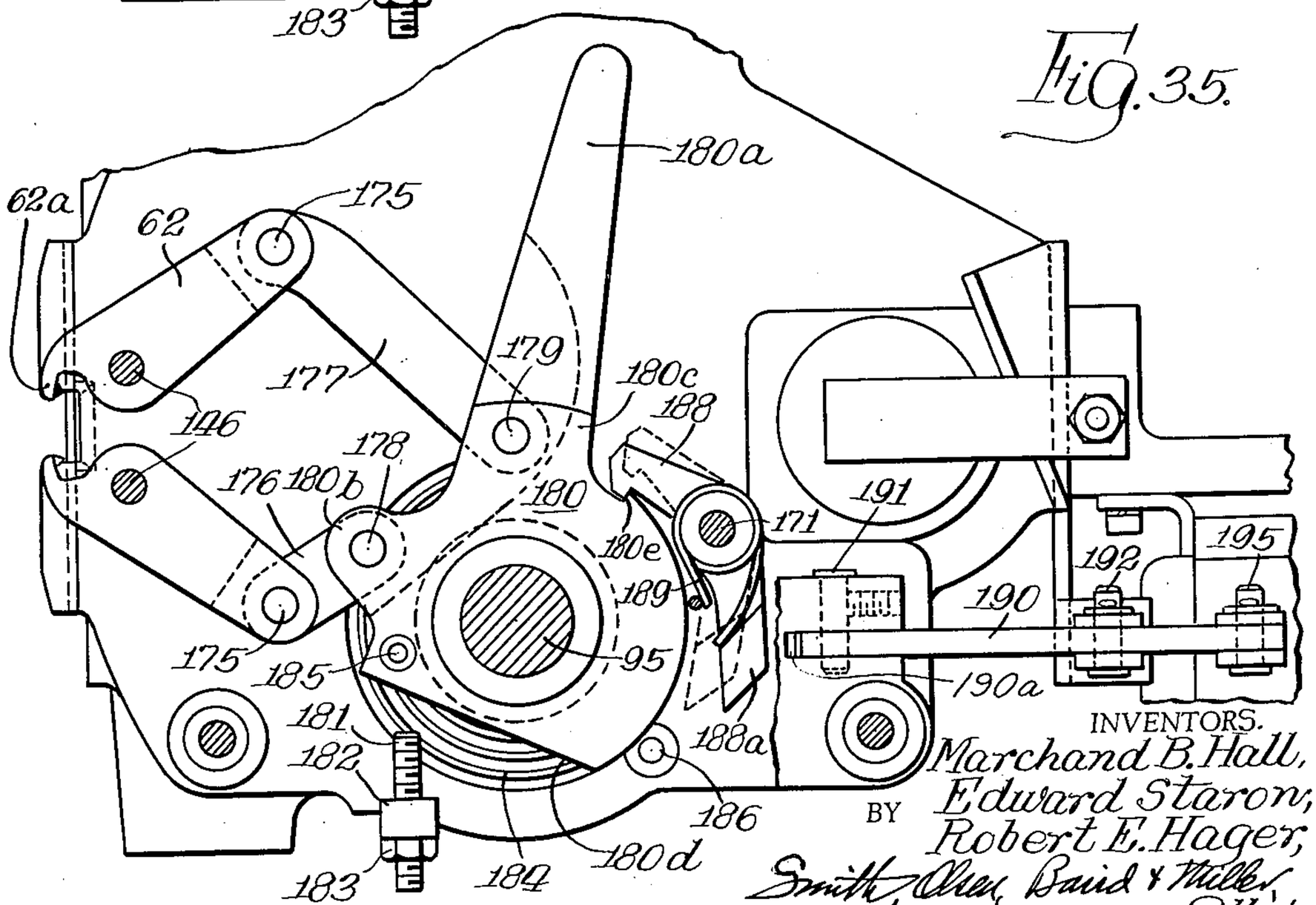

Fig. 35.

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AUTOMATIC BOX STRAPPING MACHINE

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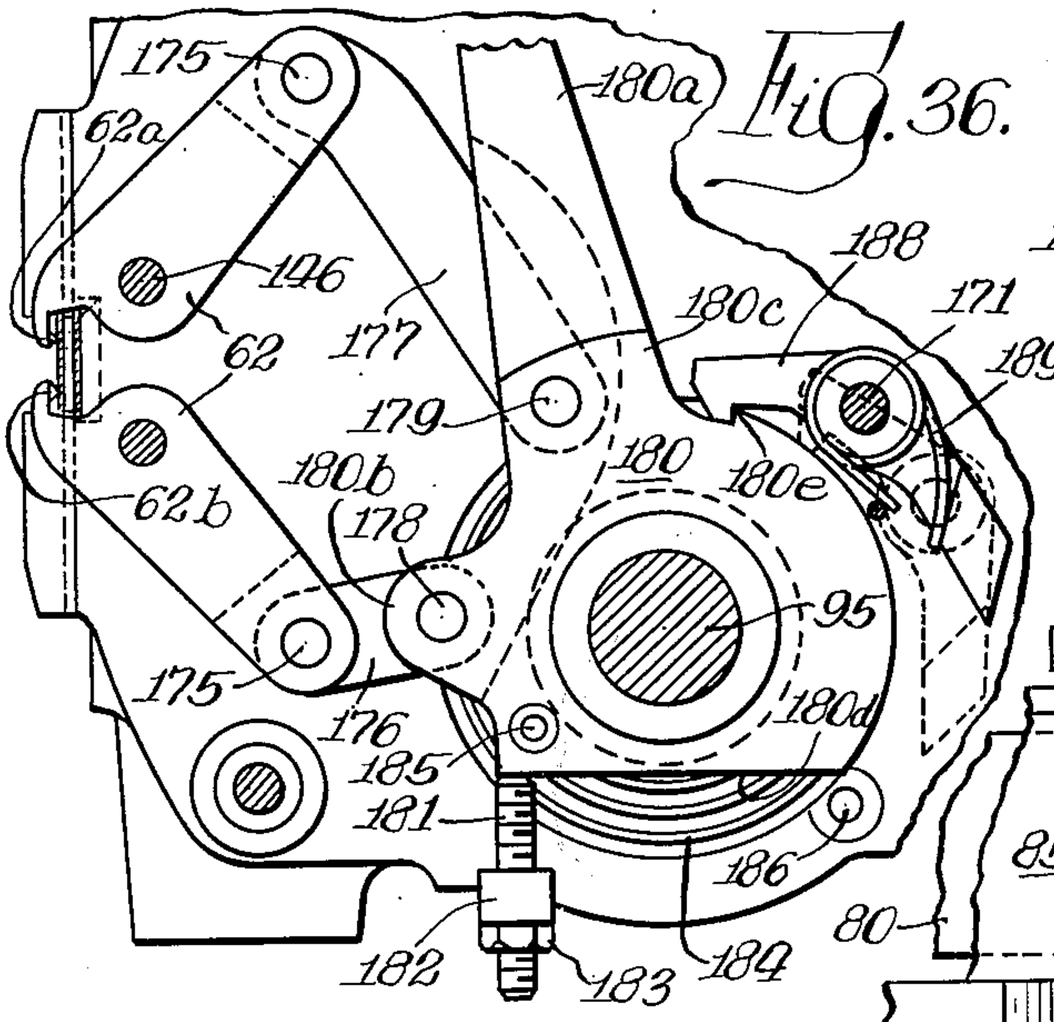

Fig. 36.

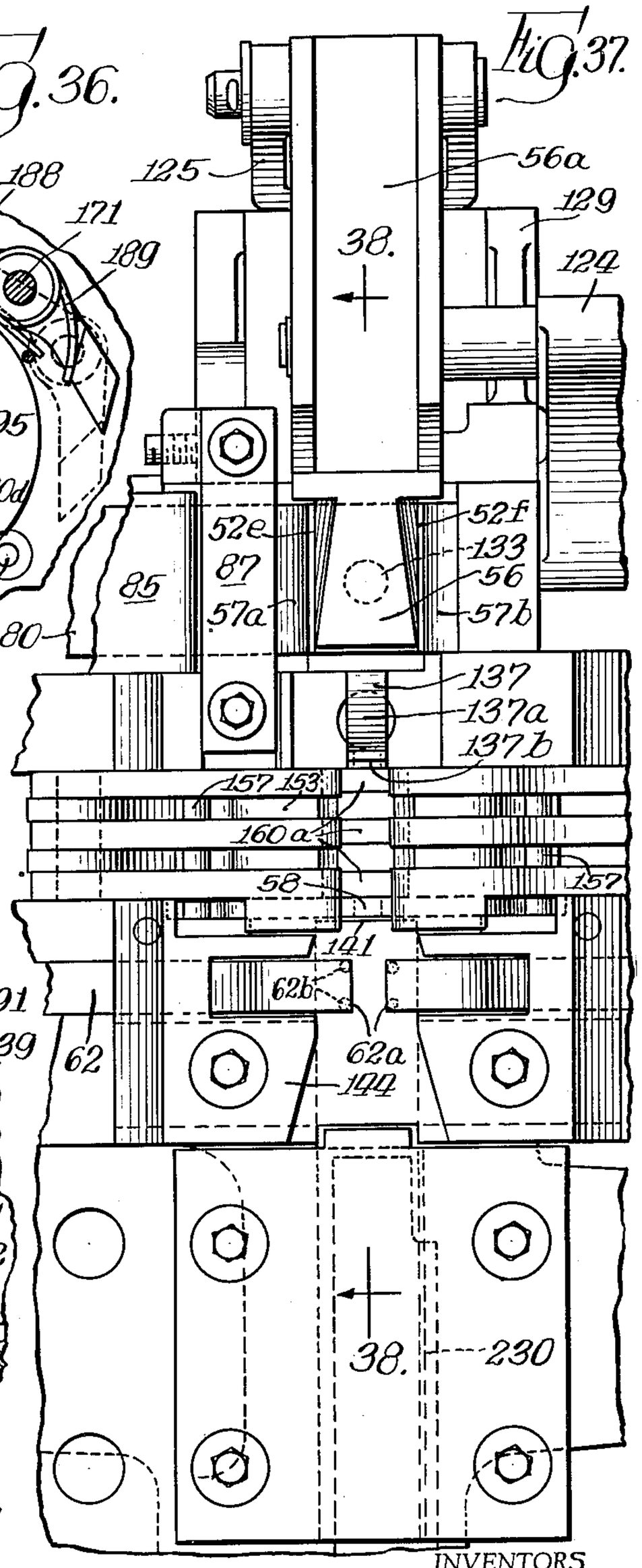

Fig. 37.

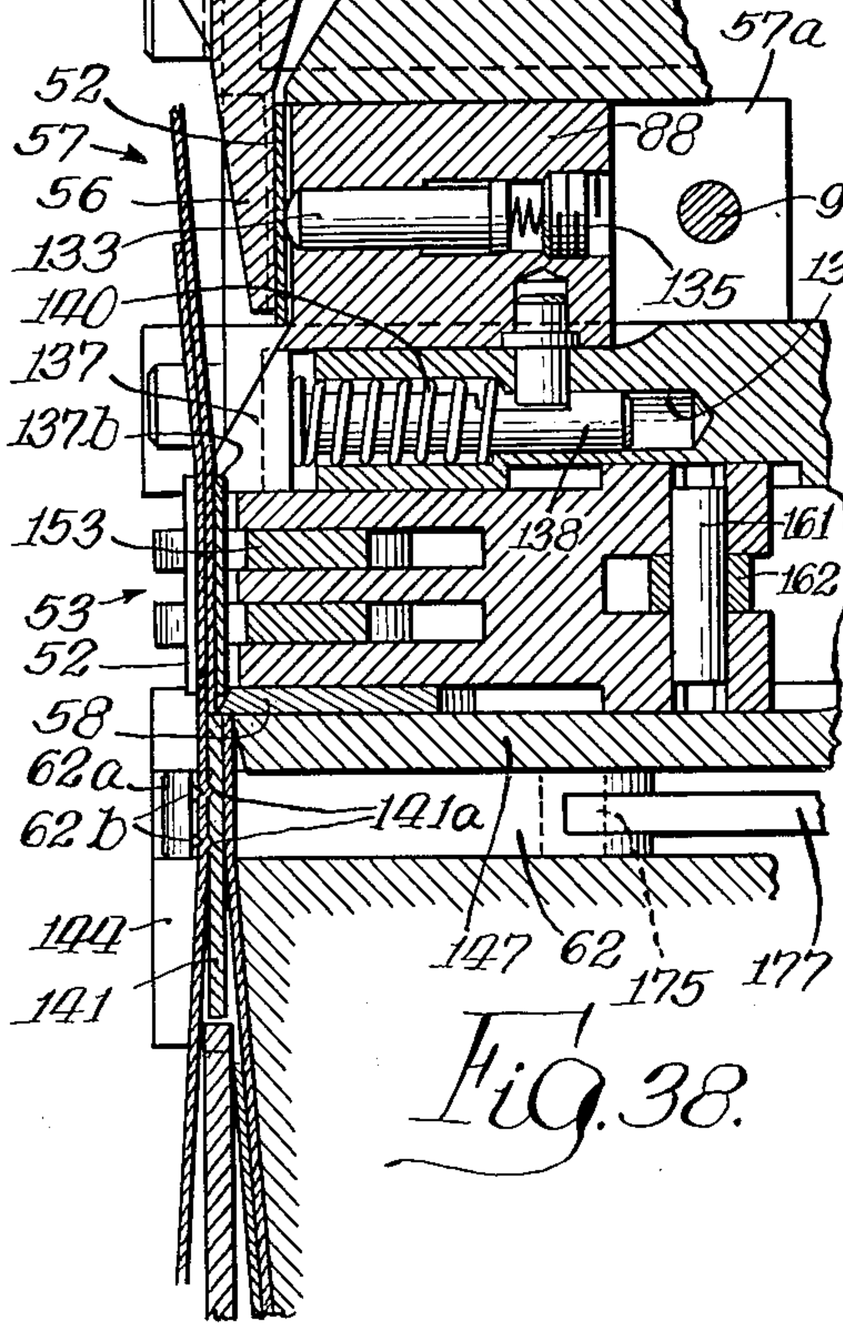

Fig. 38.

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AUTOMATIC BOX STRAPPING MACHINE

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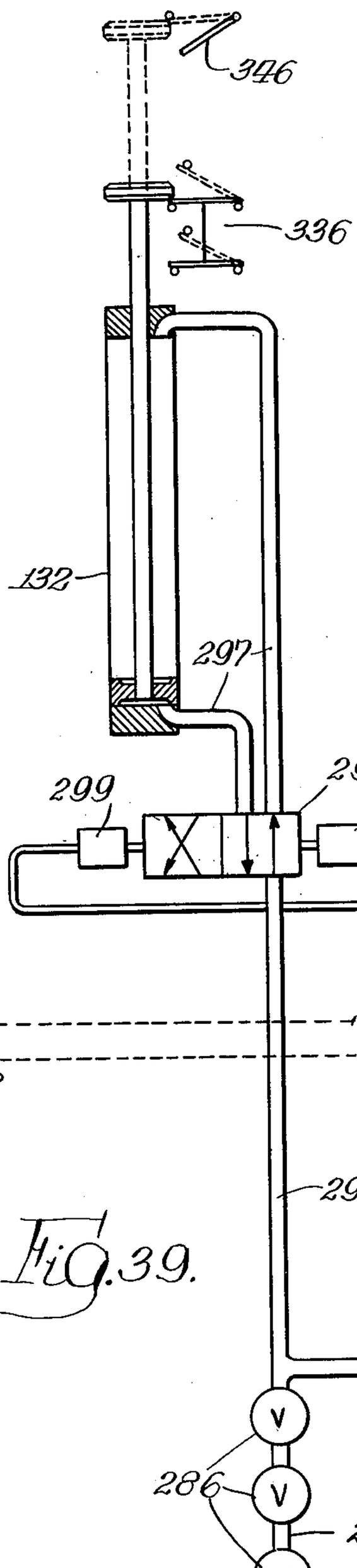

Fig. 39.

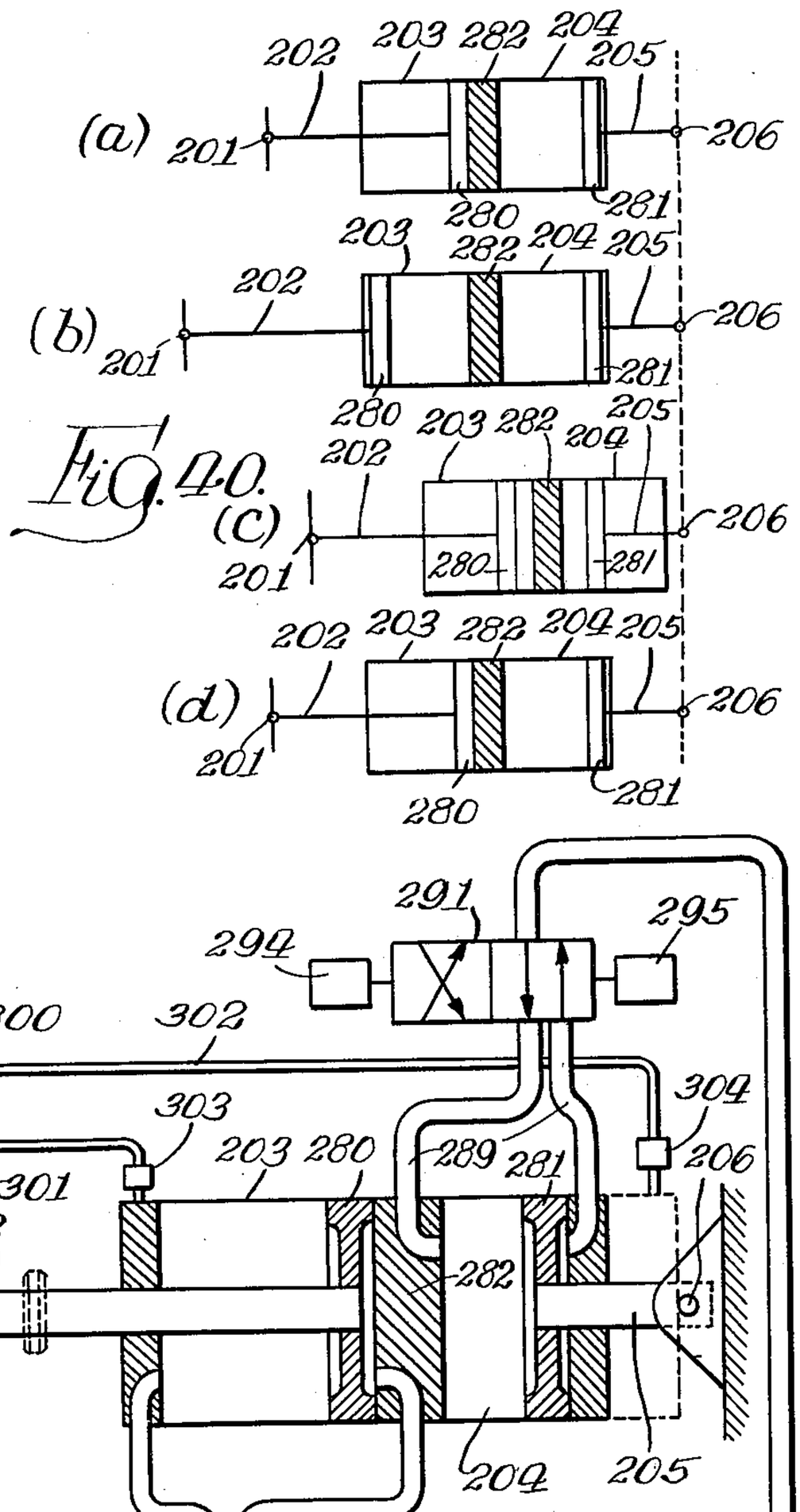

Fig. 40.

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AUTOMATIC BOX STRAPPING MACHINE

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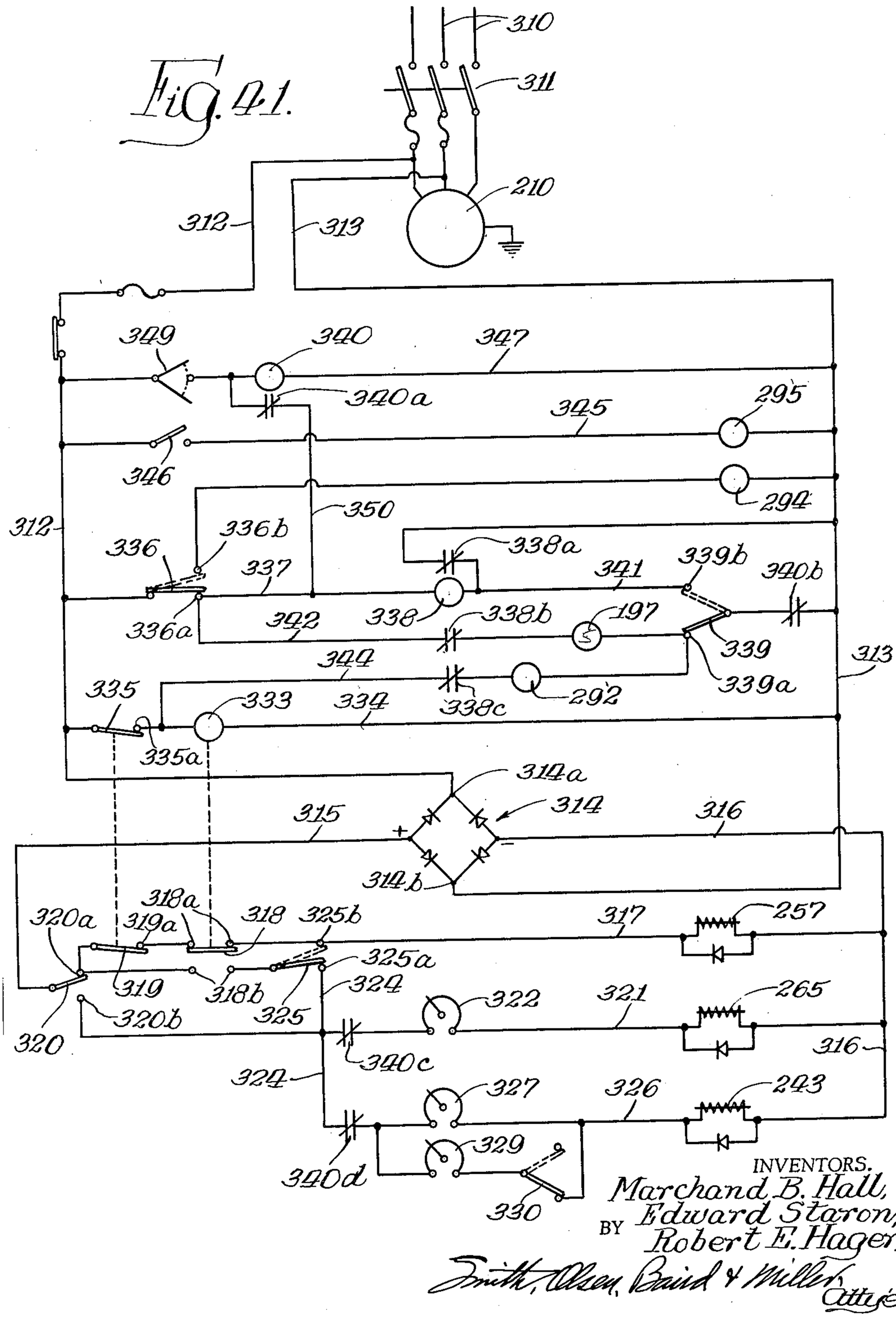
Fig. 41.



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United States Patent Office

3,101,663

Patented Aug. 27, 1963

3,101,663

AUTOMATIC BOX STRAPPING MACHINE

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Filed Feb. 14, 1957, Ser. No. 640,263
11 Claims. (Cl. 100—30)

This invention relates to improvements in machines for applying metal binding straps around boxes, packages or other objects, and its purpose is to provide an improved machine which may be efficiently employed for this purpose and which is fully automatic in its operation except for the initial step of looping the strap about the object to be bound.

The present improvements are particularly adapted for use in a machine of the type in which a metal seal is caused to enclose the overlapping strap ends and which is deformed together with the enclosed strap ends, after the strap has been drawn taut about the object being bound, to provide an interlocking joint.

The principal object of the invention is to provide a machine capable of performing all of the steps of feeding seal stock and automatically forming a channel shaped seal therefrom, moving a seal to the sealing position, feeding a binding strap from a source of supply through the channel shaped seal to provide a length of strap sufficient to be looped around the box or other object to be bound with its free end extending through said seal in overlapping relation to said supply portion, then gripping the free end of the strap, then reversing the feeding means to draw the strap taut, then operating a sealing device to form a joint between the seal and the enclosed strap portions, cutting off the supply portion of the strap as the joint is completed while at the same time forming a new seal for the next sealing operation, then ejecting the seal joint from the sealing device, and then feeding the seal which has just been formed to the sealing position in readiness for a new operation.

Another object of the invention is to provide improved mechanism for performing each of the steps of the operation which have been referred to above. A further object is to provide an improved machine of the type referred to comprising power driven mechanism having a single operating shaft which operates through novel connected devices to feed the seal stock and partially form a seal from a portion cut from the seal stock, to grip the free end of the strap while it is being drawn taut around the package, to form a sealed joint after the seal has been moved to the sealing position, and then to eject the seal joint from the sealing means. Still another object is to provide improved means for forming a seal from seal stock and for advancing the formed seal from the seal forming position to the strap sealing position. A further object of the invention is to provide a novel pneumatic system and a novel electric system for automatically causing the operations referred to above to be performed in proper sequence and timed relation. Other objects relate to various features of construction and arrangement which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one embodiment is illustrated. In the drawings,

FIGURE 1 is a diagrammatic side elevation of the primary parts of the machine showing them in the relative positions which they occupy at the commencement of a strapping operation with the binding strap being fed from the source through a partially closed channel shaped seal which acts as a guide;

FIG. 2 is a view similar to that of FIG. 1, showing a box resting on its support with the strap being fed from the supply and looped around the box with its free end extending through the partially closed guide seal through which the supply portion of the strap has been fed;

FIG. 3 is a view similar to that of FIG. 2, showing the relative positions of the parts at a later stage of the operation after the free end of the strap has been gripped and held by gripping dogs and after the strap feeding device has been reversed to draw the strap taut around the box;

FIG. 4 is a view similar to that of FIG. 3, showing the relative positions of the parts at a still later stage of the operation when the sealing device has been operated to form a joint, the shearing blade has been actuated to cut off the supply portion of the strap and the seal former has been operated to form another seal over the forming anvil;

FIG. 5 is a view similar to FIG. 4, showing the parts at a later stage of the operation when the seal former has been retracted leaving a new seal on the anvil, the gripping dogs have been withdrawn, the shearing blade and the sealing device have been retracted and the ejector has been operated to eject the completed joint from the sealing device;

FIG. 6 is a view similar to the preceding ones showing the parts after the bound box has been removed from its support, and the anvil has been actuated to move the new seal to the open jaws of the sealing device;

FIG. 7 shows the parts at a still later stage after the sealer has been operated to form partially the new seal delivered by the anvil;

FIG. 8 is a view similar to FIG. 7, showing the anvil being retracted and the strap feeding device feeding a new length of strap through the partially formed seal;

FIG. 9 shows the parts illustrated in FIG. 7 in readiness for a new strapping cycle;

FIG. 10 is a perspective view of a box which has been bound by the use of the strapping machine of the present invention with two pairs of straps extending in right angular directions;

FIG. 11 is a perspective view on an enlarged scale of one of the strap joints formed by the machine of the present invention;

FIG. 12 shows an end elevation of what may be regarded as the left hand end of a machine embodying the invention, including the parts which are diagrammatically illustrated in FIGS. 1 to 9, inclusive;

FIG. 13 shows an elevation of the right-hand end of the machine shown in FIG. 12 with certain portions broken away for clarity;

FIG. 14 shows a front elevation of the machine illustrated in FIG. 12 with the box supporting table removed, the section being taken on the line **14—14** of FIG. 13;

FIG. 15 shows a top plan view of the machine illustrated in FIG. 12 with the box supporting table and the seal stock feeding mechanism removed, the section being taken on the line **15—15** of FIG. 13;

FIG. 16 is a partial elevational view, on a reduced scale, of the rear of the machine illustrated in FIGS. 14 and 15, taken on the line **16—16** of FIG. 12 with the seal stock feeding mechanism removed;

FIG. 17 shows an elevation of the front end of the box supporting table, the view being taken on the line **17—17** of FIG. 12;

FIG. 17A is a fragmentary plan view of the portion of the machine illustrated in FIG. 17;

FIG. 18 shows an enlarged fragmentary section taken on the line **18—18** of FIG. 12;

FIG. 19 shows an enlarged section taken on the line **19—19** of FIG. 13;

FIG. 20 shows a sectional view taken on the line **20—20** of FIG. 13;

FIG. 21 shows an elevation on the line 21—21 of FIG. 15 with parts of the machine illustrated in section;

FIG. 22 shows an end elevation of the structure shown in FIG. 21, the view being taken along the line 22—22 of FIG. 21 with the seal stock feeding mechanism removed;

FIG. 23 shows a sectional view taken on the line 23—23 of FIG. 21;

FIG. 24 shows a sectional view through the seal stock illustrating the engagement with an aperture in the device of the stock feeding arm;

FIG. 25 shows an enlarged sectional view taken on the line 25—25 of FIG. 23;

FIG. 26 shows a section taken on the line 26—26 of FIG. 21, illustrating the sealing jaws and other parts of the sealing device in elevation, with the jaws in open position;

FIG. 27 is a view similar to FIG. 26, showing the jaws partially closed;

FIG. 28 is a view similar to those of FIGS. 26 and 27, showing the sealing jaws fully closed;

FIG. 29 is a horizontal section taken on the line 29—29 of FIG. 27;

FIG. 30 is a sectional view taken on the line 30—30 of FIG. 29, showing an elevation of the shearing blade and cooperating parts;

FIG. 31 is a sectional view taken on the line 31—31 of FIG. 30;

FIG. 32 is a view similar to FIG. 30, showing the shearing blade in its extended position;

FIG. 33 is a sectional view similar to but more extensive than FIG. 31, showing the shearing blade in its forward position and the joint ejector retracted;

FIG. 34 is a sectional view taken on the line 34—34 of FIG. 21, illustrating the mechanism for gripping and holding the free end of the strap, the gripping jaws being shown in open position;

FIG. 35 is a view similar to that of FIG. 34, but with the jaws in partially closed position;

FIG. 36 is a view similar to those of FIGS. 34 and 35 but with the jaws in fully closed position;

FIG. 37 is an enlarged front elevation of the upper part of the machine shown in FIGS. 12 and 14;

FIG. 38 shows a vertical section taken on the line 38—38 of FIG. 37;

FIG. 39 is a diagrammatic view of the pneumatic system by which various parts of the machine are actuated and controlled;

FIG. 40 is a diagrammatic sectional view showing different positions of the pistons and the double cylinder by which various parts of the machine are actuated by the pneumatic system shown in FIG. 39; and

FIG. 41 is a circuit diagram of the electrical system by which the sequence and time relation of the operation of the different parts of the machine are controlled.

In FIGS. 1 to 9, inclusive, of the accompanying drawings, the principal parts of the machine and the sequence of their operation are somewhat diagrammatically illustrated and these views will be described in a general way before proceeding with the detailed description of the actual structure of the machine.

The relationship of the parts preliminary to placing a box on the machine to be bound is shown in FIG. 1 where the metal binding strap 50 is shown passing upwardly past the box supporting table 51 and through a partially formed channel shaped seal 52 having converging side walls which is being held by the sealing device 53. The strap is withdrawn from a supply and moved endwise by a power driven feed roll 54 which presses the strap against an idler roll 55. Above the sealing device in an anvil 56 about which the seal 52 is formed by a seal former 57. The seal 52 is formed from metal stock which is advanced intermittently to the forming position by feeding means not shown. A shearing blade 58 is mounted below the sealing device 53 and is adapted to

be actuated to cut off the strap when the joint has been formed.

In FIG. 2 there is shown the relative positions of the parts referred to after a box 60 has been placed on the table 51 and the strap 50 has been looped manually around the box while being fed endwise by the feed roll 54 as indicated by the arrows 61. After being looped around the box the free end 50*a* of the strap is manually threaded through the seal 52 so that it overlaps the supply portion 50*b* of the strap.

The next stage of the operation is shown in FIG. 3 where gripping dogs 62 have been actuated to grip and hold the free end 50*a* of the strap while the feed roll 54 has been reversed to move the supply portion 50*b* of the strap in the direction of the arrows 63 and thereby draw the strap taut around the box.

The machine then reaches the stage shown in FIG. 4 where the sealing device is shown as having been operated to deform the seal 52 and the enclosed strap ends while the shearing blade 58 has been operated at the conclusion of the joint forming operation to sever the supply portion of the strap beneath and adjacent to the seal. At the same time the seal former 57 is actuated to form a new seal 52*a* about the lower end of the anvil 56 in readiness for the next strapping operation.

The next step of the machine operation is shown in FIG. 5 where the shearing blade 58 and the seal former 57 have been retracted and an ejector 53*a*, associated with the sealing device, has been actuated to eject the seal joint from the jaws of the sealing device.

After the ejector 53*a* and the jaws of the sealing device are fully retracted, the anvil 56 is then actuated as shown in FIG. 6 to move, the new seal 52*a* downwardly and forwardly to a position to be operated upon by the sealing device 53, the ejector 53*a* having by that time been withdrawn.

In FIG. 7 the new seal has been engaged by the sealing device 53 and its walls partially bent about the anvil 56. The anvil is then withdrawn from the seal 52*a*, as shown in FIG. 8, and the feed roll 54 is actuated to feed the free strap end upwardly through the seal 52*a*, the side walls of the seal 52*a* guiding the strap as it is fed upwardly therethrough. The parts are then in the relative positions shown in FIG. 9, like FIG. 1, from which positions a new length of strap 50 may be looped around a box as a part of the next strapping operation.

The box 60 may have two straps 50*c* looped around it in planes at right angles to the planes of two other straps extending around the box, as shown in FIG. 10, and the joints between the overlapping ends of the straps may have the form shown particularly in FIG. 11 where the seal 52 and the enclosed strap ends 50*a* and 50*b* are partially sheared transversely at the edges thereof where the seal is folded around the overlapping strap ends and the metal between each pair of cuts 52*c* is deflected transversely as shown at 52*d* so that abutting shoulders are formed which prevent relative endwise movement of the seal and the strap ends. The box 60 may be turned on the supporting table 51 to permit the convenient application of the binding straps as shown in FIG. 10.

As shown particularly in FIGS. 12, 13, 14 and 15, the machine comprises a frame 65 which includes a heavy rectangular vertical plate 65*a* secured to downwardly extending frame members 65*c* which are secured to channel-shaped horizontal frame members 65*d*.

At the forward end of the machine, the frame 65 carries the box supporting table 51 which comprises a front vertical plate 66, a rear plate 67 and a series of cylindrical rollers 68 which have their trunnions 68*a* journaled in the plates 66 and 67 so that the boxes 60 may be readily passed to and from the strapping position while allowing the binding strap to be passed downwardly between two adjacent rollers when looping the strap around a box. The front plate 66 is supported by an inverted channel shaped brace member 69 which has its lower end secured

to the frame members 65*c* and which is inclined upwardly and forwardly therefrom with its forward end secured to the plate 66 as shown in FIG. 12.

The member 69 supports a strap guide 70, shown in FIGS. 12, 17 and 18, which guides the binding strap 50 as it is looped around the box. This guide 70 comprises a downwardly and forwardly inclined curved portion 70*a* which communicates with an upwardly and forwardly inclined straight portion 70*b* arranged to terminate adjacent to the upper part of the plate 66 to which it is secured. The plate 66 is provided with a rectangular slot 66*a* (see FIGS. 12 and 17) through which the free end of the strap may be passed as it is looped around the box. A pair of guide plates 72*b* is provided on the straight portion 70*b*, the outer ends of the plates 72*b* also passing through openings in the plate 66 and being directed outwardly from each other as at 72*c* (see FIG. 17A). The outer edges of the slot 66*a* may be beveled as at 66*b* to avoid sharp corners and to aid in directing the strap through the slot 66*a* onto top of the guide portion 70*b* and between the guide plates 72*b*. The curved portion 70*a* of the strap guide directs the strap upwardly so that the strap end may be thrust through the seal 52. The portion 70*a* of the strap guide 70 comprises a bar 71 (see FIG. 18) having side plates 72 which have their upper edge portions 72*a* converging inwardly to overlap the strap passing between them. The side plates 72 are normally held against the bar 71 by coil springs 73 which are mounted on bolts 74 extending through apertures 71*a* formed in the bar 71, only one bolt 74 and associated parts being shown in FIG. 18. Each bolt 74 carries two washers 75 and a nut 76 and the two springs 73 on each bolt seat in cup-shaped retaining members 77 which fit in the aperture 71*a* and in apertures formed in the plates 72 with their annular flanges overlapping these plates. The side plates 72 are thus permitted to yield away from each other to any extent necessary to permit the strap to be subsequently removed from the guide.

Since the seal 52 serves as a guide for the binding strap, the means for forming the seal from the seal stock and placing it in the guiding position will now be described. The seal stock 80 in the form of a coiled strip is provided at equally spaced intervals with centrally located round holes 80*a* (see FIGS. 12 and 24), which are employed in the feeding of the stock to the forming position, and the stock is supplied in the form of a spiral coil 80*b* adapted to be mounted on a rotary cup-shaped drum 81. This drum has an annular rim 81*a* over which the stock is withdrawn and it has a central hub 81*b* which centers the coil 80*b* and this hub is mounted to rotate about a spindle 82 fixed in a plate 83 mounted on a pedestal 84 which extends upwardly from the frame 65 (FIG. 12).

As the seal stock 80 passes from the reel 81 (FIG. 12) it moves into a curved guide 85 (FIG. 23) which is mounted in fixed position on the upper part of the frame of the machine and which is provided with a longitudinal curved passage 85*a* through which the seal stock 80 passes in the direction of the arrow 86. The stock 80 passes from the discharge end of the guide 85 through an opening 87*a* formed in a member 87 secured to the frame and the stock then extends outwardly opposite the lower end of the anvil 56 which will have been moved downwardly to the position shown in FIG. 23 by the mechanism hereinafter described. The seal former 57, previously described, comprises two blades 57*a* and 57*b* which are mounted on opposite sides of a block 88 secured to the frame midway between the member 87 and another similar member 89 which is also secured to the frame. When the former 57 is moved toward the left, as viewed in FIG. 23, the upper blade 57*a* thereof cooperates with the member 87 to cut off the seal stock from the source of supply and at the same time to bend the end of the cut-off portion to form a wall 52*e* of a channel-shaped seal. At the same time the other blade

57*b* of the former moves beneath the anvil 56 to bend the other end of the cut-off portion of the seal stock to form the other side wall 52*f* of the seal 52 which has previously been described. The member 89 is provided with a threaded aperture engaged by a plug 90 which may be adjusted to vary the position of the blade 57*a* of the former with respect to the part 87.

The inner end of the former 57 is pivotally connected by a pin 91 to a link 92 which, in turn, is pivoted at 93 upon a crank arm 94 secured upon a shaft 95 which is the main shaft of the machine, serving not only to actuate the seal stock feeder and the seal stock former but also the means by which the joint is formed between the seal and the overlapping ends of the binding strap and the means for ejecting the joint from the jaws of the sealing device. The main shaft 95 is rotated intermittently in the manner hereinafter described and it is adapted to control the actuation of the seal stock feeding means through another crank arm 96 which is fixed thereon. The seal stock feeding means comprises a dog 100 which is pivoted at 101 upon the stock feeding lever 102. The dog 100 is provided at its outer end with a projecting tooth 100*a*, shown in FIG. 24, which is adapted to enter one of the apertures 80*a* which are formed in the seal stock 80. The dog 100 is maintained in contact with the lower face of the seal stock 80 through a slot in the guide 85 by means of a coil spring 103 which is mounted on the pivot pin 101 and which has one arm engaging the lever 102 and the other arm engaging the dog. When the lever 102, which is pivoted at 104 on the frame of the machine is moved in a counterclockwise direction, as shown in FIG. 23, the seal stock 80 is advanced by the dog 100 toward the anvil 56. The stroke of the feeding dog 100 may be regulated by a stop screw 105 which threadedly engages the lever 102 and which is adapted to abut against the upper side of the stationary member 87. This stop screw 105 may be secured in adjusted position by a lock nut 106.

The actuation of the seal stock feeding lever 102 during its feeding stroke is effected by a coil spring 107 which is mounted on a pin 108 carried by that lever and which spring 107 extends outwardly into engagement with a thimble 109 having a screw threaded engagement with a clamping device 110 mounted on the frame of the machine. The thimble 109 may be adjusted endwise to vary the compression of the spring 107 and thereby vary the pressure with which the feeding lever 102 is actuated.

The movement of the lever 102 in the reverse direction to retract the feeding dog 100 is effected by the lateral extension 102*a* of the lever 102 which is provided at its lower end with a pin 111 having a sliding engagement with a slot 112*a* formed in a link 112. This link is pivotally connected by a pin 113 with the crank arm 96 fixed on the shaft 95 and, when the crank arm 96 is moved in a clockwise direction as viewed in FIG. 23, a roller 114 mounted on the pin 111 engages a stop screw 115 which is adjustably mounted in a threaded aperture formed in the end of the link and which is held in adjusted position by a lock nut 116. The engagement of the stop screw 115 with the roller 114 causes the lever arm 102*a* to be actuated in a clockwise direction and the same motion is thereby imparted to the lever 102 so that the feeding dog 100 is retracted and moved outwardly along the guideway 85. During this reverse movement of the feeding dog 100, the seal stock 80 is held in adjusted position by means of a detent 118 which has a tooth 118*a* arranged to engage another of the apertures 80*a* in the seal stock under the influence of a coil spring 119 by which it is pivotally mounted upon an arm 120 secured at 121 on the frame of the machine. In this manner, the rotary motion of the main shaft 95 is utilized to control the movement of the seal stock to the seal forming position and also to actuate the seal former 57 by which the channel-shaped seal is formed on the anvil 56.

After the seal stock 80 has been moved in a horizontal

plane through the guideway 85 and the seal 52 has been formed on the lower end of the anvil 56, to produce a channel-shaped seal as shown in FIG. 23, the anvil 56 is moved downwardly from the position shown in FIGS. 21 and 23 until the seal 52 has been positioned between the jaws of the sealing device 53 which will be described more fully later. For this purpose, the enlarged upper end 56*a* of the anvil, shown particularly in FIGS. 13, 21 and 22, is pivotally connected to a link 124 and a lever 125. This link is pivoted at 126 to a bracket 127 carried by the frame of the machine and the lever 125 is pivoted at 128 to another bracket 129 fixed on the frame of the machine. The lever 125 extends rearwardly from its pivot 128 and has a downturned extremity which is pivoted at 130 to a piston rod 131 mounted in a cylinder 132. Upon admission of compressed fluid to this cylinder the piston connected to the piston rod 131 is actuated to operate the lever 125 and thereby move the anvil 56 in a general vertical direction. As the anvil 56 moves downwardly from the position shown in FIG. 21, it also moves forwardly and away from the block 88 (see also FIG. 23). When the seal 52 is formed against the anvil 56, as shown in FIGS. 23, 25 and 38, it is held in contact with the anvil by a plunger 133 (see FIG. 38) which is mounted in a bore formed in the block 88 and actuated by a coil spring 134 (see FIG. 25) to press its tip against the back wall of the seal. The compression of this spring is regulated by a plug 135 which threadedly engages the end of the bore and the movement of the plunger away from the plug is limited by a flange 133*a* (see FIG. 25) on the plunger which engages an annular shoulder in the wall of the bore. As the anvil 56 moves downwardly and forwardly from the position shown by full lines in FIG. 21 to the position shown by dotted lines in that figure, the seal 52 which is being pressed against the anvil by the plunger 133 slides downwardly and forwardly over the inclined face 137*a* of a head 137 on a plunger 138 slidably mounted in a bore 139 formed in the frame of the machine. A coil spring 140 is mounted in this bore between a shoulder at the end of the bore and the head 137 so that the head is normally moved toward the left as viewed in FIGS. 25 and 38 but is retracted by the pressure of the anvil and the seal as their downward movement proceeds. The upper edge of the back wall of the seal finally snaps beneath a shoulder 137*b* formed on the head of the plunger so that the seal is then held in a position frictionally between the jaws of the sealing device 53, as shown in FIG. 38, when the anvil 56 is then moved upwardly. When positioned between the jaws of the sealing device 53, the frictional engagement of the seal with the sealing jaws holds the seal against downward movement until it has been operated upon by the sealing jaws.

The sealing device 53 is shown particularly in FIGS. 14, 26 to 33, inclusive, and FIG. 38 and comprises relatively movable bending jaws 145 which are pivoted on pins 146 extending between the plates 147 (see FIG. 29) carried by the frame and which have inwardly turned extremities 145*a* adapted to move toward each other to bend the side walls 52*e* and 52*f* of the seal toward each other to embrace the overlapping strap ends. In so doing, the jaws extend into a notch 144*a* formed in a plate 144 which is secured to the front edge of the frame members 65*e* (see FIGS. 26, 27 and 28). The jaws have inwardly extending arms 145*b* which are pivotally connected by pins 145*c* to the links 148 and 149. The other ends of these links are pivotally connected by pins 150 to the arms 151*a* and 151*b* of a three armed lever 151 secured on the main shaft 95 by a key 152. The turning of the lever 151 in a counterclockwise direction is adapted to actuate the jaws 145 to cause their tips 145*a* to close upon the side walls of the seal 52 and bend them inwardly toward each other from the positions shown in FIG. 26. The lower end of the anvil 56 is then between the jaws, as shown in FIGS. 26 and 27, and when the jaws reach the positions shown in FIG. 27, the side walls of the seal have been bent inwardly toward each other in conformity with the tapered sides of the anvil.

When the side walls of the seal thus converge as shown in FIG. 27, the anvil 56 is withdrawn from the seal and the strap 50 is threaded twice through the seal as it is looped around the box 60, as previously described. The jaws of the sealer are then moved to the positions where they are fully closed as shown in FIG. 28 to provide an interlocking joint between the seal and the enclosed strap ends, having the form shown in FIG. 11.

The sealing jaws operate in conjunction with a pair of bridges or shearing dies 153 which extend transversely to the sealing head in contact with the sides of the jaws and which are provided with parallel slots 153*a* engaged by the pivot pins 146. Each jaw 145 carries a pin 154 upon which is mounted a roller 155 (see FIG. 30). These rollers engage the rear edges 153*b* of the bridges or dies 153 and as the jaws are closed upon each other these rollers ride on the inclined end portions 153*c* of these edges and force the bridges or dies forwardly against the seal so that the dies cooperate with the jaw portions 145*a* to effect the shearing of the edges of the strap and seal and the deflection of the intervening portions of metal to form the interlocking joint.

During the last stage of the joint forming movement of the jaws 145, the shearing blade 58 is actuated to sever the supply portion of the strap in proximity to the seal. This shearing blade (FIG. 30) has an inclined cutting edge 58*a* and is provided with slots 58*b* which are engaged by the pins 146. As the jaws 145 approach their final closed positions, the inclined surfaces 58*c* on the ends of the rear portion of the shearing blade are engaged by rollers 156 mounted on the jaws and the shearing blade is thereby forced forwardly to shear the supply portion of the strap. After its shearing movement, the blade is returned by pins 157 mounted on the sealing jaws 145 of the sealing head as the sealing jaws 145 are returned during the normal return stroke thereof.

In shearing the strap, the shearing blade 58 operates in conjunction with a stationary shearing blade 141 (FIG. 29) which is secured to the front plate 144 and supported by projections 145*d* on the jaws 145. The joint is almost completely formed when the shearing takes place so that there is no slipping of the overlapping strap ends during the shearing operation.

The sealed joint ejector, which constitutes the part 53*a* of the sealing device (see FIG. 5), comprises a joint engaging member 160 having three fingers 160*a*, which extend on opposite sides of the bridges or dies 153 (FIGS. 29 and 33) to bear against the completed joint and force it away from the sealing mechanism. The inner end of the ejector 160 is provided with a slot 160*b* through which a pin 161 extends with a roller 162 mounted thereon. This roller is embraced by the yoke-shaped extremity 164*a* of a lever 164 which is pivotally mounted on a pin 165 mounted in the frame. The lever 164 has a coil spring 166 connected thereto and extending to the free end of a link 167 which is pivoted at 168 on the frame.

An arm 170 is pivoted at 171 on the arm 151*c* of the 151 and extends upwardly over a roller 172 mounted on the frame. As the lever 151 is moved in a clockwise direction by the rotation of the main shaft 95, the arm 170 rides up on the roller 172 and its hooked extremity 170*a* is disengaged from the extremity of the extension 164*b* of the lever 164 so that the lever 164 is free to move in a counterclockwise direction, thereby retracting the ejector 160. Instead of relying entirely on the spring 166 to retract the ejector, the rollers 155 carried by the sealing jaws 145 for actuating the dies 153 are also arranged to engage inclined camming surfaces 160*c* on the inner portion of the ejector (FIGS. 26, 27, 28) so that the ejector is positively retracted when the sealing jaws are moved to the open position shown in FIG. 26.

Before drawing the strap **50** taut around a box it is necessary to grip the free end of the strap by the gripping dogs **62** (see FIG. 36) as previously described. These gripping dogs are pivotally mounted upon the pins **146** previously referred to and their forward extremities **62***a* are adapted to enter the notch **144***a* in the plate **144**, as shown particularly in FIG. 36. The extremities **62***a* of these gripping jaws are provided with cone-shaped projections **62***b* which extend inwardly and are adapted to hold the free end **50***b* of the strap against the stationary shearing blade **141** previously referred to. The fixed shearing blade **141** (see FIGS. 14 and 38) is provided with four dimples or recesses **141***a* (see FIGS. 14 and 38) and the projections **62***b* on the gripping jaws are adapted to project the metal of the strap into these recesses so that the strap is securely held while it is being drawn taut around the box.

The gripping jaws **62** are pivotally connected by pins **175** to the links **176** and **177** which are connected by pivot pins **178** and **179**, respectively, to the lever **180** which is rotatably mounted upon the main shaft **95** for rotation with respect thereto and which has an arm **180***a* by which it may be manually rotated if desired, see FIGS. 34 to 36. This lever has the two projecting arms **180***b* and **180***c* which are connected to the links **176** and **177**, respectively, and it has a flat face **180***d* which is adapted to be engaged by an adjustable stop screw **181** threadedly engaging a lug **182** carried by the frame of the machine. This stop screw may be secured in adjusted position by a lock nut **183** to limit the movement of the lever **180** in a counterclockwise direction as viewed in FIGS. 34, 35 and 36. A spiral spring **184** is mounted around the shaft **95** with one end secured to a pin **185** fixed on the lever and with the other end secured to a pin **186** secured on the frame so that the spring tends normally to move the lever **180** in a counterclockwise direction.

The hub portion of the lever **180** is provided with a radially extending tooth **180***e* which is adapted to be engaged by a detent **188** pivotally mounted on a pin **171** which is carried by the previously described lever **151**. A coil spring **189** is mounted on the hub of the detent **188** and is adapted normally to move the tooth of the detent **188** into engagement with the tooth **180***e* of the lever.

When the lever **180** is in the position shown in FIG. 35, the spring **184** is wound under tension and, upon movement of the detent or latch member **188** about the pivot pin **171** in a clockwise direction, the latch member is disengaged from the tooth **180***e* and the spring **184** then unwinds to cause a sudden counterclockwise rotation of the lever **180**, thereby actuating the links **176** and **177** and causing the jaws **62** to close upon the strap end **50***b* which is then seated against the stationary shearing blade **141**, as shown in FIG. 36. At a predetermined time in the cycle of operations, the lever arm **151** carrying pin **171** (see FIGS. 26 to 28) is moved by the main shaft **95**, to which the lever arm **151** is keyed, in a counterclockwise direction and this moves the latch member **188** in a counterclockwise direction until it reaches the position shown in FIG. 36. The latch member then again engages the tooth **180***e* of the lever **180** under the influence of the spring **189** and, upon reverse rotation of the main shaft **95**, the latch member **188** is carried by the lever arm **151** through the connection of pin **171**. The latch member **188** therefore is carried in a clockwise direction and carries the lever **190** with it whereby the lever **180** is rotated in a clockwise direction until it reaches the retracted position shown in FIG. 34 at which time the gripping jaws **62** are separated from each other to the maximum extent.

The mechanism for releasing the detent or latch member **188** from the lever **180** comprises a lever **190** which is pivoted on a pin **191** mounted in the frame of the machine and which has a depending arm **190***a* (see FIGS. 21 and 35) adapted to engage a laterally projecting lug

188*a* formed on an arm **188***b* which extends downwardly from the hub of the latch or detent **188**. The lever **190** is pivoted on a pivot pin **192** upon a supporting shaft **193** which is normally held in its extreme upper position by a spring **194** (see FIGS. 21 and 35). The portion of the lever beyond the pivot pin **192** is pivotally connected by a pin **195** to a rod **196** which forms the core of a solenoid **197**. When the solenoid **197** is energized, the magnetizable core **196** actuates the lever **190** which causes the projecting end thereof to engage the lug **188***a* of the latch member so that the latch member is thereby disengaged from the lever **180**. This operation takes place in the proper timed relation to the other operations of the machine as more fully described hereinafter.

The shaft **95** is adapted to be moved angularly about its axis of rotation to effect the operations controlled thereby which have been described above through the actuation of a crank arm **200** which is fixed upon the shaft **95** and which is pivotally connected by a pin **201** to a piston rod **202** which extends into a cylinder **203** having a fixed connection with another cylinder **204**, as shown in FIG. 15. The piston rod **202** is connected to a piston in the cylinder **203** and the two cylinders have a common end wall dividing them. There is a piston mounted in the cylinder **204** and connected to another piston rod **205** which is pivotally connected at **206** to a bracket **207** secured to the frame **65**. The method of operating the cylinders **203** and **204** and the pistons mounted therein will be described more fully hereinafter in connection with FIGS. 39 and 40. It will be seen from the above description that the cylinders **203** and **204** are integral and therefore cannot move independently of each other but move as a single unit. The integral cylinders **203—204** are supported by their respective piston rods **202** and **205** which are pivoted on pins **201** and **206**, respectively, and these pins **201** and **206** provide the only support for the cylinders **203—204**.

The means for feeding the binding strap **50** to the sealing device and the means for drawing the strap taut around the box are driven by a mechanism shown particularly in FIGS. 12, 13, 19 and 20 which comprises an electric motor **210** secured to the vertical frame member **65***a* and provided with a driving pulley **211** which is connected by a belt **212** to another pulley **213** which is connected through clutch mechanism hereinafter described to the feed wheel **54** having a serrated annular surface which coacts with the steel binding strap **50** seated against the idler wheel **55**. When the feed wheel **54** is driven in the direction of the arrow **214** (see FIG. 13) the binding strap **50** is drawn through a straightening device **215** comprising a series of rollers **216** from which it passes into a channel-shaped guideway **217**. The strap is drawn through this guideway by the feed wheel **54** and it is then pushed by the feed wheel around the idler wheel **55** as it is guided by another guideway **218**. This guideway **218** is secured on a pair of bars **219** which are pivotally connected at **220** to a rod **221** mounted to slide in a block **222** secured to the frame member **65***a*. On the side of the block opposite the bars **219**, the rod **221** is engaged by a coil spring **223** which is held in adjusted position on the rod **221** by lock nuts **224** readily engaging the end of this rod. The bars **219** pivotally support the feed wheel **55** on an axle **225** and their upper ends are connected to a bolt **226** passing through the frame member **65***a*. In this way the idler wheel **55** is adjustably mounted with respect to the feed wheel **54** and maintains contact with the strap **50** under a resilient pressure.

The bolt **226** is connected by springs **227** to the free end of a lever **228**, the lever **228** being pivoted at **229** to the machine frame. This lever is used to cause actuation of a switch **320** shown in FIG. 41, in case the strap jams while it is being fed. The switch **320** is actuated as the jammed strap bulges and swings the lever **228**.

Upon emerging from the passage between the idler wheel **55** and the guideway **218**, the strap **50** passes up-

wardly through a guide channel 230 by which it is directed to the place where it passes through the partially formed seal 52 in the manner previously described. Then, after being looped around the box 60, the free end of the strap is passed through the guide 70, previously described, and then again directed upwardly through the seal 52, as shown in FIG. 2.

The clutch mechanism referred to above for connecting the pulley 213 with the feed wheel 54 is shown particularly in FIG. 20 and comprises a clutch housing 223 which is fixed on the frame member 65*a*. The pulley 213 is fixed on a shaft 234 which is journaled in bearings 235 fixed in the housing and this shaft has rotatably mounted thereon a gear 236 secured on a ball bearing unit 237. A clutch disk 238 is slidably mounted on pins 239 secured in the gear 236 and this clutch disk 238 is normally moved away from the gear 236 by coil springs 240 mounted on the pins 239 so that it engages another clutch disk 241 of magnetizable steel keyed to the shaft 234. A clutch ring 242 is mounted on the casing 233 and provided with magnetizing coils 243. When these coils are energized the ring 238 is attracted into driving engagement with the clutch ring 241 so that the shaft 234 is then positively driven. When this occurs, the gear 236 drives another gear 245 which is keyed on a shaft 246 upon which the feed wheel 54 is also keyed. This shaft 246 is journaled in ball bearing units 247 mounted in the walls of the housing 233 and when the feed wheel 54 is thus driven by the gear 245, the feed wheel 54 is actuated to draw the strap 50 taut around the box.

The shaft 234 also serves to actuate the feed wheel 54 to withdraw the strap from the source of supply and feed it toward the box. For this purpose, a clutch pulley 250 is rotatably mounted on the outer end of the shaft 234 by means of a ball bearing unit 251. This clutch pulley is provided with clutch pins 252 having coil springs 253 mounted thereon to move a clutch ring 254 into engagement with another clutch ring 255 which is keyed upon the shaft 234. A ring 256 is mounted upon the adjacent wall of the housing 233 and this ring contains magnetizing coils 257. When these coils are energized the ring 255 is forced into driving engagement with the ring 254 so that the pulley 250 is then rotated to drive a belt 260 which extends to a pulley 261 keyed upon the shaft 246. When this pulley 261 is actuated the shaft 246 is operated to rotate the feed wheel 54 in a direction adapted to withdraw the strap from a source of supply and feed it to the box.

For braking purposes the shaft 246 is also provided with a disk 263 which is adapted to be engaged by a clutch ring 264 adapted to be forced into driving engagement with the disk by the energization of magnetizing coils 265 mounted in a casing 266 secured to the adjacent wall of the frame 233. When the coils 265 are energized the clutch members 263 and 264 engage each other to effect an immediate stopping of the rotation of the feed wheel 54. An auxiliary housing 267 is attached to the housing 233 to protect those portions of the clutch mechanism which project through the wall of the housing 233. The electric circuit for energizing the coils of the clutch mechanism is shown in FIG. 41 and will be described hereinafter. This magnetic brake is always energized when neither the feed clutch nor the tensioning clutch is energized.

The auxiliary housing 267 also encloses two centrifugal switches 330 and 339 which are connected in the electrical circuit shown in FIG. 41. They are mounted in a switch housing 272 from which a switch arm 273 extends to a position to be engaged by a disk 274 secured to a sleeve 275 splined on the shaft 246 for movement longitudinally thereon. When the shaft 246 begins to rotate, the weights 276 pivoted on the pulley 261 move to positions such as that shown at the right of the shaft in FIG. 20. This action causes the sleeve 275 to move longitudinally of the shaft and causes the disk 274 to break its engagement with the switch arm 273. When the shaft 246 reduces its speed of rotation, the weights 276 are moved toward each other under the influence of a spring 277 connected between pins 278 fixed in these weights, thereby causing a movement of the disk 274 in the opposite direction until it again engages the switch arm 273 to actuate switches 330 and 339 to be described more fully hereinafter.

The fluid conduits and valves for supplying compressed air or other fluid to the cylinders 132, 203 and 204 are shown in FIG. 39, and the different positions of the cylinders 203 and 204 and of the pistons mounted therein are shown in FIG. 40. The piston rod 202 is connected to a piston 280 in the cylinder 203 and the piston rod 205 is connected to a piston 281 in the cylinder 204. The two cylinders 203 and 204 are connected by a common end wall 282. The fluid connections to the cylinders 203 and 204 are adapted to actuate the main shaft 95 through the arm 200 (FIG. 15) to cause the main shaft to occupy any one of three angular positions which are the positions by which the sealing jaws 145 are caused to assume the three positions shown in FIGS. 26, 27 and 28.

When the pistons 280 and 281 and the cylinders 203 and 204 are in the relative positions shown at (*a*) in FIG. 40, the sealing jaws 145 are partially closed as shown in FIG. 27; when these parts are in the relative positions shown at (*b*) in FIG. 40, the sealing jaws are fully closed as shown in FIG. 28; and, when these parts are in the relative positions shown at (*c*) in FIG. 40, the sealing jaws are fully opened as shown in FIG. 26. The other operations performed by the shaft 95 are similarly arranged to pass through three stages corresponding to the three positions of the shaft. When the pistons and the cylinders have been restored to the next relative positions shown at (*d*) in FIG. 40, they are in the starting positions shown at (*a*).

Compressed air or other fluid is supplied to the system through a supply pipe 285 leading through regulating devices 286 including the usual oiler, pressure regulating valve and filter, as shown in FIG. 39, and from this pipe fluid is supplied to the opposite ends of the cylinders through a pipe 287 and branch pipes 288 and 289, respectively, in which valves 290 and 291 are respectively connected. The valve 290 is moved in one direction by a solenoid 292 and in the opposite direction by a coil spring 293. The valve 291 is moved in opposite directions by two solenoids 294 and 295. Compressed air or other fluid is supplied from the pipe 285 to the cylinder 132, by which the seal feed is actuated, through a pipe 296 and branch pipes 297 which lead from valve 298 which is actuated in opposite directions by two solenoids 299 and 300. The solenoids 299 and 300 are controlled through hose connections 301 and 302, respectively, extending to actuating devices 303 and 304 adapted to be engaged by the outer ends of the cylinders 203 and 204, respectively, when they reach the limits of their travel.

The electric circuit for controlling the actuation of the various parts is shown diagrammatically in FIG. 41 where the supply conductors 310 leading from a 3-phase alternating current supply are connected through a switch 311 to the motor 210 also shown in FIG. 16 and which drives the clutch through the belt 212, previously referred to, by which the pulley 213 and the shaft 234 are driven. One phase of this circuit is connected to the line conductors 312 and 313 which lead to the terminals 314*a* and 314*b* of a rectifier 314. The positive direct current terminal of the rectifier is connected to a conductor 315 and the negative direct current terminal is connected to a terminal 316.

The coil 257 of the feed clutch is connected between the conductors 315 and 316 through a conductor 317 and switches 318, 319 and 320. The coil 265 of the brake clutch is adapted to be connected between the direct current line conductors 315 and 316 by a conductor 321, a rheostat 322, the relay contacts 340*c*, a conductor 324,

a foot switch **325** (also shown in FIG. 12), the switch **318** and the switch **320**. The reversing or strap tensioning clutch coil **243** is adapted to be connected between the conductors **315** and **316** by a conductor **326**, a rheostat **327**, the relay contacts **340***d*, the conductor **324**, the foot switch **325**, the switch **318** and the switch **320**. The rheostat **327** is adapted to be used during the initial tensioning of the strap and it is adapted to be connected in parallel with another rheostat **329**, controlled by a switch **330**, which is adjusted to regulate the final tensioning of the strap as hereinafter described.

The switch **320** is normally in its upper closed position engaging its upper terminal **320***a* as shown in FIG. 41 but, if the feeding of the strap is obstructed, it is adapted to move downwardly and engage its lower terminal **320***b* and thereby establish a shunt around the switches **325**, **318** and **319**, thereby arresting the operation of the feeding mechanism by causing de-energization of the feed clutch coil **257** and energization of the brake coil **265**. As previously described, the switch **320** is actuated as the obstructed or jammed strap bulges and pivots the bracket **228** (shown in FIG. 13).

The foot switch **325** is adapted to engage its lower terminal **325***a* to complete the circuits of the brake clutch coil **265** and the reversing clutch coil **243** and it may be moved into engagement with its contact **325***b* in the conductor **317** to complete a shunt around the switch **319** when the switch **318** is in its lower position. The switch **318** has an upper pair of contacts **318***a* for completing the circuit of the feed clutch coil and a lower pair of contacts **318***b* for completing the circuits of the brake clutch coil and the reversing clutch coil. This switch **318** is controlled by an electrical timer **333** which has its winding connected between the alternating current line conductors **312** and **313** by a conductor **334** and the strap feed switch **335** which is connected to the switch **319**.

A reversing switch **336** is connected in a conductor **337** between the line conductors **312** and **313** through a relay **338**, a switch **339** and contacts **340***b*. A branch conductor **341** leads from the conductor **337** to the line conductor **313** through the relay contacts **338***a*, to establish a shunt around the switch **339** and the relay contacts **340***b*. The reversing switch **336** has two contacts **336***a* and **336***b*. When the lower contact **336***a* is engaged, a circuit is completed through the relay **338** as previously described. A conductor **342** leads from the contact **336***a* through the relay contacts **338***b* and the solenoid **197**, which controls the strap holding jaws **62**, to one contact **339***a* of the centrifugal switch **339**. Thus, when the contacts **339***a* are engaged the circuit is completed through the relay contacts **340***b* to the conductor **313**. When the switch arm is in its upper position engaging the contacts **339***b* the circuit through the relay **338** is completed assuming that the switch **336** is in its upper position engaging the contacts **336***b* a circuit is completed between the conductors **312** and **313** through a conductor and the solenoid of the reversing valve **291**.

A conductor **344** is connected to the conductor **334** between the timer **333** and the switch **335** and it leads through the relay contacts **338***c* and the solenoid **292** of the valve **290** to the contact **339***a* of the switch **339**. The solenoid **295** of the valve **291** is connected between the line conductors **312** and **313** by a conductor **345** and a switch **346**. The relay **340** is connected between the line conductors **312** and **313** by a conductor **347** and a switch **349**. A conductor **350** is connected to the conductor **347** between the relay **340** and the switch **349** and it leads through relay contacts **340***a* to the conductor **337** to which it is connected between the switch **336** and the relay **338**.

Referring now to the operation of the machine under the control of the electric circuit which has just been described, the closing of the switch **311** starts the motor

210 and applies voltage to the rectifier **314** so that direct current is supplied to the conductors **315** and **316**. The electrical timer **333** is then energized through the switch **335** and this energizes the feed clutch coil **257** to cause the feeding of the strap **50** by the feed wheel **54**. When the time of operation which has been set on the timer has expired, the timer opens the contacts **318***a* of the switch **318**, thereby deenergizing the feed clutch coil **257**, while closing the contacts **318***b* of that switch to energize the brake coil **265**.

The box **60** is then positioned on the rollers of the table **51** and the foot switch **325** is then actuated to close the contact **325***b*, thereby closing the circuit of the feed clutch coil again and deenergizing the brake coil. The operator encircles the box with the strap **50** and passes the free end thereof through the partially closed seal. The foot switch is then released and the switch **349** is momentarily closed, thereby energizing the relay **340** and closing the relay contacts **340***a*, **340***b* and **340***d* while opening the relay contacts **340***c*. The closing of the contacts **340***b* energizes the holding jaw solenoid **197** through the contacts **339***a*, thereby causing the latch **188** to release the holding jaws **62** which grip the leading end of the strap.

The closing of the relay contacts **340***d* causes the tension or reverse clutch coil **243** to be energized, thereby effecting the reverse rotation of the feed wheel **54** to draw the strap taut around the box. This tensioning operation continues until the reverse clutch slips when a partial tension is reached corresponding to the setting of the rheostat **327** and this tension effects a substantial slowing down of the feed wheel **54**. Then the centrifugal switch **330** closes due to the slow rotation of the wheel **54** to place this rheostat in parallel with the rheostat **329**, thereby increasing the magnetic field of the tension clutch coil **243** as the final tensioning of the strap is completed. During the tensioning operation, the centrifugal switch **339** shifts from the contact **339***a* to the contact **339***b*, thereby deenergizing the holding jaws solenoid **197** to return the latch **188** for the holding jaws. At the same time the relay **338** is energized to close the relay contacts **338***a*, **338***c* and to open the relay contacts **338***b*, the relay contact **338***a* being a holding contact for the relay **338**. The opening of the relay contacts **338***b* prevents the reenergization of the holding dog solenoid **197** when the switch arm of the switch **339** returns to the contact **339***a* after the strap is partially tensioned around the box as determined by the setting of the rheostat **327**. The closing of the relay contacts **338***c* energizes the solenoid **292** of the spring return valve **290** when the partial strap tension is reached, and the centrifugal switch **339** returns from the contact **339***b* to the contact **339***a*.

The energization of the solenoid **292** of the valve **290** causes the piston **280** of the cylinder **203** to extend, thereby causing a new seal **52** to be cut off and formed around the anvil **56**, causing the sealing device **53** to deform the previously formed seal and the enclosed strap ends to form a joint and causing the shearing blade **58** to shear the supply portion of the strap adjacent to the joint. At the end of the forward movement of the piston **280**, this piston actuates the reversing switch **336** to open the contacts **336***a* and close the contacts **336***b*, thereby deenergizing the relays **338** and **340** to open the relay contacts **338***a*, **338***c*, **340***a*, **340***b* and **340***d*, while closing the relay contacts **338***b* and **340***c* and energizing the solenoid **294** of the valve **291**.

The closing of the relay contacts **340***c* energizes the brake coil **265** and the opening of the relay contacts **340***d* deenergizes the tension clutch coil **243** to prevent further reverse rotation of the feed wheel after the strap has been sheared. The opening of the relay contacts **340***b* prevents the holding jaws solenoid **197** from being energized as the relay contacts **338***b* close. The opening of the relay contacts **338***a* and **340***a* prepares them for the next cycle when the relays **338** and **340** are again energized. The opening of the relay contacts **338***c* deenergizes the

solenoid 292 of the valve 290 so that its spring 293 causes the piston 280 to retract. The energization of the solenoid 294 of the valve 291 causes the piston 281 in the cylinder 204 to retract simultaneously with the retraction of the piston 280 in the cylinder 203.

As the pistons 280 and 281 retract, the common cylinder housing also retracts to the right as illustrated in FIGS. 39 and 40(*c*) and at the end of a sealing operation in accordance with the operation of the valves 290 and 291, thus to actuate the crank on 200 fixed upon the shaft 95 (see FIGS. 15, 21 and 34), to cause the sealing jaws to open completely, to retract the strap shearing blade 58 and to cause the sealed joint to be ejected from the sealing jaws. When the cylinder housing reaches the limit of its retracting movement, it strikes and actuates the poppet valve 304 to cause the piston of the seal feed cylinder 132 to be extended and thereby to cause the newly formed seal to be fed by the anvil 56 into the open sealing jaws 145. As the piston in the cylinder 132 starts to extend, it opens the contacts 335*a* and 319*a* of the switch 335. The opening of the contacts 335*a* resets the timer 333 and the opening of the contacts 319*a* keeps the feed clutch coil 257 deenergized to prevent the feeding of the strap while the timer is being reset.

At the end of the extension of the piston in the cylinder 132, the piston rod engages the switch 346 to energize the solenoid 295 of the valve 291. This causes the piston 281 in the cylinder 204 to extend and thereby actuate the sealing device 53 to cause its jaws to effect a partial closing of the side walls of the new seal which has been placed between the sealing jaws. During this movement, the seal stock is also fed forward. When the piston 281 reaches the end of its stroke, the cylinder housing strikes and actuates the poppet valve 303 which causes the piston of the seal feed cylinder 132 to retract, thereby causing the anvil 56 to retract in preparation for the formation of a new seal. At the end of the retraction of the piston in the cylinder 132, the piston rod closes the switch 336 to start the timer 333 running again and to feed out a new length of strapping as the feed clutch coil 257 is again energized to start a new cycle.

One form of machine embodying the present invention has been shown and described by way of illustration but it will be understood that it may be constructed in various other embodiments which come within the scope of the appended claims.

We claim:

1. The combination in a box strapping machine, of means for guiding a binding strap looped around a box, tensioning means for drawing the strap taut around a box, jaws for gripping the free end of the strap, a driving shaft, a lever rotatably mounted on said shaft and having arms connected to said jaws, a spiral spring having one end thereof fixed and having its other end connected to said lever, and means for releasably connecting said shaft to rotate said lever and wind said spring, said lever being adapted when released to be operated by said spring to actuate said jaws to grip the strap.

2. The combination in a box strapping machine, of means for guiding a binding strap looped around a box, tensioning means for drawing the strap taut around a box, jaws for gripping the free end of the strap, a driving shaft, a lever rotatably mounted on said shaft and having arms connected to said jaws, a spiral spring having one end thereof fixed and having its other end connected to said lever, said lever having a shoulder, and a latch mounted for rotation with said shaft and adapted to engage said shoulder, whereby rotation of said shaft rotates said lever to wind said spring.

3. The combination in a box strapping machine, of means for guiding a binding strap looped around a box, tensioning means for drawing the strap taut around a box, jaws for gripping the free end of the strap, a driving shaft, a lever rotatably mounted on said shaft and having arms connected to said jaws, a spiral spring having one end thereof fixed and having its other end connected to said lever, said lever having a shoulder, a latch mounted for rotation with said shaft and adapted to engage said shoulder, whereby rotation of said shaft rotates said lever to wind said spring, and means for actuating said latch to release said lever, whereby said lever is actuated by said spring to close said jaws.

4. The combination in a box strapping machine, of means for guiding a binding strap looped around a box, tensioning means for drawing the strap taut around a box, jaws for gripping the free end of the strap, a driving shaft, a lever rotatably mounted on said shaft and having arms connected to said jaws, a spiral spring having one end thereof fixed and having its other end connected to said lever, said lever having a shoulder, a latch mounted for rotation with said shaft and adapted to engage said shoulder, whereby rotation of said shaft rotates said lever to wind said spring, and means including a solenoid for actuating said latch to release said lever and permit said lever to actuate said jaws under the influence of said spring.

5. The combination in an article strapping machine for binding an article with a binding strap portion, of an anvil mounted adjacent to a sealing position, means for feeding seal stock to said anvil, means for cutting off a length of the seal stock and forming a channel shaped seal about said anvil, means for actuating said anvil to move said seal to the sealing position, and means at the sealing position to move the free outer ends of the side walls of the seal inwardly toward each other so that the outer ends are spaced apart a distance less than the width of the binding strap portion whereby to provide a guide subsequently for looping the strap portion about an article with overlapping strap portions extending through the seal.

6. The combination in an article strapping machine for binding an article with a binding strap portion, of an anvil mounted at a forming position adjacent to a sealing position, means for feeding seal stock to said anvil, means for cutting off a length of the seal stock and forming a channel shaped seal about said anvil, means for actuating said anvil to move the seal to the sealing position, means to press and hold the seal against said anvil as said anvil is moved from the forming position to the sealing position, and means at the sealing position to move the free outer ends of the side walls of the seal inwardly toward each other so that the outer ends are spaced apart a distance less than the width of the binding strap portion whereby to provide a guide subsequently for looping the strap portion about an article with overlapping strap portions extending through the seal.

7. The combination in an article strapping machine for binding an article with a binding strap portion, of an anvil mounted at a forming position adjacent to a sealing position, means for feeding seal stock to said anvil, means for cutting off a length of the seal stock and forming a channel shaped seal about said anvil, means for actuating said anvil to move the seal to the sealing position, means at the sealing position to move the free outer ends of the side walls of the seal inwardly toward each other so that the outer ends are spaced apart a distance less than the width of the binding strap portion whereby to provide a guide subsequently for looping the strap portion about an article with overlapping strap portions extending through the seal, and abutment means at the sealing position to engage the seal and to retain the seal at the sealing station position when said actuating means move the anvil from the sealing position to the forming position thereof.

8. The combination in an article strapping machine for binding an article with a binding strap portion, of an anvil mounted at a forming position adjacent to a sealing position, means for feeding seal stock to said anvil when said anvil is in the forming position, means for cutting off a length of the seal stock and forming a channel shaped seal about said anvil, means for moving said anvil between the forming position and the sealing position

thereof, means to press and hold the seal against said anvil as the anvil is moved from the forming position to the sealing position, seal deforming means at the sealing position to move the free outer ends of the side walls of the seal inwardly toward each other so that the outer ends are spaced apart a distance less than the width of the binding strap portion whereby to provide a guide subsequently for looping the strap portion about an article with overlapping strap portions extending through the seal, and abutment means positioned at the sealing station to engage the seal after deformation thereof and in cooperation with said seal deforming means to hold and retain the seal at the sealing station when said anvil is returned to the forming position.

9. The combination in an article strapping machine for binding an article with a binding strap portion, of an anvil mounted at a forming position adjacent to a sealing position, means for feeding seal stock to said anvil, means for cutting off a length of the seal stock and forming a channel shaped seal about said anvil, means for actuating said anvil to move the seal to the sealing position, seal deforming means disposed adjacent to the sealing position, means for actuating said seal deforming means to cause the side walls of the seal to converge and form a guide for subsequent feeding of strap portions therethrough, feeding means for withdrawing a second binding strap portion from a source of supply and feeding it to the sealing position about an article adjacent thereto and through the seal as a guide, means for drawing the binding strap portion taut around the article while the strap portion is guided in the seal held in said seal deforming means, and means for further actuating said seal deforming means to close the seal about the overlapping strap portions and to deform the seal and the strap portions to provide an interlocking joint.

10. The combination in an article strapping machine for binding an article with a binding strap portion, of an anvil mounted at a forming position adjacent to a sealing position, means for feeding seal stock to said anvil, means for cutting off a length of the seal stock and forming a channel shaped seal about said anvil, means for moving said anvil between the forming position and the sealing position, means for pressing and holding the seal against said anvil as said anvil is moved from the forming position to the sealing position, seal deforming means disposed adjacent to the sealing position, means for actuating said seal deforming means to cause the side walls of the seal to converge and form a guide for subsequent feeding of strap portions therethrough, retaining means disposed adjacent to the sealing position to engage the seal and in cooperation with said seal deforming means to retain the seal at the sealing station as said anvil is returned to the forming station, feeding means for withdrawing a second binding strap portion from a source of supply and feeding it to the sealing position about an article adjacent thereto and through the seal as a guide, means for drawing the binding strap portion taut around the article while the strap is guided in the seal held in said seal deforming means, and means for further actuating said seal deforming means to close the seal about the overlapping strap portions and to deform the seal and the strap portions to provide an interlocking joint.

11. The combination in a box strapping machine, of means for guiding a binding strap having a free end around a box, tensioning means for drawing the strap taut around a box, a blade over which said binding strap passes, jaws for gripping the free end of the strap against the blade, said blade having dimples formed therein and said jaws having sharp projections adapted to force material of said strap into said dimples to hold said strap taut after operation of said tensioning means, a driving shaft, a lever rotatably mounted on said shaft and having arms connected to said jaws, a spring interconnecting a fixed point and said lever, and means for releasably connecting said shaft to rotate said lever and stress said spring, said lever being adapted when released to be operated by said spring to actuate said jaws to grip the strap against said blade with said sharp projections forcing the material of the strap into said dimples.

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