

Jan. 6, 1953

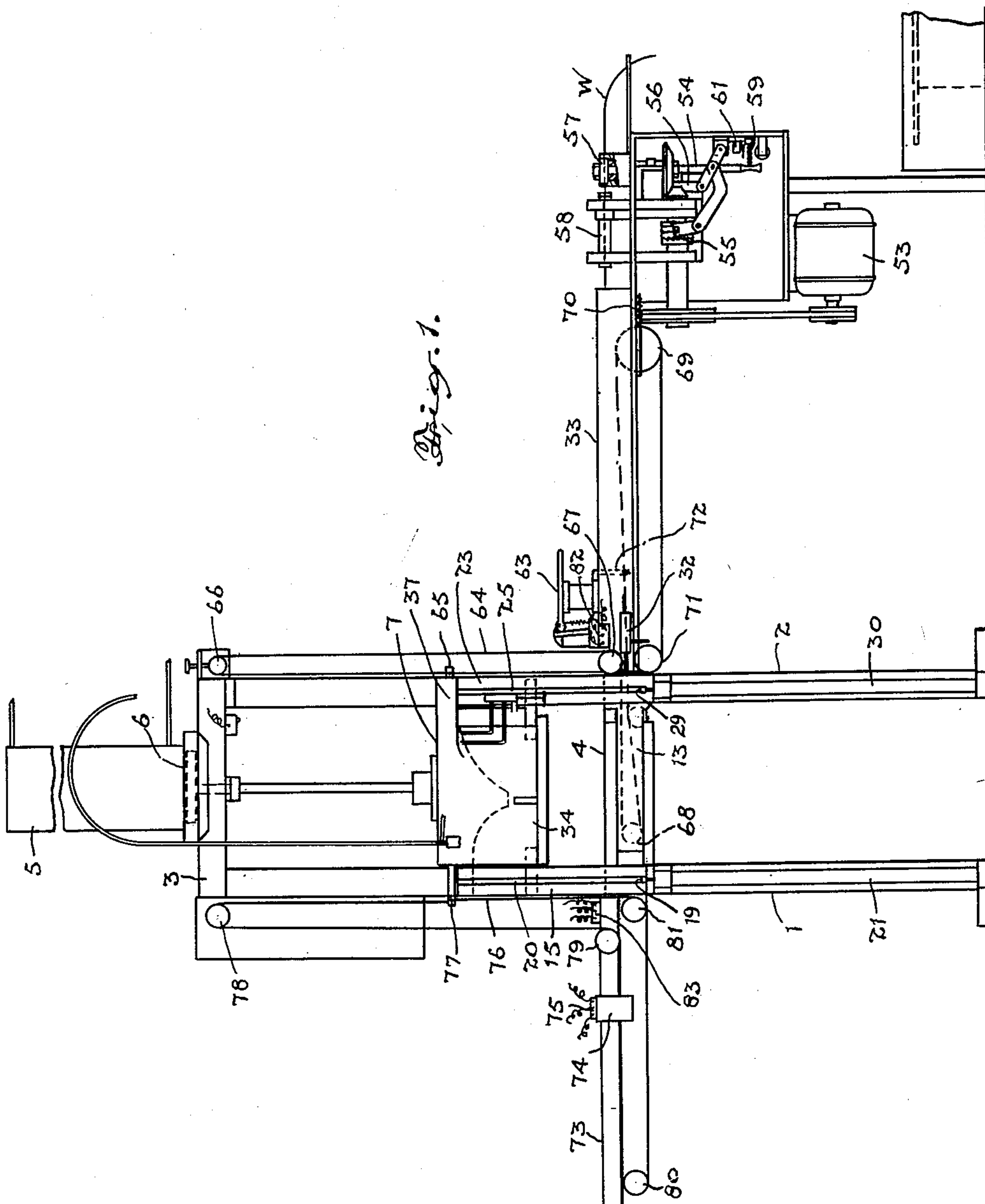
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2,624,270

MACHINE FOR WIRE BINDING BOXES OR THE LIKE

Filed June 22, 1948

5 Sheets-Sheet 1



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5 Sheets-Sheet 2

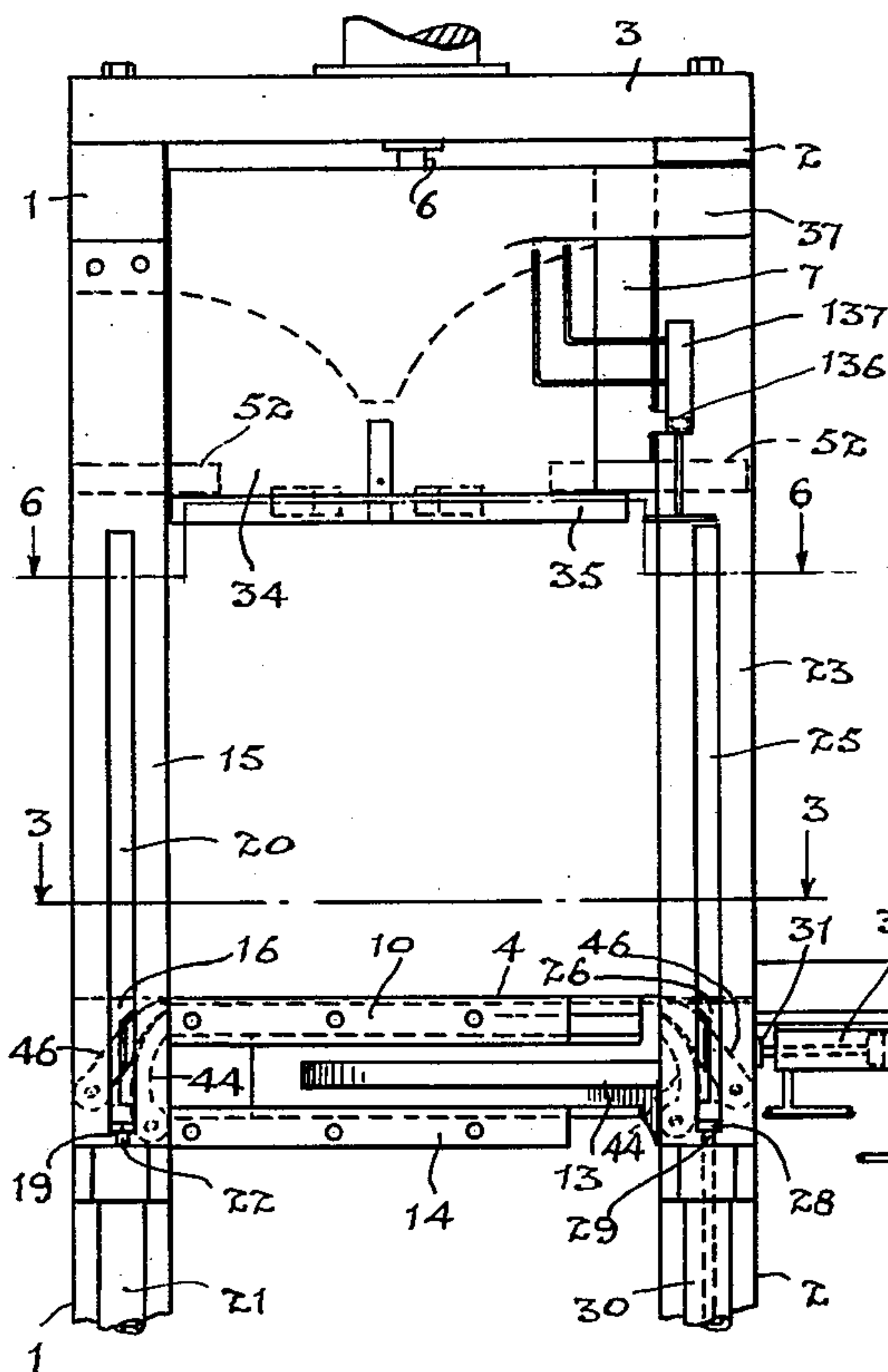


Fig. 2.

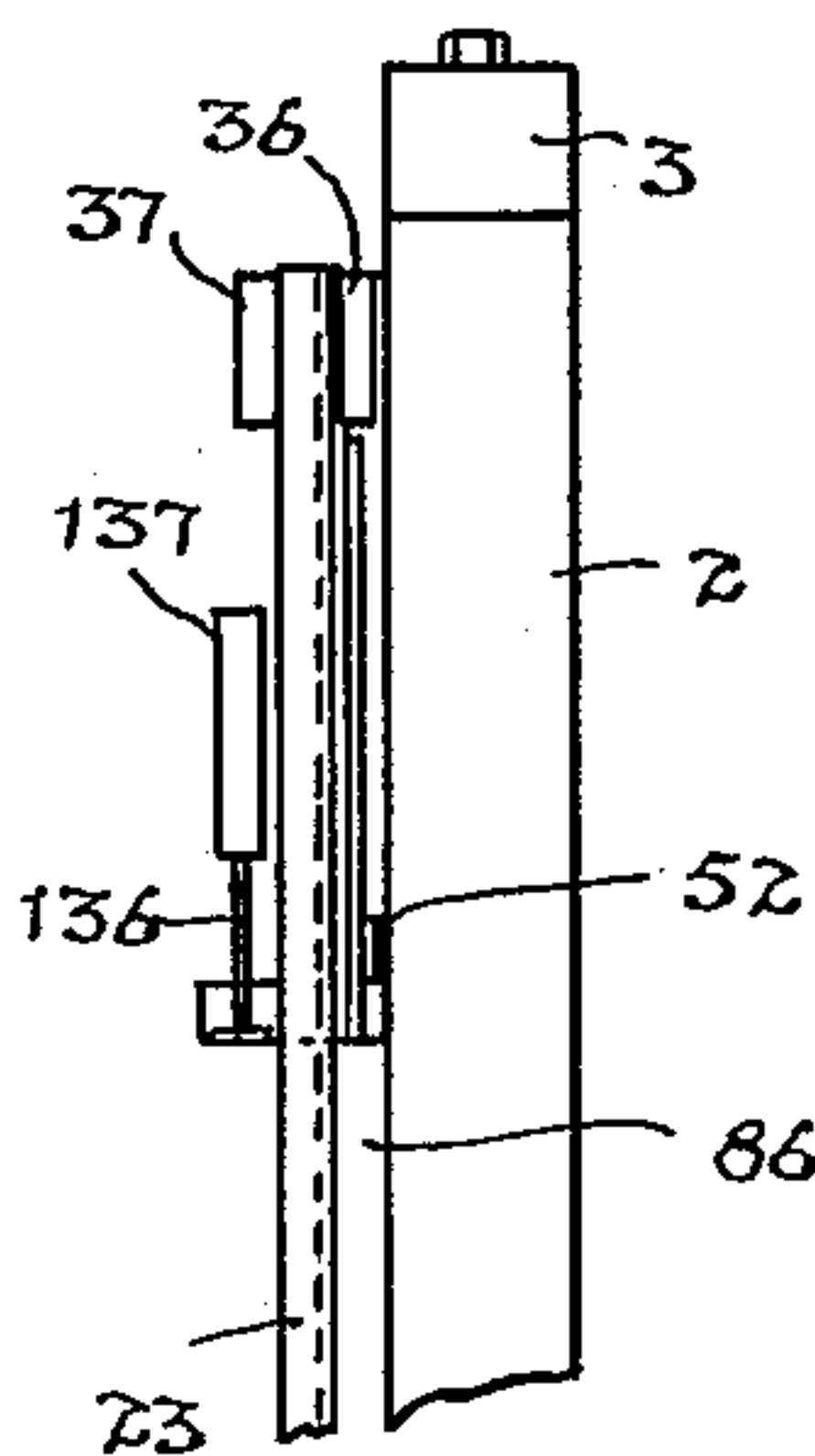


Fig. 11.

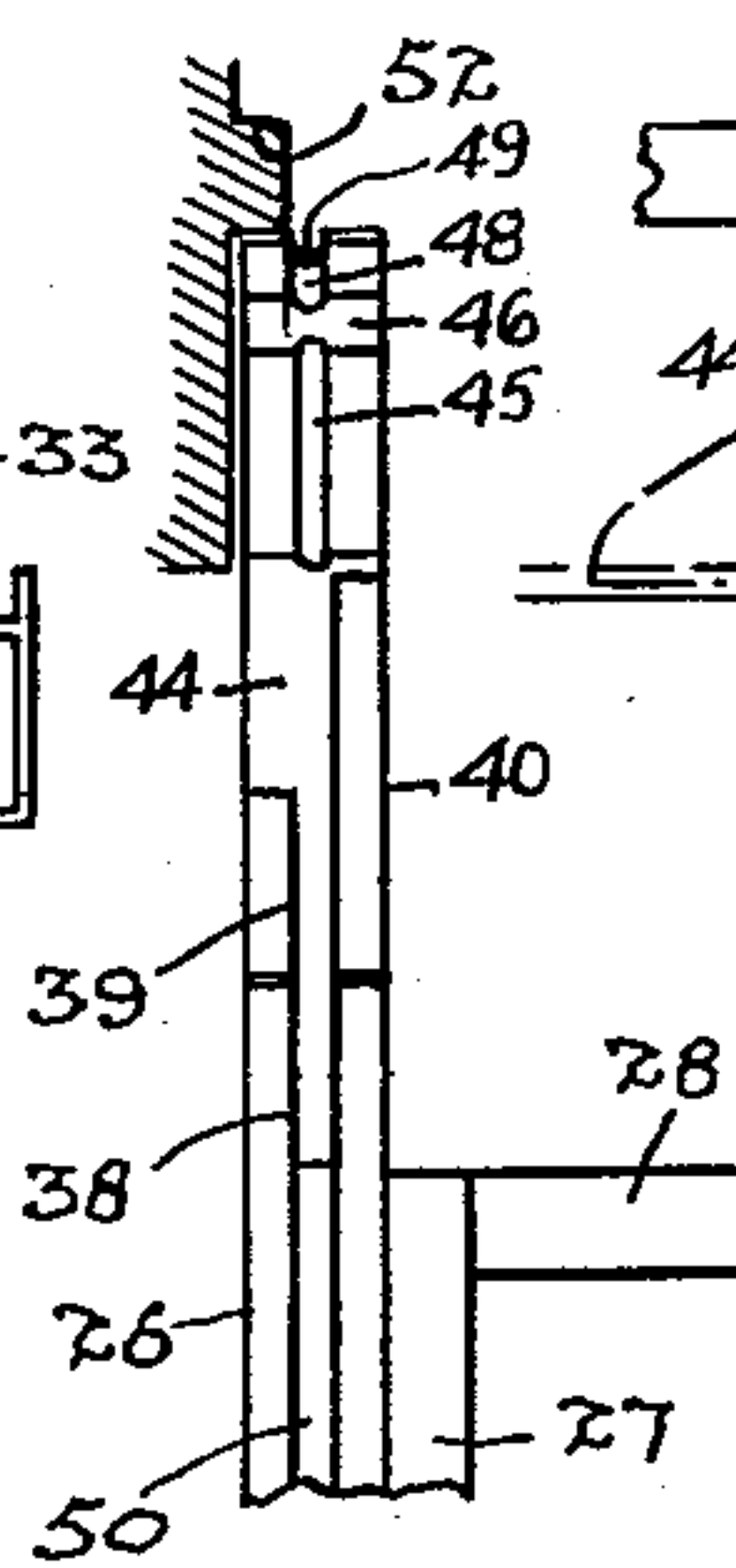


Fig. 8.

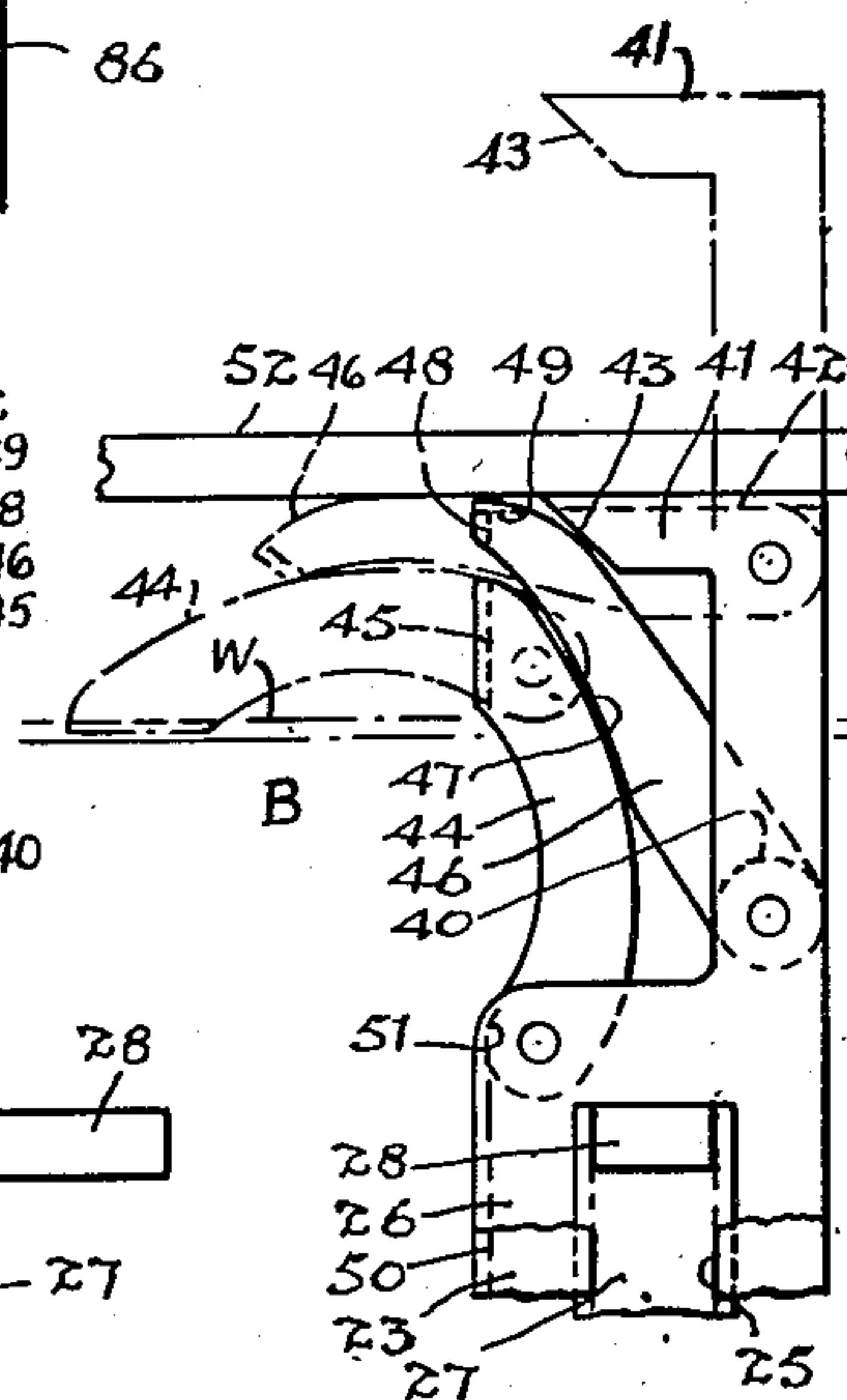


Fig. 7.

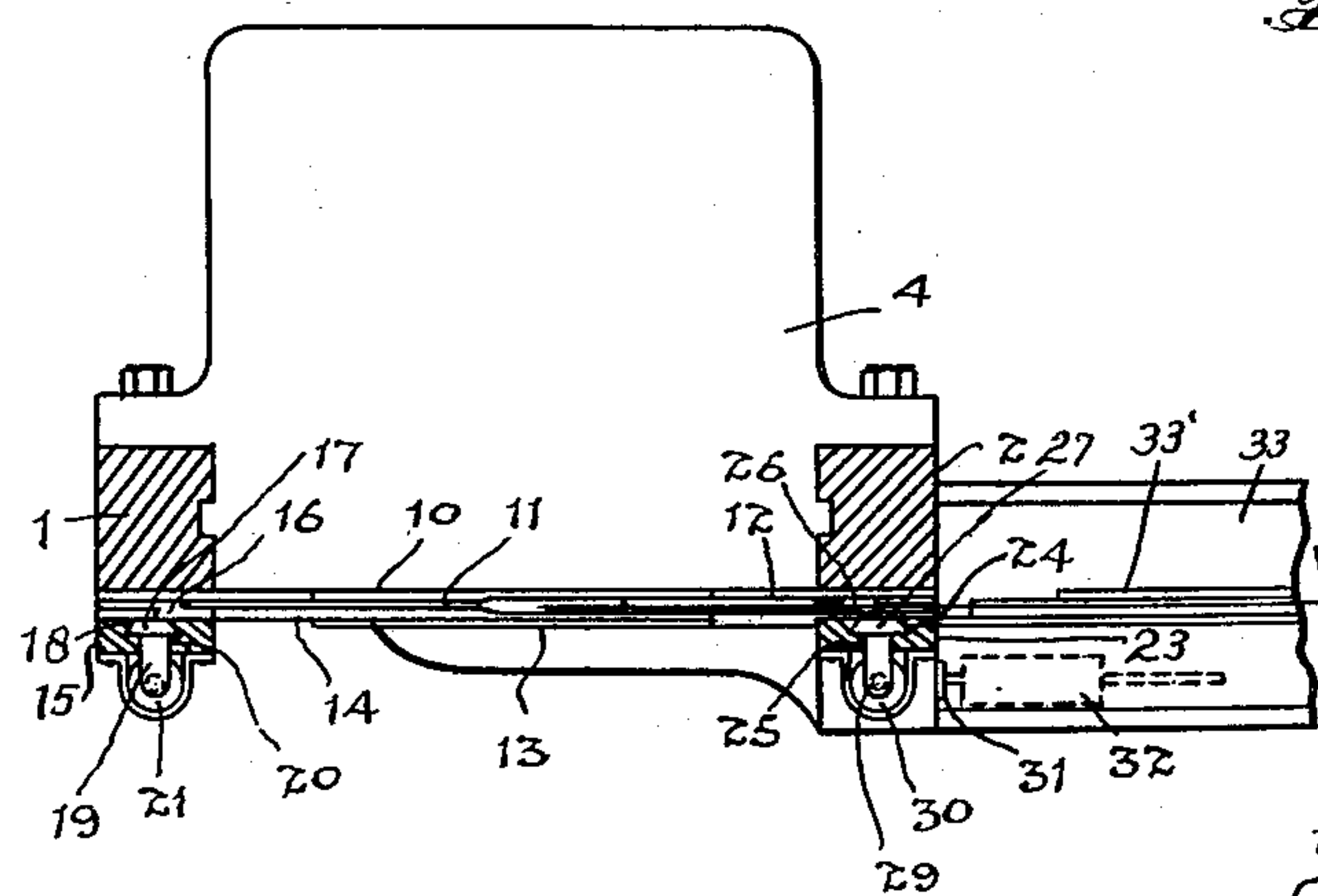


Fig. 3.

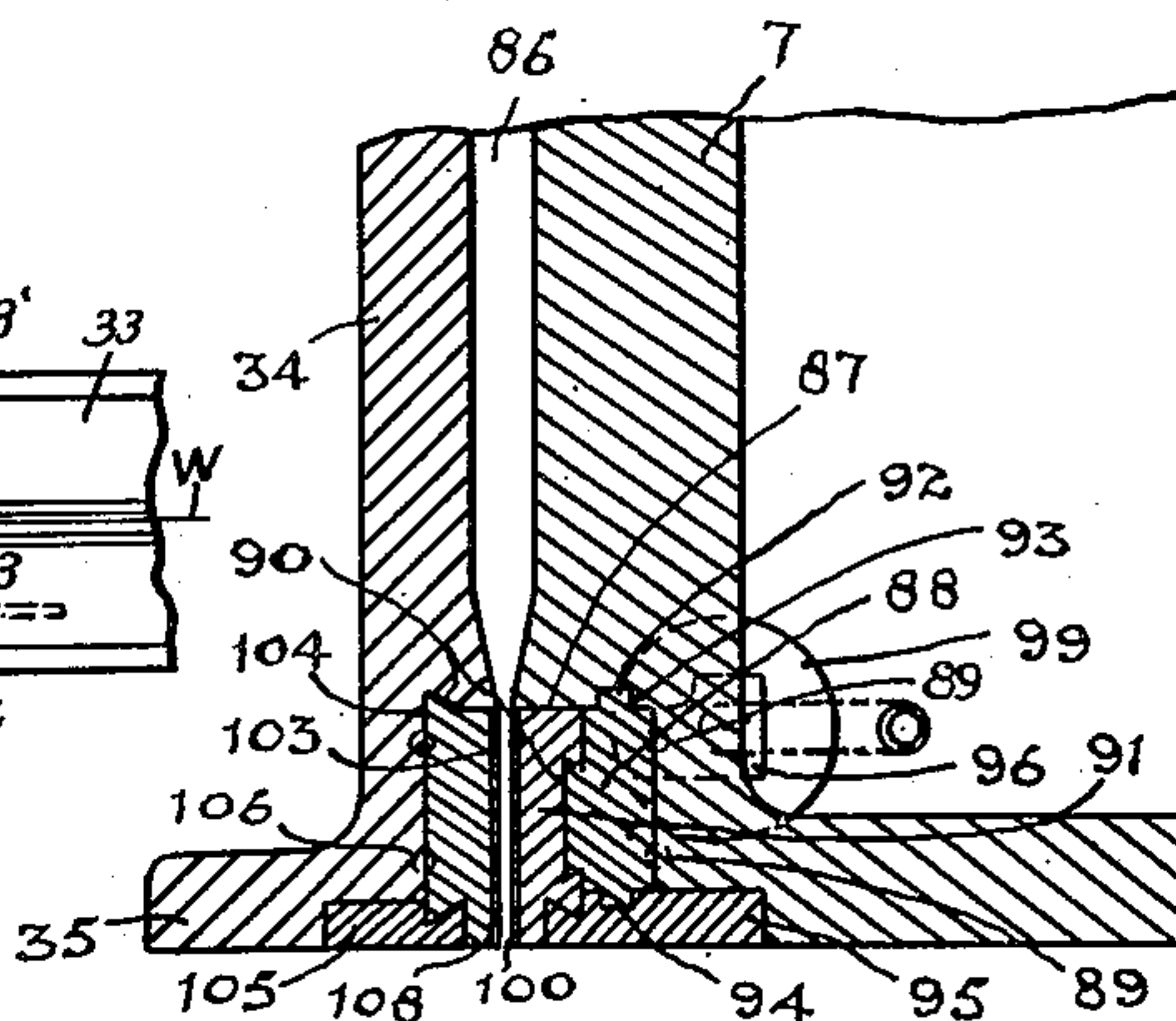


Fig. 10.

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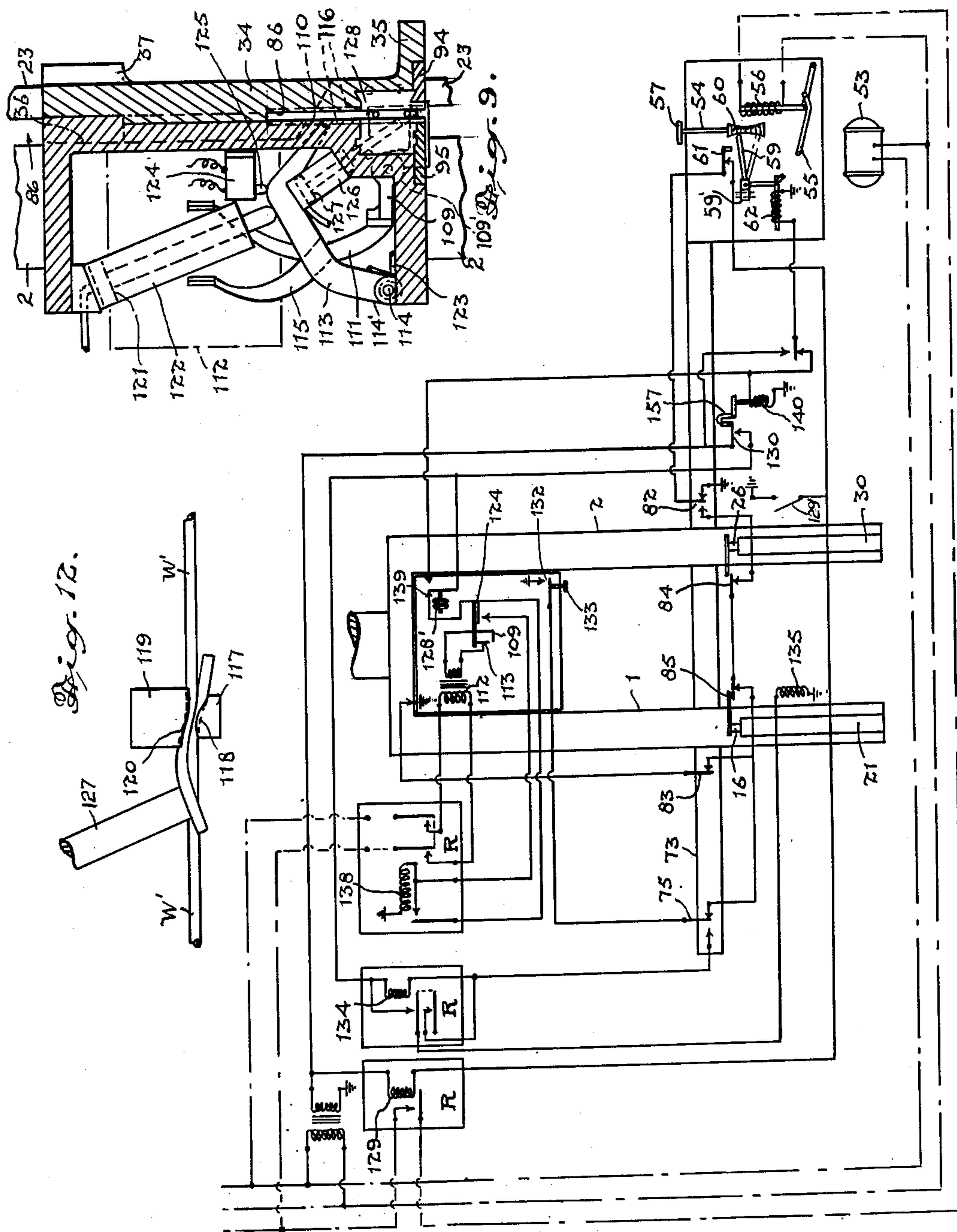
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MACHINE FOR WIRE BINDING BOXES OR THE LIKE.

Filed June 22, 1948

5 Sheets-Sheet 3



Page 5.

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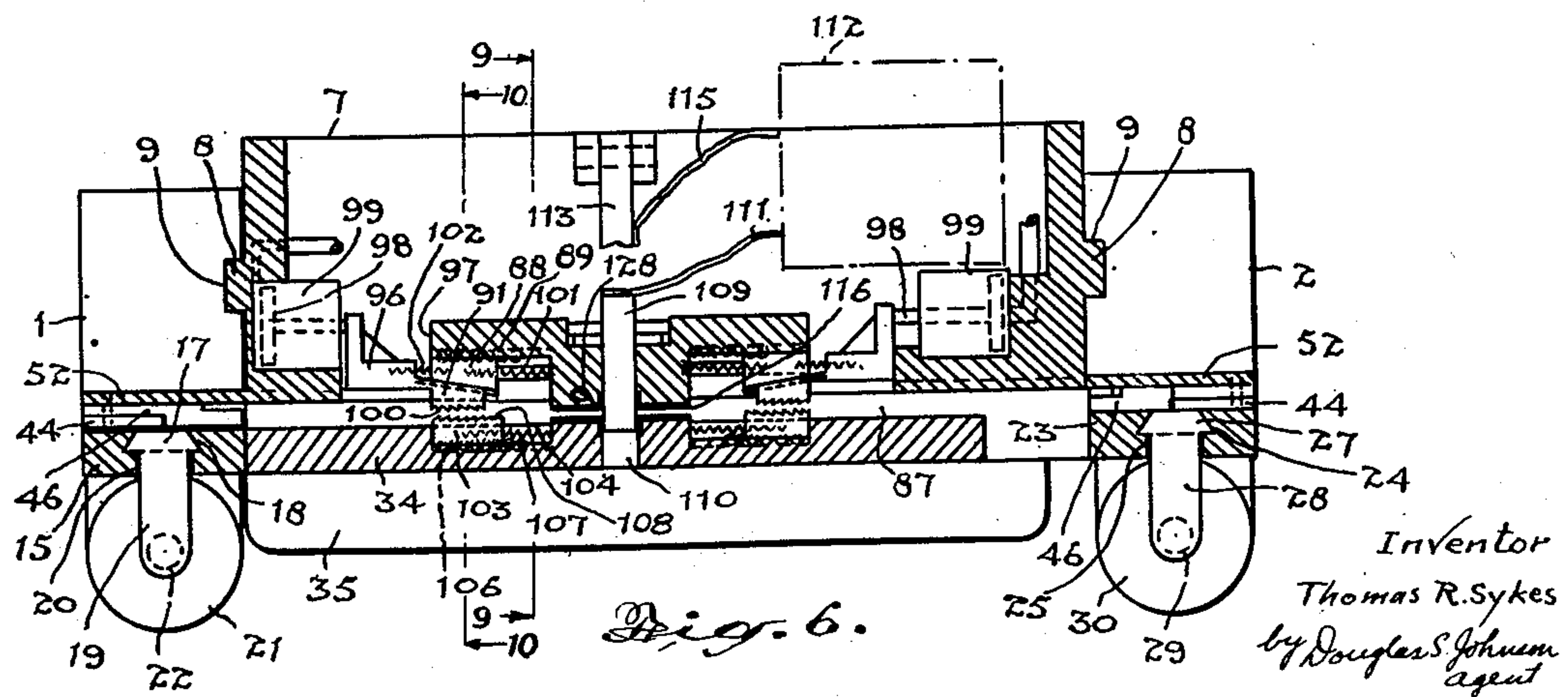
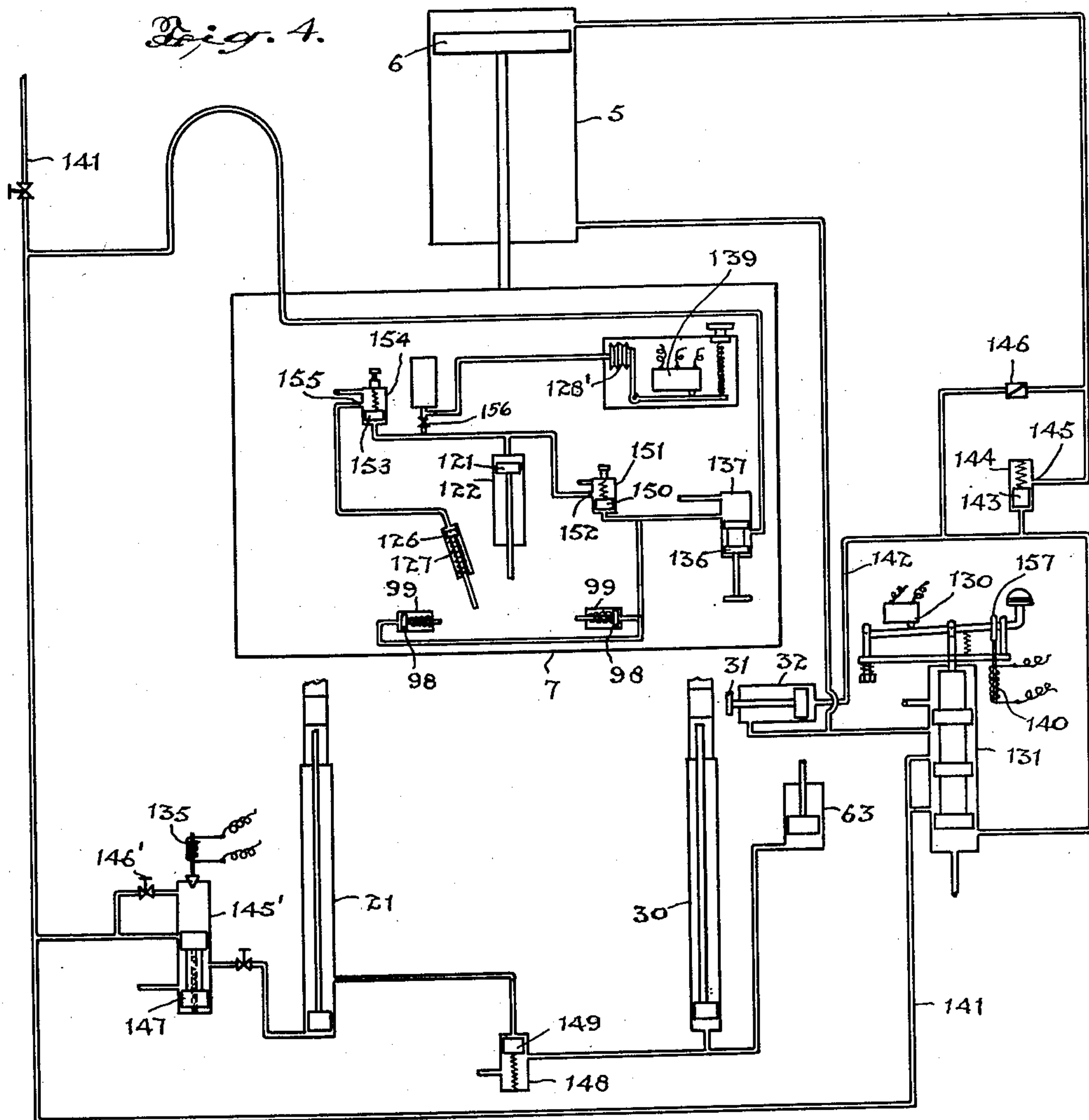
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MACHINE FOR WIRE BINDING BOXES OR THE LIKE

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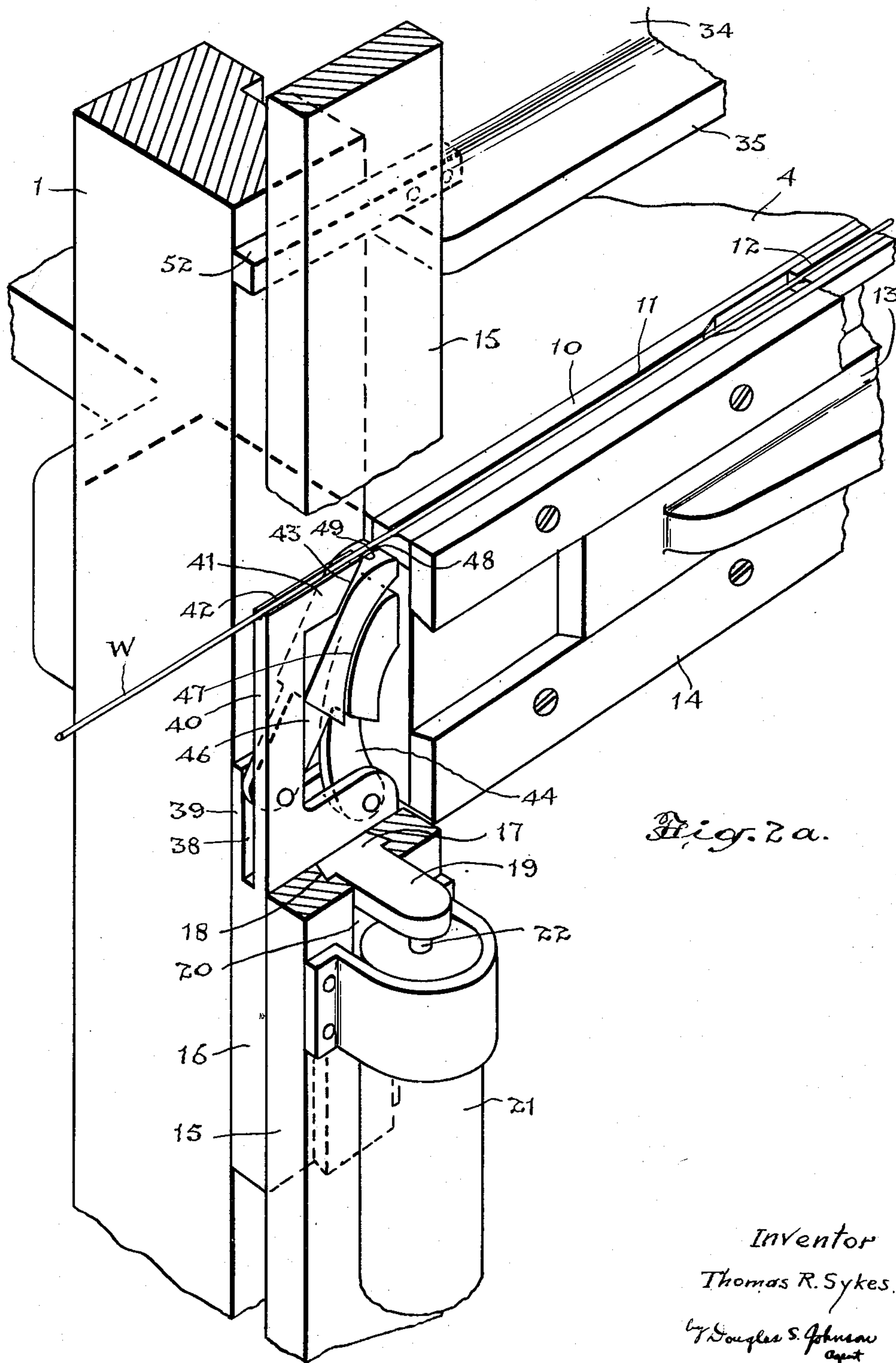
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MACHINE FOR WIRE BINDING BOXES OR THE LIKE

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UNITED STATES PATENT OFFICE

2,624,270

MACHINE FOR WIRE BINDING BOXES
OR THE LIKE

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Application June 22, 1948, Serial No. 34,528

12 Claims. (Cl. 100—8)

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This invention relates to improvements in baling machines particularly of the type disclosed in United States Patent 2,331,818 and co-pending United States application Serial Number 673,375, filed May 31, 1946, now Patent No. 2,581,776, and the principal object of the invention is to provide an improved and simplified machine which will effectively and tightly wire-bind boxes or other non-compressible material as well as material which can be compressed.

A further important object is to provide an improved wire-welding mechanism which will materially increase the strength of the weld to provide a stronger and safer joint between the ends of the binding wire.

A still further important object is to provide means for automatically aligning a box or bundle in the machine for the tie and providing improved means for folding the wire about the box.

One of the principal features of the invention consists in providing a machine of the type referred to with a pair of air-operated wire-gripping mechanisms slidably mounted in the operating ram of the machine and arranged to grip and pull the wire to tension same after it has been folded around the box or bundle and until the completion of the weld joining the wire ends.

Another important feature is to provide an improved arrangement of welder jaws which have an elongated stroke in the wire path to eliminate missed welds and which provide a weld wherein the axes of the wire sections either side of the welds are in alignment to provide axial loading, giving a materially stronger and safer joint.

A further important feature consists in providing means to automatically bend the top overlapping wire end downwardly from an exposed position upon completion of the weld to prevent catching the hands or clothing of a person handling the bound box or bundle.

A further important feature consists in providing improved and simplified folder arm arrangement to fold the wire around the bundles or box and providing improved folding fingers pivotally mounted in the folder arm and co-operating with a simple ledge on the ram to turn the wire over the top of the bundle.

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A further feature consists in providing means for automatically moving one of the folder arm assemblies against the box or bundle to position same for the tie.

5 A still further feature consists in providing a folder arm assembly which will eliminate the catching of an overhanging part of a compressible bundle by the folder arm as it rises to fold the wire about the bundle.

10 Referring to the accompanying drawings, Figure 1 is a front elevational view of the machine.

Figure 2 is an enlarged front elevational view of the upper portion of the machine showing the folder arms, the ram and the bundle aligning side-shoving ram.

15 Figure 2a is an enlarged perspective view of the left hand folder assembly and bed plate showing details of the folding fingers and wire guide groove arrangement for feeding wire across the bed plate.

Figure 3 is a horizontal section taken on the line 3—3 of Figure 2.

20 Figure 4 is a diagrammatic view of the pressure air system of the machine.

Figure 5 is a diagrammatic view of the electrical system of the machine.

25 Figure 6 is an enlarged plan section on line 6—6 of Figure 2 of the ram showing details of the wire gripper.

30 Figure 7 is an enlarged front elevational view of the upper portion of one of the folder arms showing details of the folder fingers.

35 Figure 8 is a side elevational view of the upper portion of the folder arm showing further details of the folding fingers.

Figure 9 is an enlarged vertical sectional view through the ram taken on the line 9—9 of Figure 6 and showing the arrangement of the welder electrodes and the wire bender.

40 Figure 10 is a vertical section through the ram taken on the line 10—10 of Figure 6 and enlarged to show details of the wire grippers.

45 Figure 11 is a side elevational view of the machine and frame showing the manner in which the movable folder arm guide is guided into the ram during the aligning of the bundles or boxes.

Figure 12 is a front elevational view of the welder electrodes.

50 The machines shown and described in the

aforesaid patents comprise primarily the arrangement of co-operating mechanisms whereby a pressure ram operates to compress the material of the bundle upon a fixed bed plate and a length of wire measured in accordance with the movement of the ram is fed beneath the bundle and is subsequently bent upwardly along the sides of the bundle and then bent inwardly over the top thereof with the ends overlapping and finally the overlapped ends are welded together. The expansion of the compressible bundles upon release of the ram results in the tensioning of the binding wire, ensuring that the bundle will be tightly and securely tied.

This reliance on the expansion of compressible material following release by the ram to tension the binding wire renders the machine unsatisfactory for binding non-compressible material, such as boxes or the like or stacks of non-compressible and non-resilient articles or material.

One of the major aspects of the present invention is therefore to provide a machine in which the binding wire will be folded about the bundle or box tie and will be properly tensioned prior to the weld to enable such non-compressible material or boxes to be tightly and securely wire-bound.

Another important aspect is to incorporate in the machine a novel arrangement of welding electrodes to increase the strength of the weld, providing a stronger and safer joint and to eliminate missed welds.

Other improvements and advantages will become apparent from the following detailed description.

Referring to the drawings, the machine illustrated comprises a pair of uprights 1 and 2 connected at the top by a cross bar 3, and intermediate of their height by a horizontal bed plate 4. An air cylinder 5 is centrally mounted on the cross bar 3 and the piston 6 extending therefrom supports the ram 7 which is formed with vertical ribs 8 slidably engaging in grooves 9 in the uprights.

A horizontal bar 10, shown in Figures 2 and 3, is mounted on the front edge of the bed plate 4 and is formed with a groove 11 in its upper edge into which the binder wire is guided to pass under a box or bundle placed upon the bed plate. The right-hand end of the groove 11 is widened to slidably support a grooved bar 12 mounted on a slidable bracket plate 13 which slides between the bar 10 and a similar bar 14 secured to the bed plate.

Sliding vertically between the upright 1 and a vertical guide 15 is a folder arm 16 provided with a dove-tailed rib 17 engaging in a dove-tailed groove 18 formed in the guide 15.

Extending forwardly from rib 17 of the folder arm 16 adjacent the top thereof is a lug 19 which extends through a vertical slot 20 in the guide.

A cylinder 21 is attached to the outer face of the guide 15 and its piston 22 is adapted to engage the lug 19 to effect the vertical movement of the folder arm 16.

Secured to the slidable bracket 13 is a vertical guide 23 similar to the guide 15, being formed with a dove-tailed groove 24 in its inner face and a vertical slot 25 communicating with the groove 24.

Sliding between the upright 2 and the guide 23 is a folder arm 26 similar to the folder arm

16, being provided with a dove-tailed rib 27 engaging in the guide groove 24.

A lug 28, extending outwardly from the folder arm 26 through the vertical guide slot 25, is adapted to be engaged by the piston 29 of an air cylinder 30 secured to the guide 23.

The vertical movement of the folder arm 26 is thus accomplished by the upward movement of the piston 29, engaging the lug 28, forcing same upwardly in the slot 25 to carry the folder arm 26 upwardly. Thus the folder arms 16 and 26 are actuated in a similar manner by the pistons 22 and 29 respectively.

In the case of the folder arm 16, its movement is entirely vertical and its guide 15 is secured to the upright 1 above and below the limits of movement of the folder arm.

Since the guide 23 for the folder arm 26 is secured to the guide bracket plate 13 the whole folder arm assembly, including the guide and folder arm, is movable laterally to accommodate the various widths of boxes or bundles B placed on the bed plate.

Secured to the right-hand guide 23 is a piston rod 31 moving in the air cylinder 32 secured to a lateral extending frame 33 carrying a wire guiding grooved bar 33'. This piston effects the lateral movement of the folder arm assembly and slide bracket 13.

Secured to the front face of the ram 7 is a vertical plate 34 formed with an outwardly extending flange 35 along its lower edge.

The upper end of the guide 23 is guided between a boss 36 on the ram 7 and a boss 37 formed on the plate 34, as illustrated in Figures 11 and 9.

Referring to the details of the folder arm 26 shown in Figures 7 and 8 (which details are the same for folder arm 16), it will be seen that the upper end of the folder arm is provided with a vertical slot 38. Projecting upwardly from the slotted folder arm end adjacent the outer edge are a pair of extensions 39 and 40 with the inner extension 39 adjacent the ram 7 (Figure 8) being relatively shorter, and the outer extension 40 outwardly of the ram being formed with a laterally turned upper end 41 formed with a wire guide groove 42 in its upper surface and a bevelled stop surface 43 at its inner end. (Similar details of the folder arm 16 are clearly shown in Figure 2a.)

Pivotally secured in the slot 38 at the inner edge of the folder arm is a curved finger 44, the angled free end of which is provided with a wire guide groove 45.

Pivotally mounted between the extensions 39 and 40 is a second finger 46 which engages the finger 44, being provided with a curved surface 47 to conform to the curved surface of the finger 44.

The inner angled end of the finger 46 is provided with a wire guide groove 48, while the upper edge of the finger is provided with a guide groove 49 in alignment with the groove 42 in the extension end 41.

The inner edge of the folder arm is also provided with a guide groove 50 and this groove intersects the outer edge of the lower end of the finger 44 which is provided with an aligning groove 51.

As shown, particularly in Figure 6 and in Figures 7 and 8, the ram 7 is provided with a ledge 52 which extends across the front of the uprights 1 and 2 to operate the fingers 44 and 46.

As shown in Figure 7 in solid line, the normal

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position of the fingers is inwardly of the inner edge of the folder arm with the upper finger 46 abutting stop surface 43. It will thus be seen that, as the folder arms move upwardly to fold wire fed beneath a box or bundle placed on the bed plate around the sides of the box, the wire guide grooves 50, 51, 45 and 48 are in alignment to receive and guide the wire as it is folded upwardly.

When the folder arm reaches the ram ledge 52 the upper surface of the finger 46 projecting inwardly of the lateral extension 41 of the folder arm will be engaged by the ledge and because of the angled position of this finger 46 it will be swung downwardly, forcing the finger 44 outwardly to bend the wire over the top of the bundle or box.

To provide the desired bending of the wire it is essential that the pivot of the finger 44 be located as closely as possible to the box or bundle, and since its upper end must be in alignment with the inner edge of the folder arm the second finger 46 is required to effect the turning movement of the finger 44. Without the second finger 46 the reaction of the ram ledge would act directly through the pivot point without effecting a turning moment.

The dotted line showing of the fingers in Figure 7 illustrates the position which they assume when the folder arm has reached the limit of its upward movement.

Since it is desirable that one end of the wire being folded about the box be consistently under the opposite end of the wire, the fingers of the left-hand folder arm 16 are slightly longer than the fingers of the right-hand folder arm 26, so that the left-hand wire is folded first to lie beneath the right-hand wire.

The actual details of the wire feed mechanism and the mechanism for measuring and cutting the wires to the correct length for the bundle or box being bound are fully described and shown in detail in the aforesaid Patent No. 2,581,776 and are shown principally in diagrammatic form in the instant drawings as the specific operation of these parts forms no part of this invention.

Essentially the wire feed mechanism includes the motor 53 which drives the vertical spindle 54 through a suitable clutch 55 operated by the solenoid 56, as shown in Figure 1 and diagrammatically in Figure 5.

Mounted on the spindle 54 is a roller 57 which co-operates with a similar roller, not shown, to feed the wire W towards the machine. The wire after being driven between the rollers and through a suitable straightening device 58 passes across the frame 33 in a suitable guide slot and is fed beneath a box or bundle placed on the bed plate being guided by the grooved bar 12 and the groove 11 in the bar 10.

The control of the feed of the wire is effected by an arrangement of movable switches, as hereinafter described.

The wire feed preferably incorporates a safety device which will operate to stop the feed in the event the wire should jump out of its groove, run out or jam. In the instant showing the safety device comprises an arm 59 adapted to engage a longitudinally concaved threaded portion 60 of the spindle 54, the centre of curvature of which is the pivot of the arm 59.

The arm 59 has its outer end normally engaging the threads of the spindle 54 so that an over-travel of the wire beyond the size of the maximum box or bundle will move the arm upwardly to

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make the micro-switch 61, which is arranged to effect the stopping of the wire feed, as will be seen on reference to Figure 5.

The pivot of the arm 59 is in a member 59' movable laterally by the operation of the solenoid 62 to move the arm out of engagement with the spindle threads. This solenoid normally operates before the arm 59 is raised sufficiently to make the micro-switch 61 and allows the arm to fall, but in the event that the wire is fed beyond the specified limits the arm will operate the switch 61 to stop the feed.

The wire cutting and measuring device includes a plurality of movable switches which are illustrated diagrammatically in Figure 5 and shown in Figure 1.

Referring to Figure 1, it will be seen that slidably mounted on the frame 33 is a suitable wire-cutting and marking device 63 which is caused to travel on the frame by means of an endless cable 64. This cable is connected to a lug 65 extending from the ram 7 and extends upwardly, passing over a pulley 66. Adjustably mounted at the top of the ram frame and returning downwardly it passes over a pulley 67, then extends horizontally beneath the bed plate 4 around the pulley 68 mounted on the back of the bracket 13 so that the transverse movement of the bracket to accommodate different widths of boxes or bundles will alter the position of the cable correspondingly. From the pulley 68 the cable returns horizontally and extends beneath the frame 33 passing around the pulley 69 which is held under tension by a spring 70 and from thence it returns horizontally and passes over a pulley 71 mounted on the frame and then returns upwardly to the lug 65.

The sliding carriage of the wire cutter 63 is provided with an extension 72 which is secured to the cable. The spring 70 holds the cable taut and the adjustable pulley 66 enables the adjustment of the cutter to provide the correct length of overlap of the wire when folded around the box.

The cable 64 and the slidable cutter operated thereby are operated directly by the movement of the ram 7 as it moves into engagement with the box, so that the length of the wire on the right-hand side is determined, the cutter being operated as hereinafter described.

A grooved bar 73 aligns horizontally with the bar or frame 33 and extends from the left upright 1 of the frame and has a slidable carriage 74 mounted thereon carrying a control switch 75.

An endless cable 76 is connected to a lug 77 extending from the left side of the ram 7 and extends over a pulley 78 mounted at the top of the ram frame and returns downwardly under a pulley 79 from whence it returns horizontally beneath the bar 73 and around an end pulley 80.

The cable after passing around the pulley 80 returns and passes under a pulley 81 and returns upwardly to the ram lug 77.

The carriage of the control switch 75 is secured to the cable 76 between the pulleys 79 and 80.

The movement of the ram thus causes the switch carriage 74 to move corresponding to the size of the bundle on the bed plate to provide the correct length of wire to the left of the bed plate to fold up and around the bundle or box and overlap with the wire folded from the right side of the bed plate.

To effect the control of the wire feed to provide the correct wire length as described the con-

trol switch 75 is arranged in the path of the wire feed across the bar 73 and this switch is a single pole double-throw switch illustrated diagrammatically in Figure 5 and operated by engagement of the wire being fed along the bar 52.

Arranged either side of the bed plate to project into the path of the wire being fed across the bed plate are additional feed control switches 82 and 83 respectively, the switch 83 being arranged at the left of the bed plate and the switch 82 at the right.

The contacts of the switches 82 and 83 are normally closed to ground as illustrated in Figure 5 but are operated by the passage of wire across the bed plate and engaging their contacts to interrupt the ground connection to de-energize the feed controlling solenoid 56 as will hereinafter be described.

With the arrangement of switches shown the wire normally feeds to the switch 83 and stops upon opening switch 83 in preparation for the binding of a box or other material placed on the bed plate.

The control switch 82 is arranged to prevent wire feed past this switch when the folder arms are raised since the alternate path from the centre contact of the switch 82 is through the safety switches 84 and 85 interrupted by the rise of the folder arms.

Defined between the ram 7 and its front plate 34 is a vertical slot 86 which opens to the bottom of the ram and extends transversely the full width of the ram, and it is into this slot that the wire is turned by the folding fingers 44 of the folder arms.

The wire tensioning mechanism to tighten the wire about the box or other non-compressible material or object is particularly shown in Figures 6 and 10. This tightening mechanism includes two similar gripper devices which are first actuated to engage the wire and to draw same about the box or object to be tied. Each gripper is constructed as follows.

Slidably arranged in a groove 87 adjacent the centre of the face of the ram 7 at the lower edge thereof is a block 88 engaging on roller bearings 89 arranged in the inner face of the groove 87. This block 88 has an angled or bevelled outer face which extends outwardly towards the centre of the ram and is provided with a dovetailed guideway 90 on which a gripper or jaw member 91 slides. The block 88 is also provided with ribs 92 which engage in a groove 93 in the upper edge of the ram groove 87 and in the groove 94 formed in the retaining plate 95.

An extension 96 of the gripper or jaw member 91 extends inwardly through a slot 97 in the ram to project into the path of the piston 98 of an air cylinder 99. The portion of the gripper 91 engaging the dovetailed guideway 90 of the block 88 has an angled inner face opposite to the angle of the outer block face so that the outer toothed face 100 of the gripper is parallel with the face of the ram.

Acting to urge the block 88 to the outward end of its stroke is a relatively stiff spring 101, while acting to separate the block 88 and the gripper extension 96 is a spring 102 which is weaker than the spring 101.

Slidably mounted in the inner face of the ram plate 34 opposite the gripper 91 is a co-acting gripper 103 guided in a dovetailed groove 104 defined in the plate 34 and by bottom plate 105. This gripper member 103 is arranged to slide on the roller bearings 106 and is held normally at

the outward end of its stroke by the spring 107.

With the wire folded over by the folder fingers into the slot 86 and between the grippers or jaws 91 and 103 the outward movement of the piston 98 first forces the gripper 91 along its slide on the block 88 which is held against the action of the spring 102 by the stiffer spring 101.

The movement of the gripper continues and due to the angled sliding faces of the block 88 and the gripper it moves outwardly to engage the wire between its toothed face 100 and the corresponding toothed face 108 of gripper 103. Since further outward movement of the inner gripper is resisted upon gripping the wire the continued movement of the piston 98 effects movement of the block 88 and the grippers together to tighten the wire, forcing same inwardly toward the centre of the ram.

To prevent undue squeezing of the wire it will be noted that the gripper extension 96 will engage the block 88 after limited movement of the gripper and damage to the wire will be prevented.

An identical arrangement of grippers is provided on the opposite side of the centre of the ram to tighten the wire fed in by the folder fingers of the opposite folder arm, like reference numerals indicating like parts.

Upon tensioning of the wire with the mechanism described the overlapped ends of the wire are ready to be welded together. The welding mechanism is shown particularly in Figures 9 and 12. As shown, the lower welding electrode 109 is hinged to the body of the ram adjacent the centre and extends through a vertical slot 110 in the ram face, the slot also extending into the ram plate 34 as shown in Figure 6. Thus the lower welding electrode extends across 86 at the base of the ram and underlies the overlapped wires.

This electrode is connected through a suitable high capacity flexible cable 111 to the welding transformer 112 mounted on the ram.

The top welder electrode 113 is in the form of an angled arm pivoted at one end at 114 at the rear of the ram in an insulated bushing 114'. This top electrode 113 is arranged to have its free end enter the vertical slot 110 relatively high up to catch wires and force them down on the lower electrode. This top electrode is connected through the high capacity flexible cable 115 to the welding transformer.

To prevent the electrodes from shorting to the frame, insulated or insulating strips 116 are secured to the ram and extend along the wall of the slot 86 and right angularly along the wall of the slot 110. The lower electrode, like the upper electrode of course, is pivoted in a suitable insulated bushing 109'. The arrangement of the insulating strips 116 is clearly shown in Figure 6.

Referring to Figure 12, which shows the wire contacting ends of the electrode, it will be seen that the free end 117 of the lower electrode is provided with a bevelled upper surface 118 which is slightly convex. The free end 119 of the upper electrode, which is of a width somewhat greater than the width of the lower electrode, is provided with a somewhat curved wire contacting surface 120 having a central bevelled portion corresponding to the bevelled portion of the under or lower electrode. Thus when the wires are pressed by the electrodes and welded it will be seen on examination of Figure 12 that the axes of the wire portions W' each side of the electrodes are in a straight line and the welding upon completion of the tie is subjected to an

axial load only tending to shear the welded surfaces. This arrangement of providing axial load by forming the weld with bevelled electrodes, as shown, greatly increases the weld strength up to nearly the full strength of the wire.

The movement of the upper electrode is effected by the piston 121 of the cylinder 122 and upon completion of the folding and tensioning of the wire this piston is operated as hereinafter described to engage the upper electrode and force same about its pivot 114 downwardly to catch the wires overlapped in the slot 86 and force same down against the lower electrode.

It will be seen from Figure 9 that the upper electrode operates against a suitable spring 123 which serves to return the electrode clear of the slot 100 when released by the piston 121.

To effect the energization of the transformer relay 138 a suitable switch mechanism 124 normally opened by the plunger 125 is supported from the ram adjacent the upper electrode and its plunger is normally held depressed to hold the switch open by the upper electrode in its inoperative position. Thus movement of the piston 121 in forcing the upper electrode into welding position effects the energization of the welding transformer through the switch 124, as will be explained in conjunction with the circuit diagram Figure 5.

To eliminate the hazard of injury from the end of the upper wire of the weld means are provided to force this wire down against the box or object from an exposed position. This means includes the cylinder 126 supported on the ram as shown in Figure 9 and provided with piston 127 which operates through a hole 128 in the ram.

This cylinder 126 and piston 127 are obliquely arranged and the piston is adapted to move down at such an angle that it knocks the end of the top of the upper wire laterally and downwardly below the weld and against the box or bundle.

This action is timed to occur while the wires are still firmly held by the welding electrode.

Following completion of the weld, the length of which may be regulated through any suitable timing device, for instance a bellows arrangement 128' herein shown in Figures 4 and 5, the machine is operated to return to a normal position. The manner in which this return is effected will be described in connection with the air and electrical circuit diagrams, Figures 4 and 5 respectively.

Referring to Figure 5, it will be seen that the motor 53 for effecting the wire feed is continually energized but the wire feed mechanism as actuated by the clutch 55 is operated only when relay 129 is energized. Unless connected to ground by the hand feed switch 129' the energization of this relay depends on the switches 75, 82 and 83 arranged in the wire path and safety switches 84 and 85 operated by movement of the folder arms and safety switch 61 operated by over-travel of the arms 59 the switches herein illustrated diagrammatically being of the type disclosed in the said United States application No. 673,375, now Patent No. 2,581,776.

The wire normally feeds to switch 82 opening its connection with ground and connecting it with switch 83. If switch 83 is closed and safety switches 84 and 85 are closed with the folder arms in their lowered position, the wire continues to feed to switch 83 to open the switch opening the circuit to ground. Relay 129 is then

deenergized, de-energizing the clutch solenoid 56 stopping wire feed.

When the main switch 130 is operated to initiate the machine cycle, the main air valve 131, Figure 4, is also operated to move the ram 7 downwardly, and when the ram strikes a box or bundle or object placed on the bed plate the switch 132 is closed through the plunger 133 to connect the relay 129 to ground through switch 75 which has been positioned by the movement of the ram through the endless cable 76, as previously explained, to stop the wire at the proper length.

As will be hereinafter explained in connection with Figure 4, the right folder arm has been moved in by the piston 31 to align the box in the machine against the left upright 1 prior to the movement of the ram, and the wire cutting mechanism 63 is positioned in accordance with the movement of the right folder arm assembly and the ram as previously described to provide the correct length of wire to the right of the machine.

Upon the wire feeding to the switch 75 after the ram has been lowered and switch 132 operated, switch 75 is operated to open the wire feed solenoid circuit and close the relay 134. Relay 134 then effects the energization of the solenoid 135 to allow air from the high pressure system to enter the folder arm piston ram cylinders 21 and 30 respectively and to operate the wire cutting mechanism.

The folder arms are then actuated to fold the wire about the bundle upon moving upwardly at the same time breaking the safety switches 84 and 85 in the wire feed circuit to prevent wire from being fed past the switch 82 while the tie is being effected.

Upon the fingers 46 striking the ram ledge 52 the wires are turned over the top of the box, as explained, entering the vertical slot 86 in the ram.

The upward movement of the right folder arm effects, upon engagement with the piston 136, the movement of the piston in its cylinder 137 to apply high pressure air to the wire gripping cylinders and welding control cylinders to effect the operation of the weld.

Upon movement of the upper electrodes as effected through the piston 121 of the cylinder 122, as explained, switch 124 is operated to energize relay 138 to apply line voltage across the welding transformer 112 and to apply the requisite low voltage across the welding electrodes.

Since the path from the overlapped wires to the gripper jaws is a relatively long high resistance path, essentially all the current flows between the top and bottom electrodes directly through the overlapped wires.

Upon completion of the weld, switch 139 is operated by the bellows 128' in which pressure air is building up during the weld and this switch effects the energization of a relay 140 to release the main switch 130 which may be either a mechanical or an electrical latch-in switch. The completion of the switch 139 also effects the energization of the relay 62 to reset the arm 59 of the wire feed safety device.

It will be understood that the main switch 130 may be manually operated through a suitable lever which effects simultaneously the operation of the main air valve 131 or may be electrically operated through the entry of a box or object into the machine by means of a feeder,

such as described in co-pending application Serial No. 19,744 filed April 8, 1948.

To obtain a proper understanding of the sequence of the operation of the machine reference is had to the air circuit diagram, Figure 4.

Upon operation of the main air valve 131 pressure air from a supply pipe 141 is directed to the cylinder 32, forcing out the piston 31, which in turn moves the right-hand folder arm assembly inwardly to force the box or object against the left-hand upright 1.

While air enters the cylinder 32 directly through the pipe 142 the build up of pressure in this cylinder forces up the spring-operated piston 143 of the cylinder 144 to uncover a port 145 communicating with the upper end of the ram cylinder 5. Thus following completion of the inward movement of the right-hand folder arm assembly the ram is operated to descend and contact the box or object.

By-passing the cylinder 144 is a suitable check valve 146 permitting flow only in a direction from the upper end of the cylinder 5.

Upon engagement of the ram with a box or bundle on bed plate 4, switch 132 is operated to ground relay 129 to energize wire feed and upon the wire being fed through to switch 75 and operating same the wire feed mechanism is de-energized and the relay 134 controlling solenoid 135 is operated to cause solenoid 135 (Figure 4) to open the upper end of cylinder 145' connected to the air pressure supply through a restriction valve 146' which permits limited flow there-through. The release of pressure from the upper end of the cylinder 145' allows the spring-operated piston 147 to rise, allowing pressure air to flow to the bottom of the left-hand folder arm cylinder 21 to operate folder arm 16 and thence through a cylinder 148 upon building up sufficient pressure to operate the spring-loaded piston 149 to the right-hand folder arm cylinder 30 to operate folder arm 26 and thence to the wire-cutting mechanism 63.

The folder arms move upwardly and their fingers turn the wire over the top of the bundle and into the slot 86. As explained, the fingers of the left-hand folder arm are slightly longer than the right-hand so that the right-hand wire overlaps.

Upon the right folder arm striking the plunger 136 of the cylinder 137 air is permitted to flow directly to the cylinders 99 of the gripping mechanisms arranged either side of the centre of the ram.

Upon the outward movement of the cylinder pistons 98 the inner gripper or jaw members 91 are first moved longitudinally of their blocks 88 and due to the angled surfaces thereof are forced outwardly to grip the wires in conjunction with their co-operating gripping members 103. During this interval the blocks are maintained against movement by the stiff springs 101.

Upon further movement of the pistons 98 the blocks 88, together with the gripping members, move inwardly towards the centre of the ram, tensioning the wire about the box or object.

When sufficient pressure has built up in the cylinders 99 to tension the wire properly a piston 150 is operated against its restraining spring in cylinder 151 to uncover a port 152, allowing air to flow to the cylinder 122 to effect the operation of the upper welding electrode and the energization of the welding relay through switch 124.

When pressure has built up on the weld the piston 153 is operated against its restraining

spring in cylinder 154 to uncover port 155, permitting pressure air to flow to cylinder 126, forcing piston 127 downwardly to knock the end of the upper of the overlapped wires downwardly while still firmly gripped by the welding electrodes.

During the welding operation pressure air is also fed through a restricting valve 156 to the bellows 128' to effect after a desired interval of time, the operation of the switch 139 operating the relay 140 releasing the latch 157 of the main switch 130, and simultaneously releasing the main air valve to return to an upper position, connecting the inner end of the various cylinders with the low pressure. Thus release of the main air valve acts to release the wire grippers and allow them to return to a normal position under action of the springs 101, release the welding electrode operated by the piston 121, allow the folder arm cylinders to exhaust to atmosphere to return the folder arms to their lowered position, to elevate the ram, the lower end of the cylinder of which is connected to the high pressure source and to return the right-hand folder arm assembly to an outward position to receive the next box.

It will be noted that with the arrangement of welding jaws provided a strong and secure weld will result, eliminating breaking of the wire or weld under load.

Thus it will be seen that, with a machine such as described, boxes or non-compressible material or objects may be quickly bundled and tied with a wire that will be securely tensioned around the perimeter thereof.

With a machine such as described it is only required to place the bundle upon the bed plate and depress or effect the depression of the main switch and main air valve to initiate the machine cycle. Upon initiation of the cycle the entire operation of measuring, cutting, wrapping, tensioning and welding the wire and the release of the bundle and the return of the parts to normal is automatically effected.

It will be understood that my binding machine will be equally effective for the binding of compressible materials or bundles and the improved arrangement of folder arms and folding fingers and welding arrangement will provide improved performance whether on compressible or non-compressible materials.

In the case of compressible materials it may be understood that although the wire tensioning arrangement need not necessarily be required, it can be utilized to advantage to provide tighter and more compact bundles.

In practice the machine has proven to be extremely efficient and reliable and has almost entirely eliminated missed or defective welds so that no repeat operations are required on the objects or materials being bound.

What I claim as my invention is:

1. A wire binding machine comprising the combination with a bed plate, a reciprocating ram arranged above the bed plate, and means for feeding a wire beneath an object placed on the bed plate and folding the wire about the object, of two sets of gripper jaws mounted in said ram in aligned position, the jaws of each set being normally horizontally spaced apart to receive the folded wire therebetween while permitting unobstructed vertical movement in folding therebetween and being relatively movable horizontally into and out of wire-gripping relation, said jaw sets being relatively movable longitudinally in opposite directions upon gripping said wire to

tension same about said object, means to effect the movement of said jaws to grip and tension said wire, and means to weld the ends of the tensioned wire together.

2. In a machine for wire binding non-compressible objects or the like, the combination with a bed plate, a reciprocating ram arranged above the bed plate, means for feeding wire beneath an object placed on the bed plate, and means for folding the wire about the object and into a slot in said ram to overlap the wire ends while said ram is in engagement with said object, of a pair of gripping devices mounted in spaced relation in the walls of said ram slot and each including gripper members mounted on opposite sides of said slot and permitting unobstructed vertical wire movement in said slot in folding about the object and relatively movable transversely of said slot to first grip said wire and movable longitudinally of said slot to then tension said wire about said object, means to effect the movement of said gripping devices transversely and longitudinally of said slot, and means to weld the overlapped ends of the tensioned wire together.

3. In a wire binding machine, the combination with a bed plate, a reciprocating ram arranged above the bed plate, means for feeding a wire beneath an object or the like placed on the bed plate and means for folding the wire about the object to overlap the wire ends while said ram is in engagement with said object, of a pair of welding electrodes carried by said ram and arranged to engage and grip the overlap wire ends, said electrodes having angled transverse wire-engaging surfaces whereby the wire either side of said electrodes is in substantially axial alignment upon completion of the weld.

4. A machine as claimed in claim 3 in which means are provided to bend the upper of the overlapped wire ends downwardly adjacent the object being bound.

5. A machine as claimed in claim 3 in which an air cylinder is obliquely arranged in said ram, a piston operating in said cylinder and arranged to strike the end of the upper of said overlapped wires engaged by said welding electrodes to force same laterally and downwardly from an exposed position.

6. A wire binding machine comprising the combination with a bed plate and an air-operated ram of a reciprocating press, means for placing a length of wire beneath an object placed on the bed plate, adjustable air-operated folder means to fold the wire around the object to overlap the wire ends, and means to weld the overlapped ends of the wire when folded around the object, of air-operated means to adjust said adjustable folder means to align the object on said bed plate, a compressed air supply, a main air valve operable to direct compressed air to operate said folder-adjusting means, means to direct compressed air to said ram upon operation of said bundle-adjusting means, means operable upon movement of said ram into engagement with the object to direct compressed air to said folder means to fold the wire about the bundle, and air-operated means operated upon completion of the folding of the wire to actuate said welding means.

7. A machine as claimed in claim 6 in which air-operated wire tensioning means are arranged in said ram, means to direct compressed air to said tensioning means following the folding of the wire around the object, and means to direct compressed air to said air-operated welding actu-

ating means upon completion of the tensioning of said wire.

8. A machine as claimed in claim 6 in which air-operated means are provided to turn down the exposed end of the upper overlapped wire end, and means to direct compressed air to said last-mentioned means following the actuation of said welding means.

9. In a machine for wire binding non-compressible objects, the combination with a bed plate, a reciprocating ram arranged above the bed plate, means for feeding wire beneath an object placed on the bed plate and means for folding the wire about the object and into a slot in the ram to overlap the wire ends to be welded, of a pair of gripper devices to grip and tension wire folded into said slot, said gripper devices each including a block slidably mounted in one wall of said ram slot to move longitudinally of said slot and having an angled outer face, a gripper member having an angled inner face mounted to slide on the angled face of said block longitudinally of said slot to move outwardly and inwardly of the slot wall, a second gripper member slidably mounted in the wall of said slot to slide longitudinally thereof opposite the aforesaid gripper member and adapted to co-operate therewith, means restraining movement of said block until the gripper member slidably mounted thereon has been moved outwardly into cooperative wire-gripping relation with said second gripper member, and means to operate said block and gripper member slidable thereon longitudinally of said slot.

10. In a wire binding machine, the combination with a bed plate, a reciprocating ram arranged above the bed plate, means for feeding wire beneath an object placed on the bed plate, and means for folding the wire about the object and into a slot in the ram to overlap the wire ends to be welded, of a pair of gripper devices to grip and tension wire folded into said slot, said gripper devices each comprising a block slidably mounted in a guideway in one wall of said ram slot to move longitudinally of said slot, said block having an angled outer face formed with a longitudinal guideway extending longitudinally of said slot, a slidable gripper jaw having an angled inner face engaging the guideway of said angled block face and having a lateral projection extending beyond the outer end of said block, a spring urging said block along said slot outwardly from the centre of said ram, a spring relatively weaker than the aforesaid spring arranged between said block and said lateral projection, and a second gripper jaw slidably mounted in a guideway in the opposite wall of said slot opposite the aforesaid gripper jaw, and gripper actuating means engaging said lateral projection to first move said angled gripper jaw on said block to move same into adjacent cooperative gripper relation with said second gripper jaw and to then effect movement of said block and gripper jaws as a unit to tension the wire.

11. In a wire binding machine, the combination with the ram and bed plate of a reciprocating press and means for feeding a measured length of wire under a bundle or the like placed on said bed plate, of means adjustable in accordance with the size of the bundle for folding the wire around the bundle and fluid pressure operated means operatively connected with said adjustable folder means and operable prior to the operation of said ram and folding of said wire to adjust said folding means to engage and align the bundle on the bed plate, said adjustable folder means comprising a pair of vertical relatively

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movable guide assemblies arranged adjacent the sides of the bed plate, a pair of folder arms vertically slidable in said guide assemblies, fluid pressure operated means for operating said folder arms to fold the wire up the sides of the bundle, a curved folding finger pivoted adjacent the inner edge of each folder arm adjacent the upper end thereof and normally retracted to assume a substantially vertical position, a second normally obliquely extending finger abutting and projecting above the aforesaid finger and pivoted to the folder arm remote from the inner edge thereof, and ledge means on said ram to engage the upper obliquely extending fingers of said folder arms to force same downwardly and inwardly to actuate said curved folding fingers to turn the wire over the top of the bundle.

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12. A machine as claimed in claim 11 in which the inner faces of the upper ends of said folding fingers are provided with wire receiving grooves and the inner and upper edges of the upper ends of said normally oblique fingers are provided with wire receiving grooves.

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10 The following references are of record in the file of this patent:

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