Aug. 27, 1963 E. R. BURDEN 3,101,653

MACHINE FOR FOLDING PAPER BOXES

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Fig. 1.

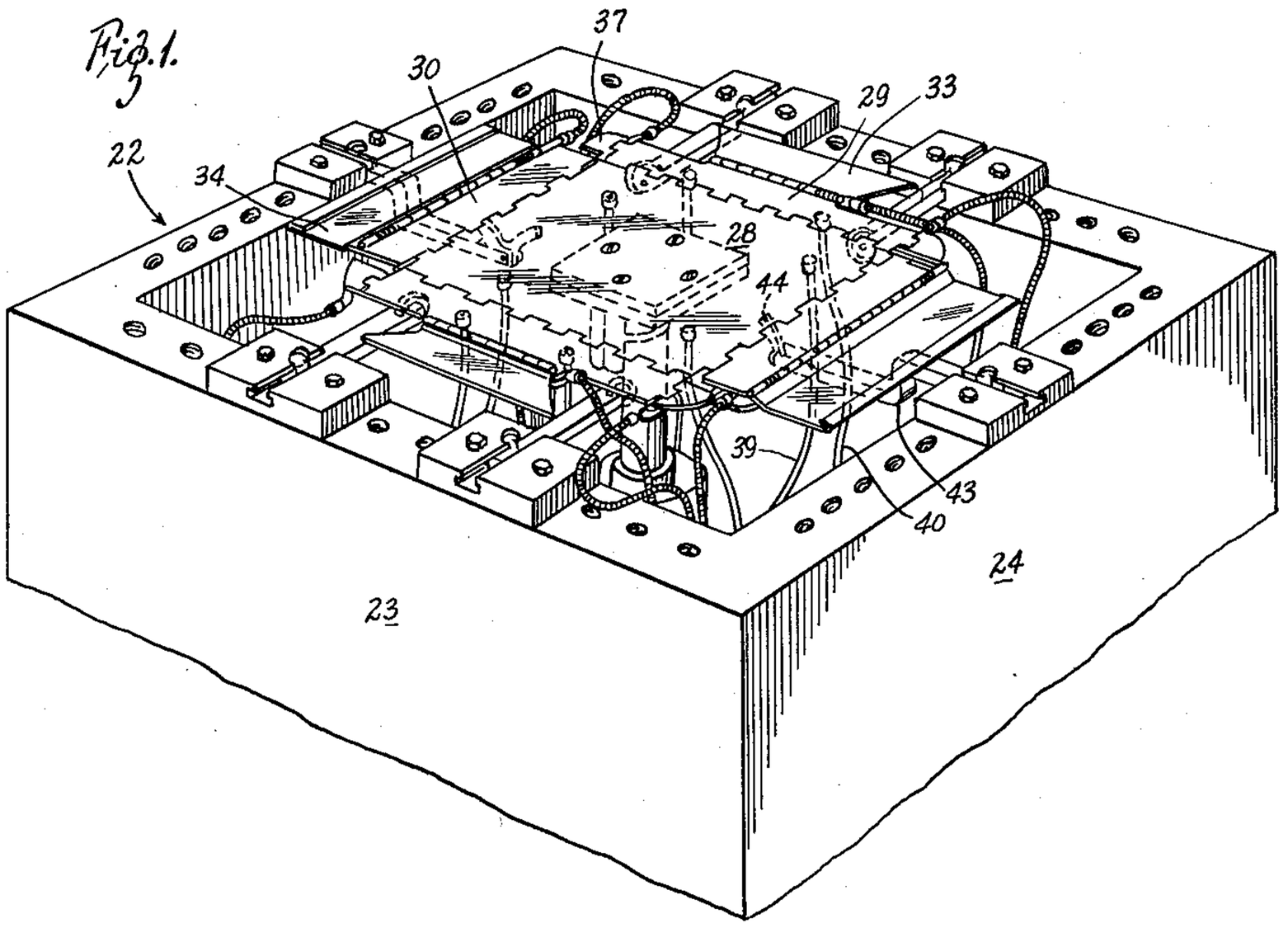

Fig. 2.

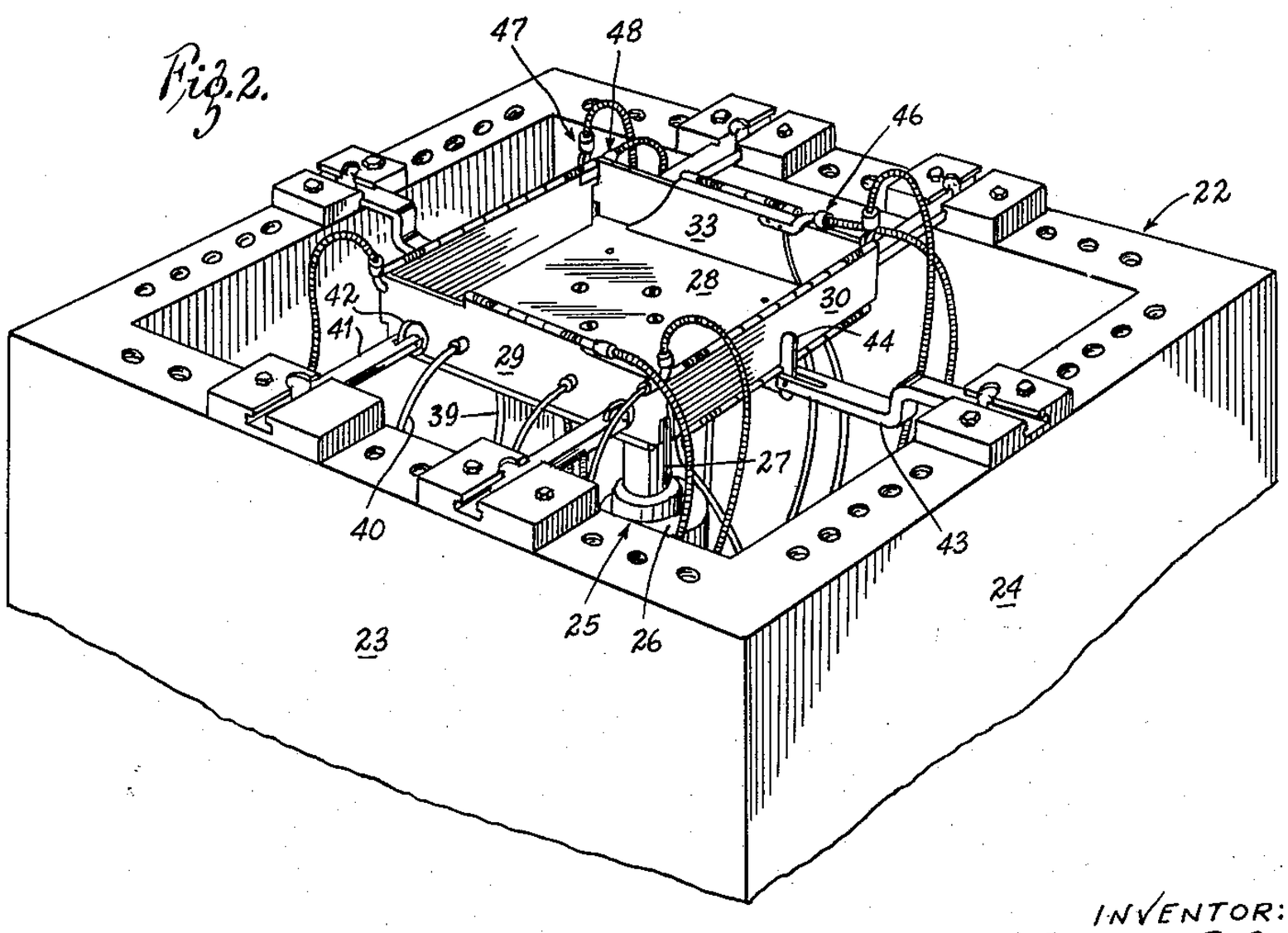

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Fig. 3.

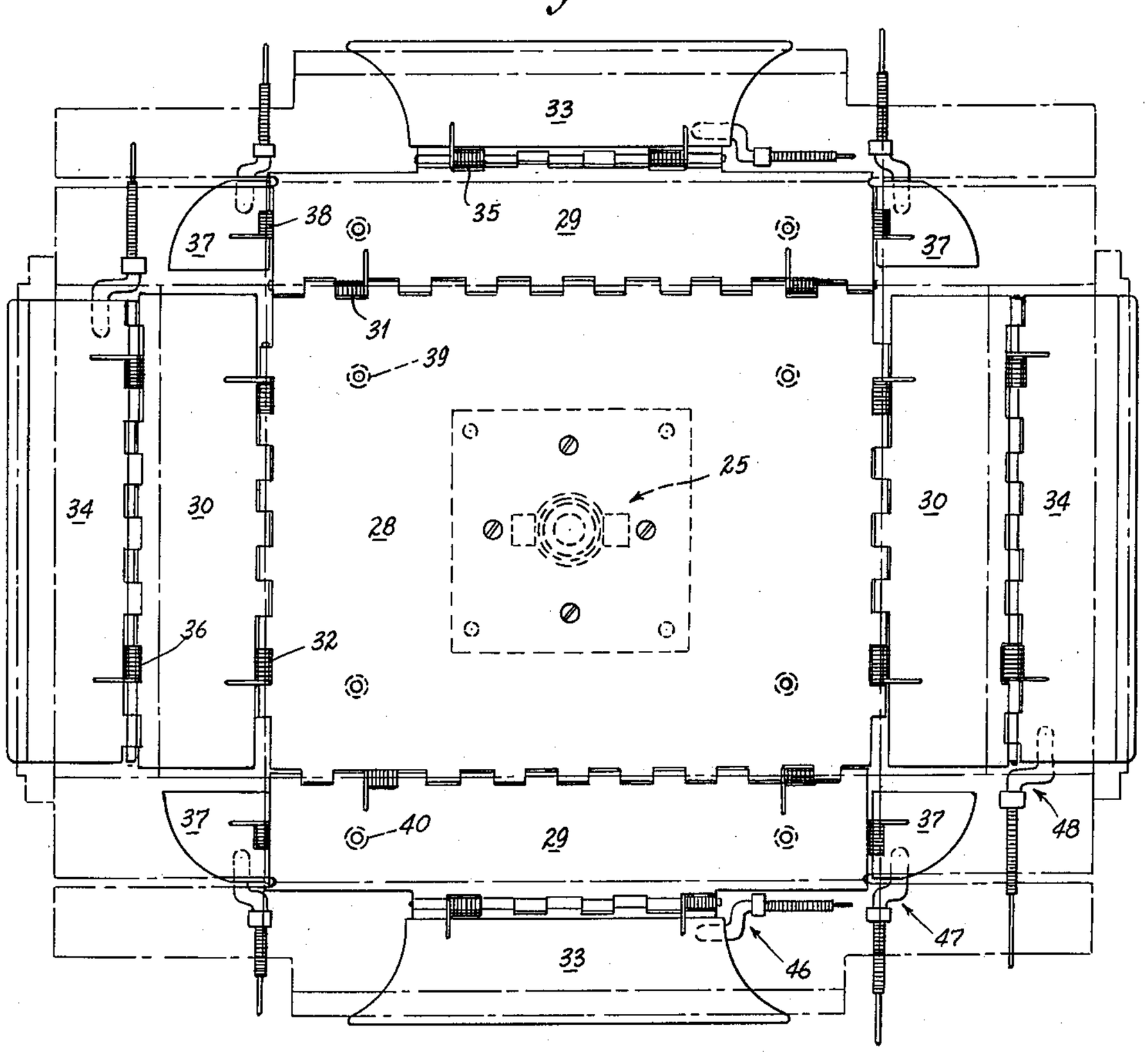

Fig. 4.

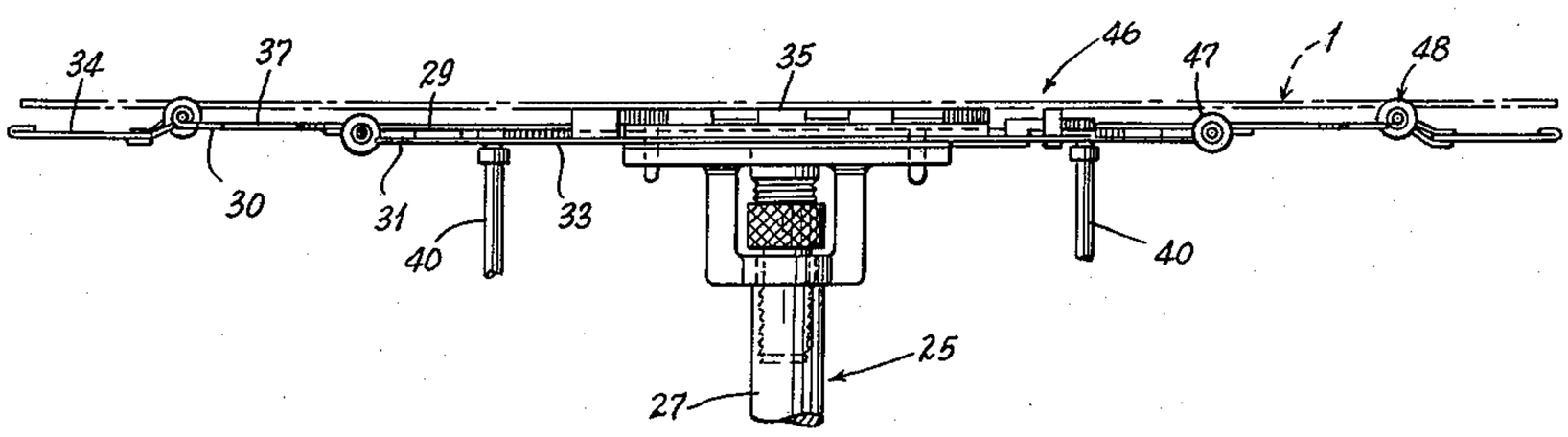

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Fig. 5.

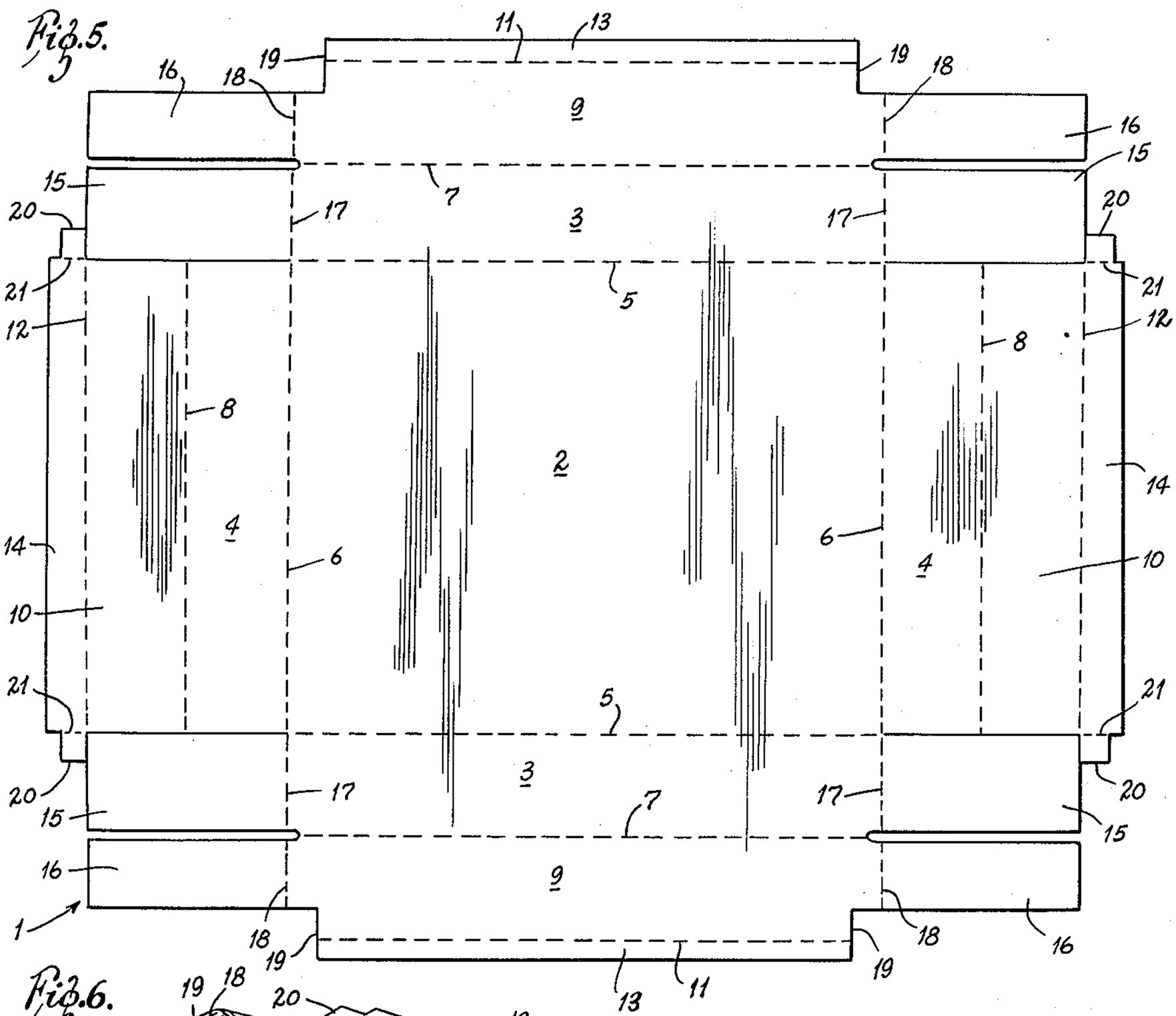

Fig. 6.

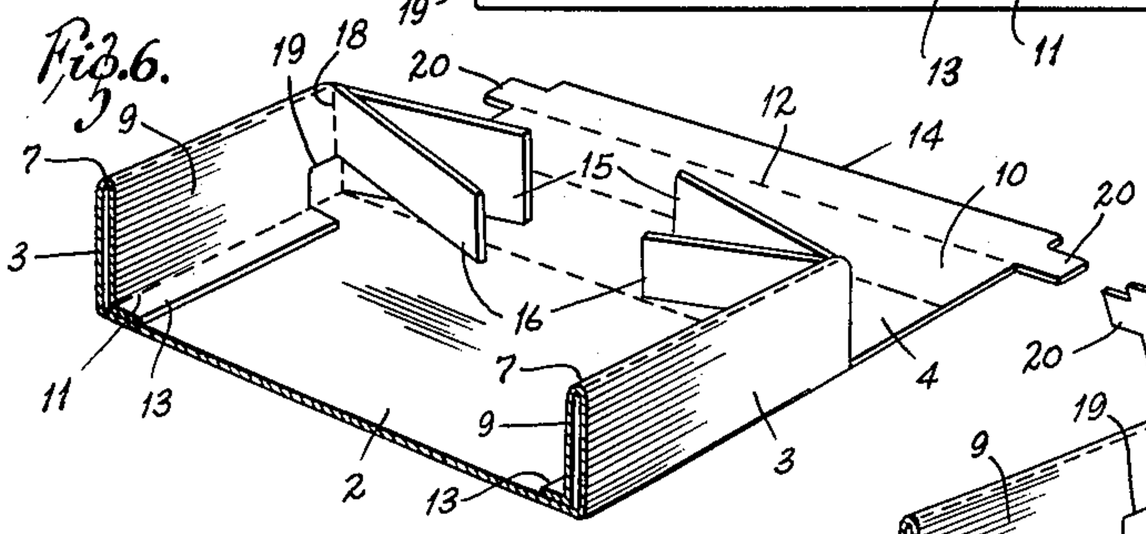

Fig. 7.

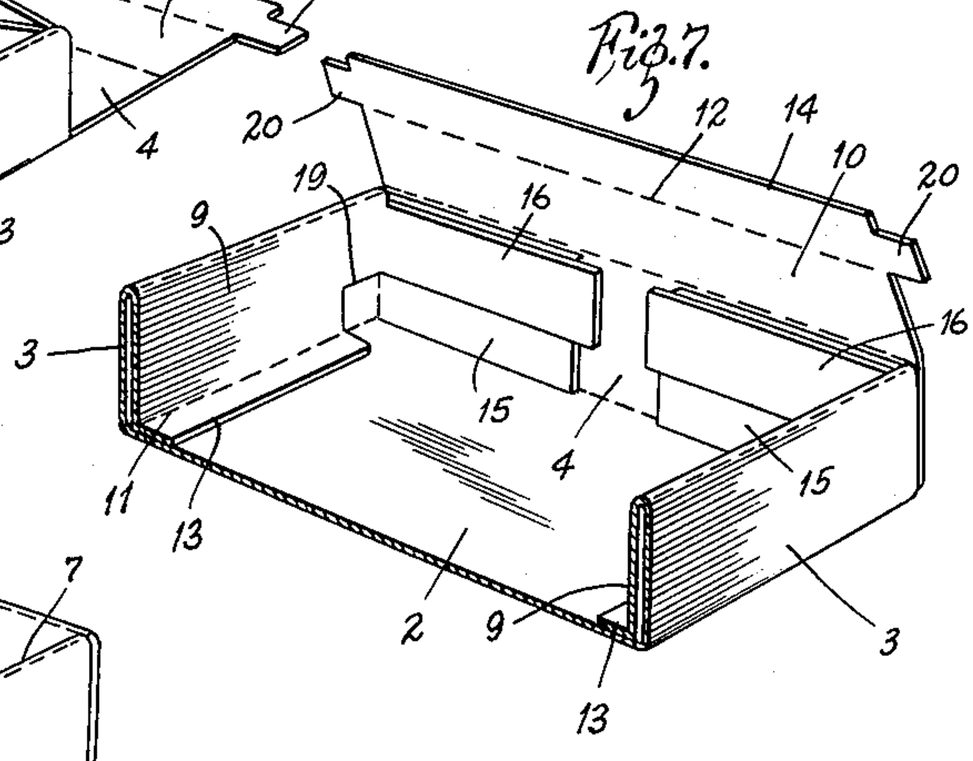

Fig. 8.

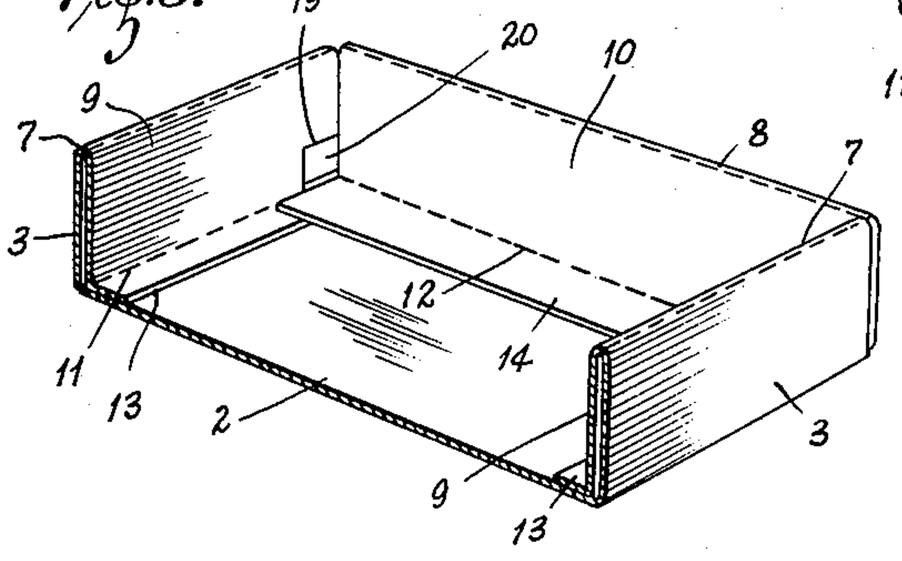

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Fig. 9.

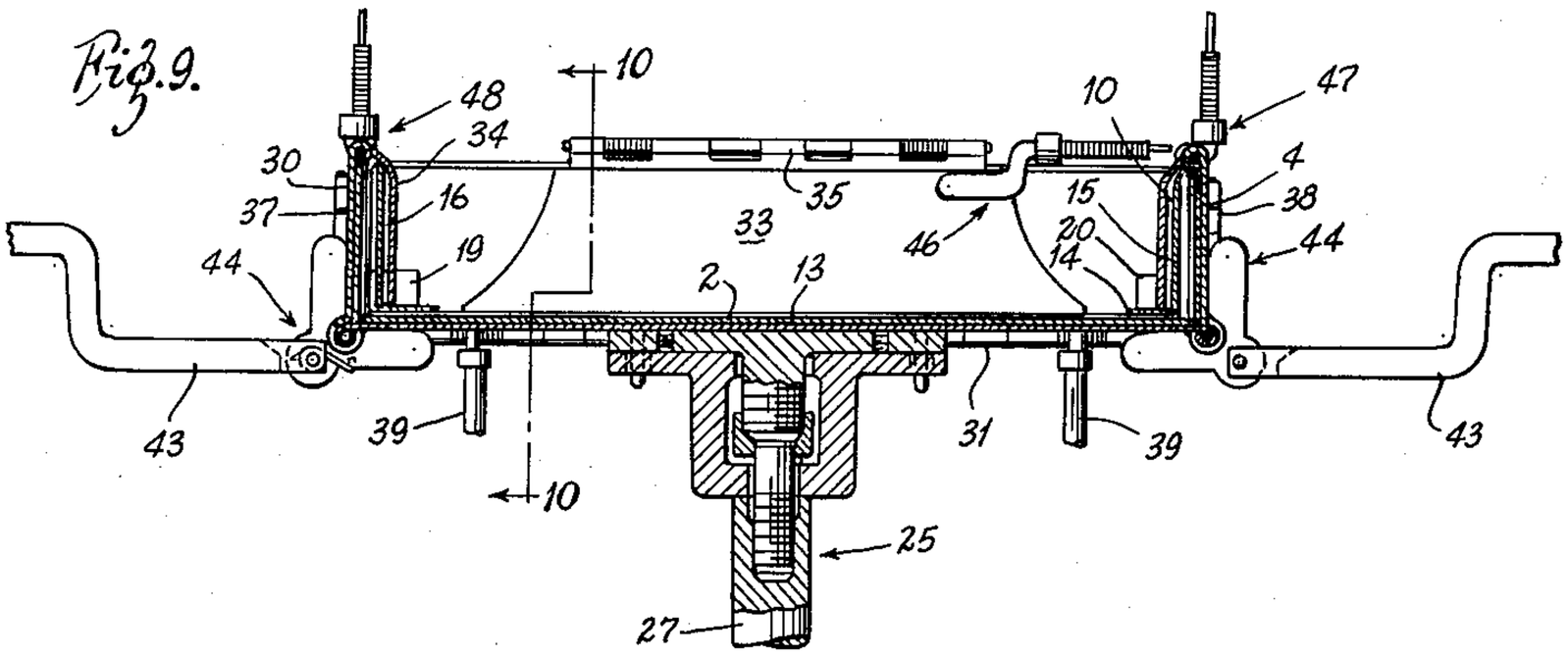


Fig. 10.

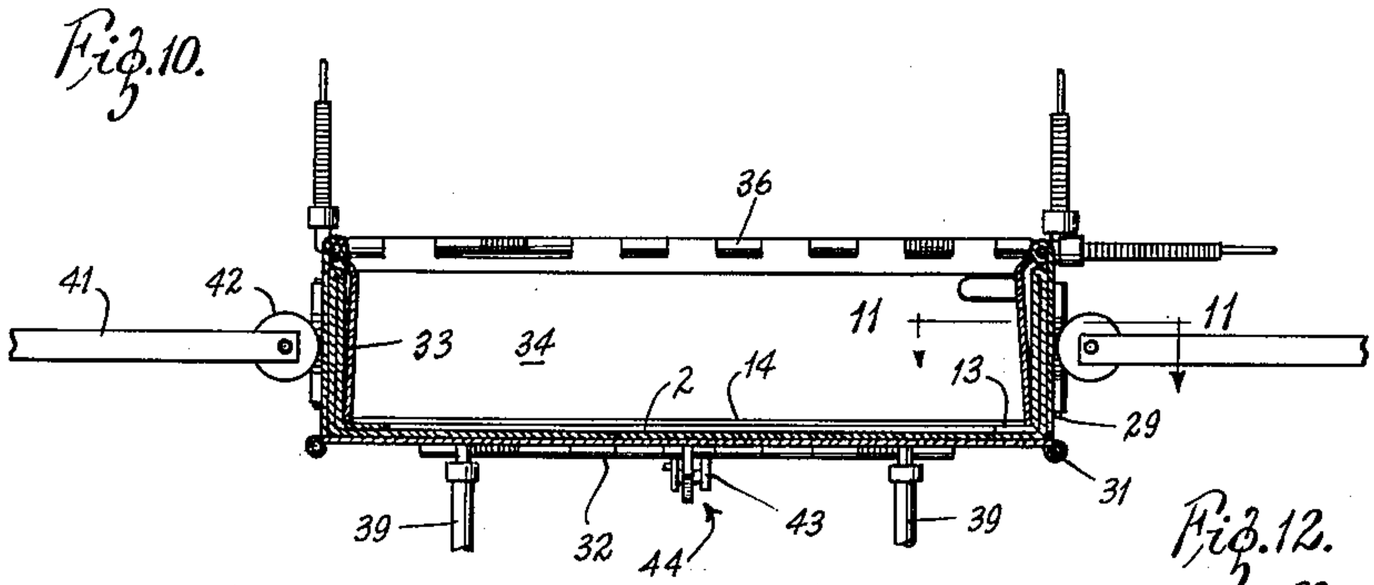


Fig. 12.

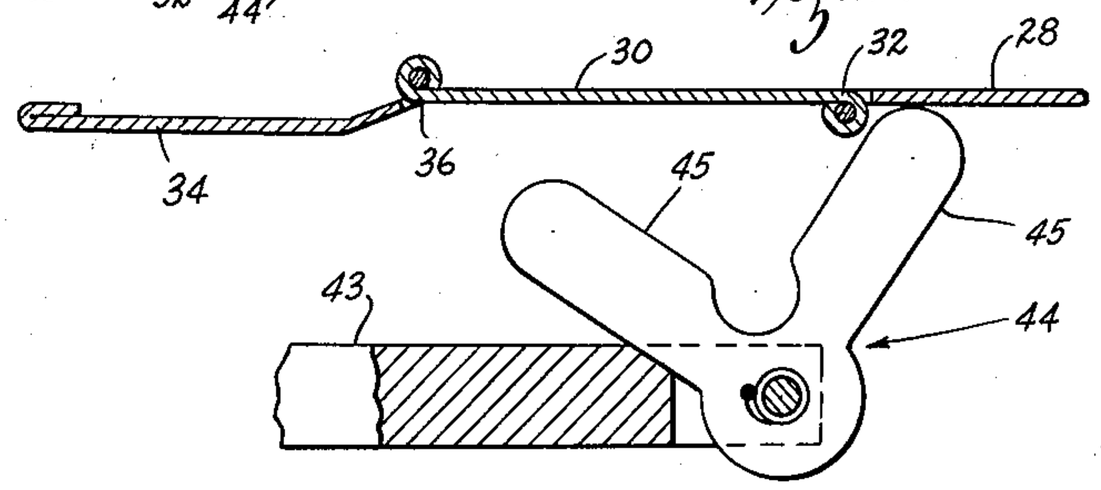
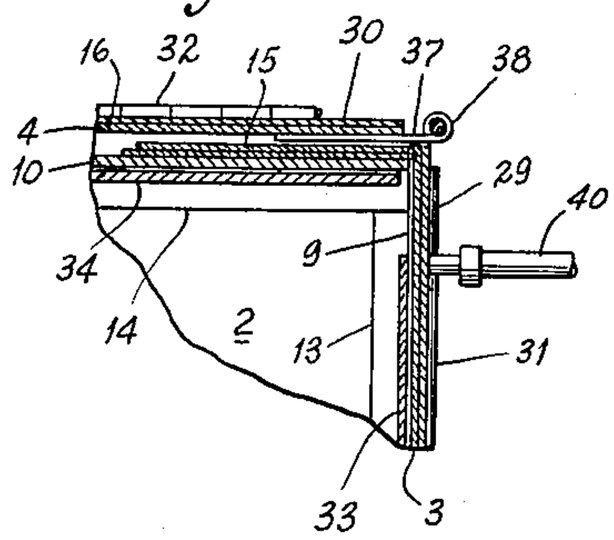


Fig. 11.



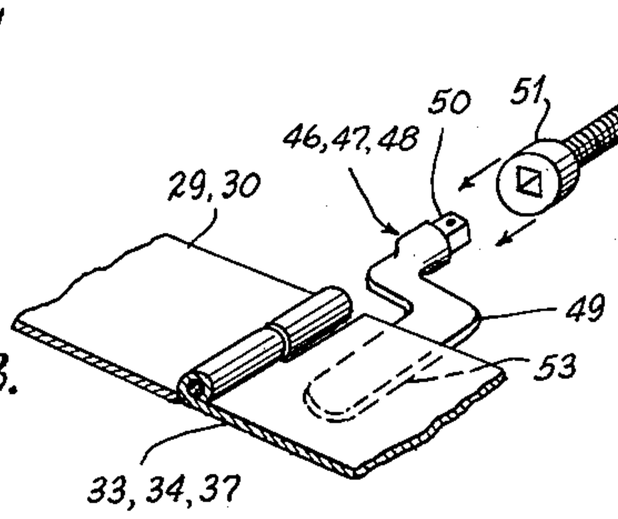


Fig. 13.

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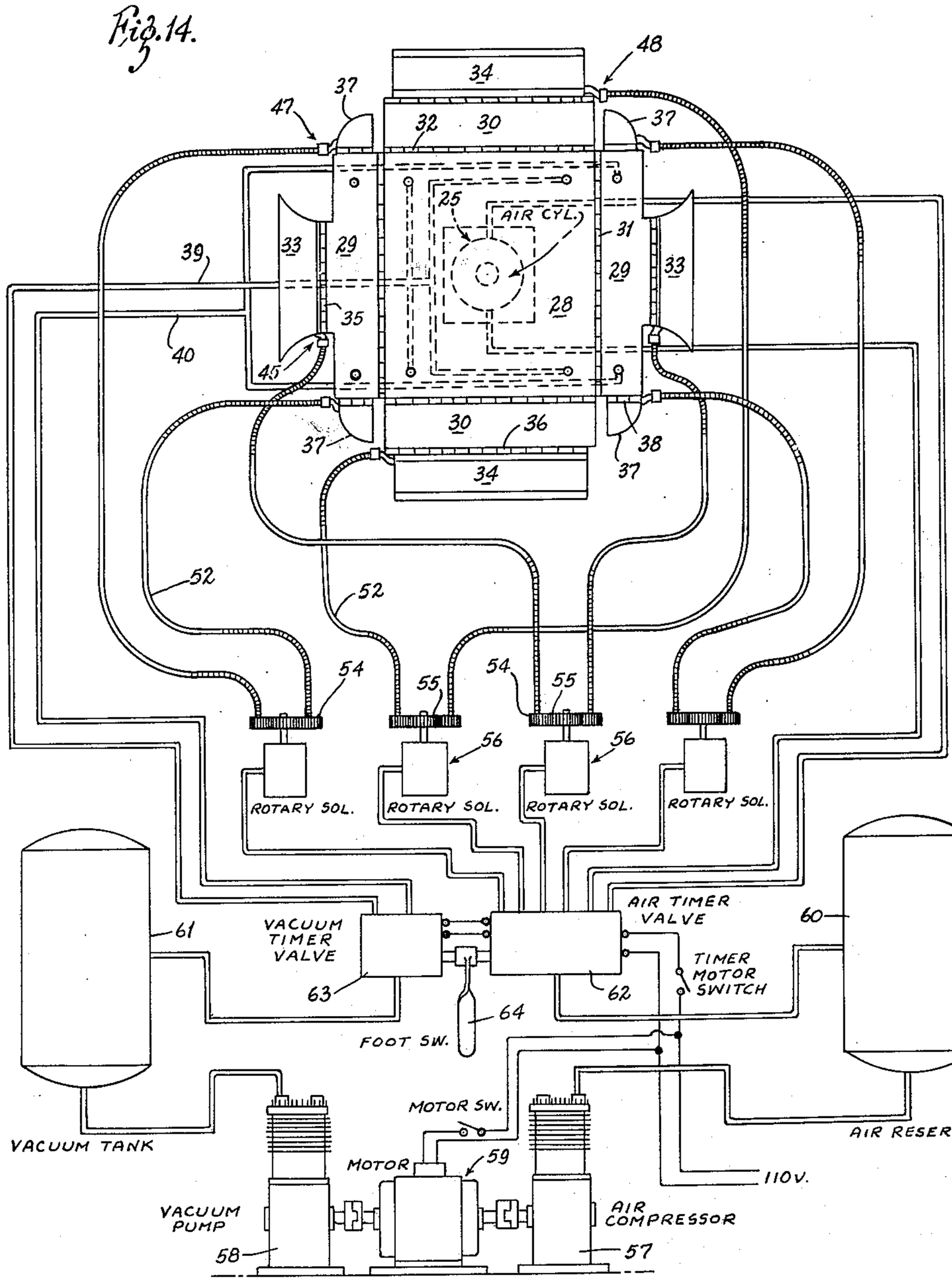
Fig. 14.



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3,101,653
MACHINE FOR FOLDING PAPER BOXES

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Filed Sept. 6, 1960, Ser. No. 54,191
5 Claims. (Cl. 93—49)

This invention relates to a machine for folding paper boxes, and it concerns more particularly a machine which is peculiarly adapted for use in folding paper boxes of the type shown in my Patent No. 2,846,133, dated August 5, 1958.

An object of the invention is to provide a fully automatic machine for the purpose described which is of simple, rugged construction and is sufficient and dependable in its operation.

The invention will be readily understood by referring to the following description and the accompanying drawing, in which:

FIGURE 1 is a fragmentary perspective view of a paper box folding machine embodying the invention, showing the machine in one of its operating positions;

FIGURE 2 is a view similar to FIGURE 1, showing the machine in another of its operating positions;

FIGURE 3 is a top plan view, on an enlarged scale, of a portion of the apparatus shown in FIGURE 1, with a blank of the type used in forming the box, shown in dotted lines, in position to be folded by the machine;

FIGURE 4 is a side elevational view of the apparatus shown in FIGURE 3;

FIGURE 5 is a view showing one side of the blank used in forming the box;

FIGURE 6 is a perspective view showing an end portion of the box in one of its partly folded positions;

FIGURE 7 is a view similar to FIGURE 6, showing the end portion of the box in another of its partly folded positions;

FIGURE 8 is a view similar to FIGURES 6 and 7, showing the end portion of the box in its completely folded position;

FIGURE 9 is a sectional view, taken on a median line, of a portion of the apparatus shown in FIGURE 1, showing the box in its completely folded position;

FIGURE 10 is a sectional elevational view taken on the line 10—10 of FIGURE 9;

FIGURE 11 is a fragmentary sectional plan view taken on the line 11—11 of FIGURE 10;

FIGURE 12 is a fragmentary sectional elevational view, on an enlarged scale, partly broken away, showing a portion of the apparatus illustrated in FIGURE 9 in another of its operating positions;

FIGURE 13 is a fragmentary, exploded perspective view showing details of construction; and

FIGURE 14 is a diagrammatic view showing the complete machine.

Referring to FIGURES 5 to 8 of the drawing, the numeral 1 designates generally a blank of the type which is adapted to be folded to form a box by operation of the paper box folding machine of the invention. As shown in FIGURE 8, the box is rectangular, and has a bottom 2, a pair of sides 3, and a pair of ends 4, as hereinafter described.

The sides 3 and the ends 4 each comprise two thicknesses of material, and are formed by folding the material thereof upwardly, along the lines 5 and 6, at the juncture of the sides 3 and the ends 4 with the bottom 2, and folding the material upon itself, along the lines 7 and 8, whereby the inner thicknesses 9 and 10 of the sides 3 and the ends 4 are turned downwardly, inside the box. The material of the sides 3 and the ends 4 is again folded along the lines 11 and 12, whereby marginal portions 13 and 14 thereof overlie the adjacent edges of the bottom 2.

The two thicknesses of material which comprise the sides 3 have tabs 15 and 16 extending beyond their ends which are folded along the lines 17 and 18 whereby they are arranged parallel to the two thicknesses of material which comprise the ends 4. The inner thicknesses 10 of the ends 4 are folded over the tabs 15 and 16, whereby the marginal portions 14 of the ends 4 overlie the marginal portions 13 of the sides 3.

Indentations 19 are formed in the inner thicknesses 9 of the sides 3, the marginal portions 13 thereof, and the corresponding tabs 16, adjacent the corners of the box. Tabs 20, which are formed on the ends of the marginal portions 14 of the ends 4, are folded upwardly along the lines 21, and are received in the indentations 19, to thereby secure the box in its folded position.

The operation of the automatic paper box folding machine of the invention, as hereinafter described, is stepwise, substantially as follows:

(1) The material of the sides 3 is folded upwardly upon itself, along the lines 7, whereby its inner thicknesses 9 overlie its outer thicknesses, the marginal portions 13 overlie the adjacent edges of the bottom 2, and the tabs 16 overlie the corresponding tabs 15;

(2) The tabs 15 and 16 are folded upwardly, along the lines 17 and 18, whereby they are disposed at right angles to the sides 3;

(3) The material of the sides 3 is folded upwardly, along the lines 5, at the juncture of the sides 3 with the bottom 2, whereby the sides 3 are disposed at right angles to the bottom 2, while at the same time

(4) The material of the sides 3 is folded along the lines 11, whereby the marginal portions 13, which overlie the adjacent edges of the bottom 2, are disposed in parallel, juxtaposed relation thereto;

(5) The material of the ends 4 is folded upwardly along the lines 6, at the juncture of the ends 4 with the bottom 2, whereby the ends 4 are disposed at right angles to the bottom 2;

(6) The material of the ends 4 is folded upon itself, along the lines 8, whereby the inner thicknesses 10 thereof are folded over the juxtaposed tabs 15 and are turned downwardly inside the box, while at the same time

(7) The material of the ends 4 is folded along the lines 12, whereby the marginal portions 14 thereof, which overlie the adjacent edges of the bottom 2, are disposed in juxtaposed, parallel relation thereto, above the adjacent ends of the marginal portions 13 of the sides 3, and

(8) The tabs 20 are folded upwardly along the lines 21, and are received in interlocking engagement with the indentations 19.

Referring to FIGURES 1–4 and 9–14 of the drawing, the automatic paper box folding machine of the invention has a frame including a hollow, generally rectangular enclosure, indicated generally by the numeral 22, which is open at the top and has parallel sides 23 and ends 24.

A pneumatically operable hydraulic jack, indicated generally by the numeral 25, is disposed vertically within the enclosure 22, centrally thereof. The jack 25 has a cylinder 26 which is mounted on the frame, and is stationary relative thereto, and a piston having an upwardly extending rod 27 which is movable reciprocally relative to the enclosure 22.

A horizontally disposed rectangular plate 28, which conforms to the shape of the bottom 2 of the box, is rigidly connected to the upper end of the piston rod 27, which provides a reciprocally movable support therefore. A pair of side plates 29, and a pair of end plates 30, which conform to the shapes of the sides 3 and the ends 4 of the box, are connected by spring biased hinges 31 and 32 to the corresponding edges of plate 28, whereby the side plates 29 and the end plates 30 are normally supported in horizontally outwardly extending positions relative to

the plate 28, and are movable upwardly about the hinges 31 and 32.

A pair of side plate extensions 33, and a pair of end plate extensions 34, which correspond to the inner thicknesses 9 and 10 of the sides 3 and the ends 4, are connected by spring biased hinges 35 and 36 to the longitudinal edges of the side plates 29 and the end plates 30 opposite the plate 28, whereby the side plate extensions 33 and the end plate extensions 34 are normally supported in horizontally outwardly extending positions relative to the side plates 29 and the end plates 30, and are movable upwardly about the hinges 35 and 36.

Two pairs of tab plates 37, which correspond to the tabs 15, are connected by spring biased hinges 38 to opposite ends of the side plates 29, whereby the tab plates 37 are normally supported in horizontally outwardly extending positions relative to the side plates 29, and are movable upwardly about the hinges 38.

The plates 28, 29, 30, 33, 34, and 37 together form a table like structure adapted to support the blank 1 in position to be folded by relative movement of the plates as hereinafter described. Vacuum lines 39 communicate with corresponding openings in the plate 28, and vacuum lines 40 communicate with openings in the side plates 29, whereby the bottom 2 and the sides 3 of the blank 1 are adapted to be secured in parallel, juxtaposed relation thereto during the folding operation.

Two pairs of arms 41, which are adjustably secured to opposite sides 23 of the enclosure 22 and extend horizontally inwardly therefrom, have rollers 42 on their inner ends which are engageable with the side plates 29 upon downward movement of the plate 28 relative to the enclosure 22, in response to the action of the hydraulic jack 25, whereby the sides 3 are folded upwardly relative to the bottom 2 of the blank 1.

A pair of arms 43, which are adjustably secured to opposite ends 24 of the enclosure 22 and extend horizontally inwardly therefrom, have spring biased elements 44 pivotally connected to their inner ends. The elements 44 each consist of a pair of fingers 45 which are disposed at right angles to each other and are pivotally connected to the corresponding arm 43 at their juncture.

The elements 44 are capable of a limited pivotal movement in a vertical plane, whereby the respective fingers 45 thereof are engageable successively with the bottom 2 and the adjacent ends 4 of the blank 1, upon downward movement of the plate 28 relative to the enclosure 22, in response to the action of the hydraulic jack 25, whereby the ends 4 are adapted to be folded upwardly relative to the bottom 2 of the blank 1.

The elements 44 are characterized by a delayed action whereby the ends 4 are folded, by the action of the elements 44, after the sides 3 have been folded by the action of the rollers 42.

The side plate extensions 33 have driven rotary elements 46 operatively connected thereto, whereby the side plate extensions 33 are adapted to be folded over the side plates 29, to thereby fold the inner thicknesses 9 over the sides 3, and at the same time fold the tabs 16 over the tabs 15.

The tab plates 37 have driven rotary elements 47 operatively connected thereto, whereby the tab plates 37 are adapted to be folded at right angles to the side plates 29, to thereby position the juxtaposed tabs 15 and 16 at right angles to the sides 3.

The end plate extensions 34 have driven rotary elements 48 operatively connected thereto, whereby the end plate extensions 34 are adapted to be folded over the end plates 30, to thereby fold the inner thicknesses 10 over the ends 4 and the tabs 15 and 16.

The driven rotary elements 46, 47, and 48 each comprise an angularly bent connecting member 49 having an end portion 50 received in a socket 51 attached to a flexible cable 52, and having an eccentric lug 53 on its opposite end which is attachable to a side plate extension, an end plate extension 34, or a tab plate 37, whereby it is adapted to be rotated about the axis of the cable 52.

As shown in FIGURE 14, the flexible cables 52 are arranged in pairs, and each have a pinion gear 54 connected to one end thereof. The pinion gears 54 mesh with appropriate idler gears and with gears 55 which are connected to the shafts of rotary solenoids 56, whereby the rotary elements 46, 47, and 48 are driven.

The machine further includes an air compressor 57 and a vacuum pump 58, which are driven by a motor 59. The air compressor 57 is connected to a tank 60, from which air is supplied to the hydraulic jack 25. The vacuum pump 58 is connected to a tank 61, which in turn is connected to the vacuum lines 39 and 40.

An electrical timing mechanism whereby air is supplied to the hydraulic jack 25, and the solenoids 56 are actuated in predetermined sequence, to thereby control the operating cycle of the machine, is indicated generally by the numeral 62. An electrically operable valve 63, whereby vacuum is applied to the vacuum lines 39 and 40, is actuated by the timing mechanism 62, upon completion of the operating cycle, whereby the vacuum is released. The valve 63 is opened, and operation of the timing mechanism 62 is initiated, by means of a foot switch 64.

In the operation of the machine, the driven rotary elements 46 and 47 are first actuated, to thereby fold the inner thicknesses 9 over the sides 3, to fold the tabs 16 over the tabs 15, and to position the juxtaposed tabs 15 and 16 at right angles to the sides 3. Thereafter the sides 3 and the ends 4 are folded successively at right angles to the bottom 2, by the action of the hydraulic jack 25, and the inner thicknesses 10 are folded over the ends 4 and the tabs 15 and 16 by the action of the driven rotary elements 48.

The marginal portions 13 are folded parallel to the bottom 2, by frictional engagement therewith, as the sides 3 and the inner thicknesses 9 are folded upwardly together. Similarly, the marginal portions 14 are folded parallel to the bottom 2, and the tabs 20 are folded upwardly, and received in interlocking engagement with the indentations 19, by frictional engagement with the bottom 2 and the sides 3, respectively, upon folding the inner thicknesses 10 downwardly over the ends 4 and the tabs 15 and 16.

The invention may be modified in various ways without departing from the spirit and scope thereof.

What is claimed is:

1. In an automatic machine for folding paper boxes operable on a blank therefor, the combination of a frame including a hollow enclosure having sides and ends and being open at the top, movable means disposed vertically within the enclosure, centrally thereof, and having an upwardly extending piston rod movable reciprocally relative to the enclosure, a horizontally disposed rectangular bottom plate conforming to the bottom of the box supported on the piston rod for movement therewith, a pair of side plates, and a pair of end plates, conforming to the sides and the ends of the box, connected by spring biased hinges to the corresponding edges of the bottom plate, whereby the side plates and the end plates are normally supported in horizontally outwardly extending positions relative to the bottom plate, and are movable upwardly about the hinges, and means carried by the sides and ends of the enclosure, engageable with the side plates and the end plates, whereby the side plates and the end plates are adapted to be folded upwardly, one after the other, relative to the bottom plate upon downward movement of the bottom plate relative to the enclosure in response to the action of the movable means, means for applying a vacuum to thee space between the bottom plate and the bottom of the box, and separate means for applying a vacuum to the spaces between the side plates and the sides of the box, whereby the bottom and sides of the box are positively secured to the bottom plate and the side plates, respectively, a pair of side plate extensions and a pair of

end plate extensions, corresponding to inner thicknesses of the sides and ends of the box, connected by spring biased hinges to the longitudinal edges of the side plates and the end plates, respectively, opposite the bottom plate, whereby the side plate extensions and the end plate extensions are normally supported in horizontally outwardly extending positions relative to the side plates and the end plates, and are movable upwardly about their hinges, and driven rotary elements acting on the side plate extensions and the end plate extensions to fold them upon the side plates and the end plates.

2. The structure of claim 1, two pairs of tab plates, corresponding to tabs connected to opposite ends of the sides of the box, connected by spring biased hinges to opposite ends of the side plates, whereby the tab plates are normally supported in horizontally outwardly extending positions relative to the side plates, and are movable upwardly about their hinges, and driven rotary elements acting on the tab plates to fold them at right angles to the side plates.

3. An automatic machine for folding paper boxes comprising a frame, a generally horizontal platform supported by the frame, the platform having parallel sides and parallel ends, a pair of side plates pivotally attached to the sides of the platform, a pair of end plates pivotally attached to the ends of the platform, means for pivoting the side plates and end plates upwardly from substantially horizontal to substantially vertical positions, a pair of side plate extensions pivotally connected to the outer edges of the side plates, and means to pivot the side plate extensions against the inner surfaces of the side plates when the side plates are in substantially vertical positions.

4. An automatic machine for folding paper boxes comprising a frame, a platform movably supported by the frame, means for moving the platform vertically with respect to the frame, a pair of side plates, a pair of end plates, means for pivotally attaching an edge of each side plate to the platform in such wise that the side plates are parallel, means for pivotally attaching the end plates to the platform in such wise that the end plates are parallel, means for biasing the side and end plates toward substantially horizontal positions, means responsive to downward vertical movement of the platform for pivoting the side and end plates upwardly to substantially vertical positions, a pair of side plate extensions pivotally attached to the outer edges of the side plates, means for biasing the side

plate extensions to positions generally parallel to the side plates, and means for pivoting the side plate extensions against the inner surfaces of the side plates.

5. In an automatic machine for folding paper boxes operable on a blank therefor, the combination of a frame including a hollow enclosure having sides and ends and being open at the top, movable means disposed vertically within the enclosure, centrally thereof, and having an upwardly extending piston rod movable reciprocally relative to the enclosure, a horizontally disposed rectangular bottom plate conforming to the bottom of the box supported on the piston rod for movement therewith, a pair of side plates, and a pair of end plates, conforming to the sides and ends of the box, connected by spring biased hinges to the corresponding edges of the bottom plate, whereby the side plates and the end plates are normally supported in horizontally outwardly extending positions relative to the bottom plate, and are movable upwardly about the hinges, and means carried by the sides and ends of the enclosure, engageable with the side plates and the end plates, whereby the side plates and the end plates are adapted to be folded upwardly, one after the other, relative to the bottom plate upon downward movement of the bottom plate relative to the enclosure in response to the action of the movable means, a pair of side plate extensions and a pair of end plate extensions, corresponding to inner thicknesses of the sides and ends of the box, connected by spring biased hinges to the longitudinal edges of the side plates and the end plates, respectively, opposite the bottom plate, whereby the side plate extensions and the end plate extensions are normally supported in horizontally outwardly extending positions relative to the side plates and the end plates, and are movable upwardly about their hinges, and driven rotary elements acting on the side plate extensions and the end plate extensions to fold them upon the side plates and the end plates.

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