

Oct. 4, 1966

E. R. ST. DENIS
ASSEMBLING MACHINE

3,276,409

Filed Nov. 12, 1963

4 Sheets-Sheet 2

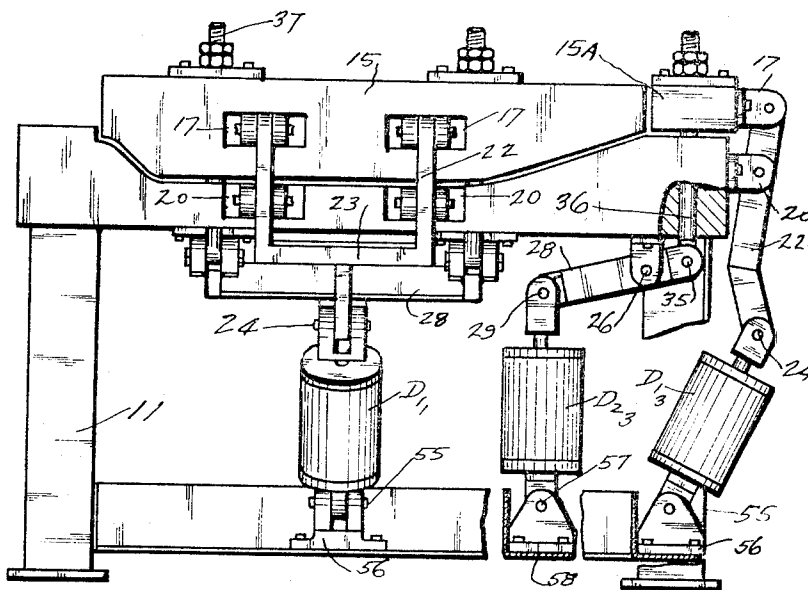


FIG. 2

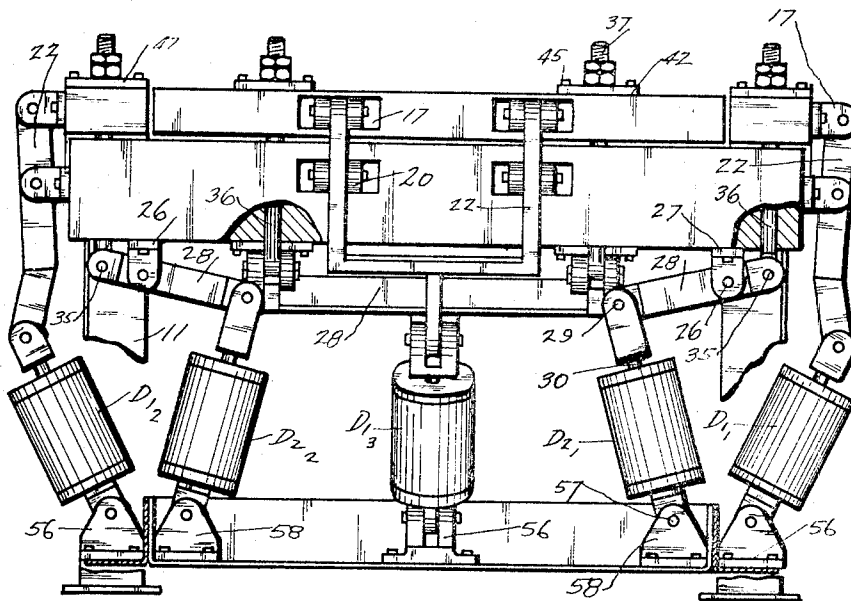


FIG. 3

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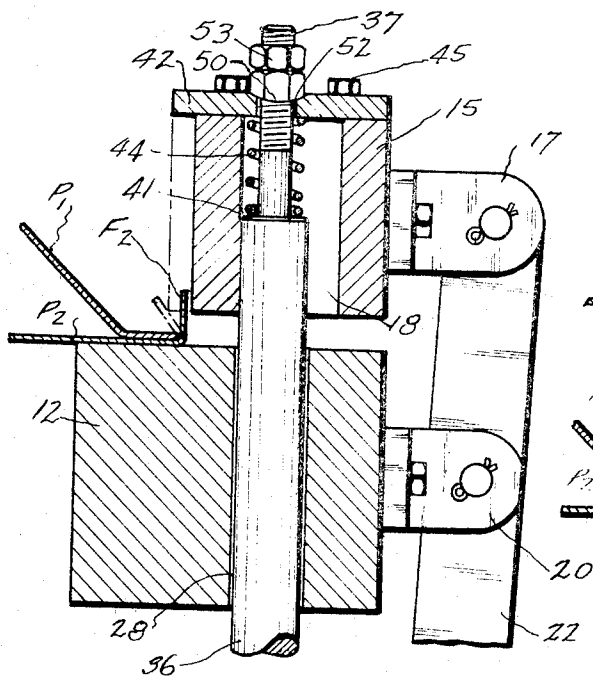


FIG. 4

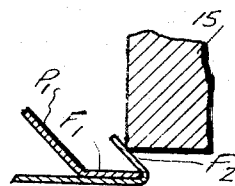


FIG. 5

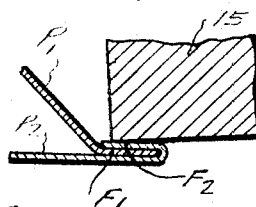


FIG. 6

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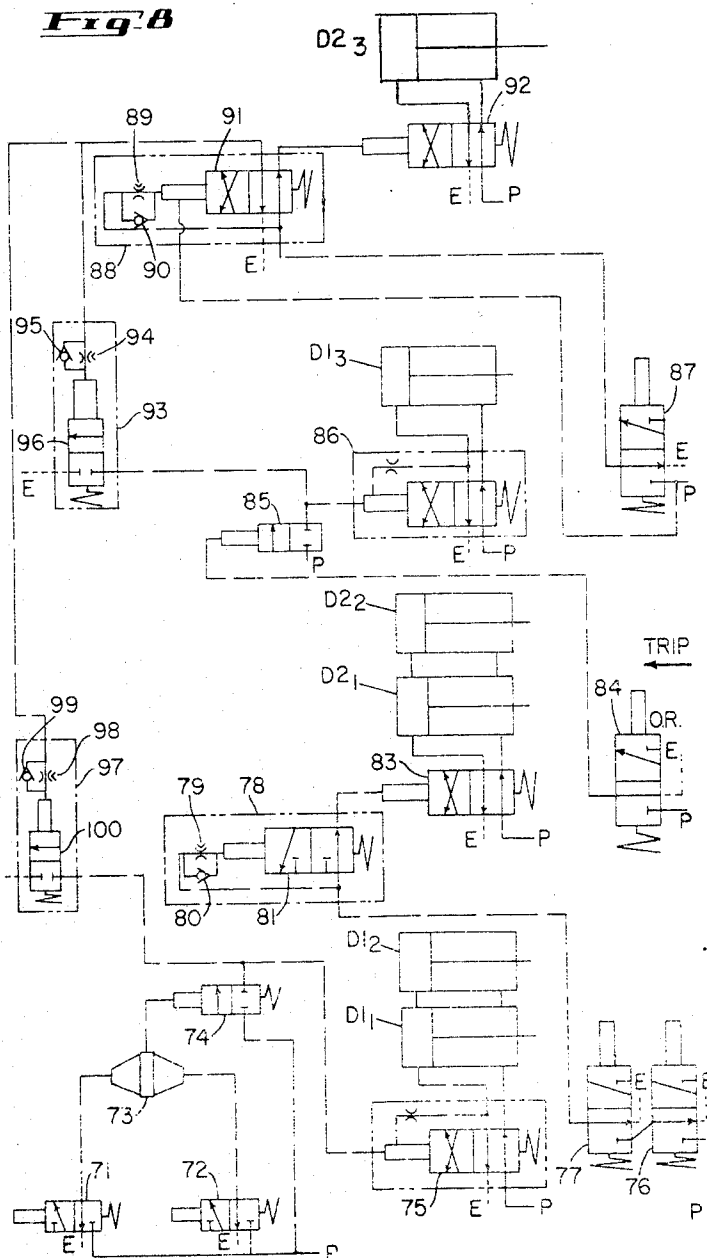
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Fig 8



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ASSEMBLING MACHINE

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4 Claims. (Cl. 113-54)

My invention relates to an assembling machine.

More particularly, the machine serves to secure two metal preformed panels or components together into a unitary, two-part hollow door. Such hollow doors are now universally used in automobile vehicles—passenger cars and trucks.

One preformed panel of such a door is formed on its peripheral edges (or some of its peripheral edges) with a flange rising at right angles (or substantially so) to the general plane of the panel, which flanges may be termed a "securing" flange; the other panel is formed on its peripheral edges (or on some of its peripheral edges) with a marginal flange which rests upon the first-mentioned panel when the two panels are placed into their cooperating relative position in the assembling machine preparatory to assembling the panels into a unitary, hollow door as aforesaid, the outer edges of the marginal flanges of the last-mentioned panel lying close to the base of the "securing" flanges of the first-mentioned panel.

The "securing" flanges of the first-mentioned panel are turned back and pressed against the flanges of the "other" panel, thereby assembling the two panels into a unit or door.

As already stated, this type of door is now standard practice in passenger cars and trucks.

The several methods now used (including a manual method) of locking the two panels together into a door are costly and not entirely satisfactory, so much so that the automobile industry has already manifested considerable interest in my improved assembling machine, as evidenced by the orders placed with me for such improved assembling machine.

In accordance with my invention, the "securing" flange is first bent approximately 45° by a member which is moved substantially at right angles to the plane of the securing flange, the member being in engagement with the flange close to its upper or free edge when the member has reached the end of its bending stroke; the member is then lowered vertically, but, and most importantly, slightly rotatively, progressively and fully, to bend the flange into full engagement with the other companion flange.

The main object of the invention is to provide a novel and most efficient machine for securing together two complementary parts or panels of a two-piece hollow automobile door.

In the drawings, wherein like numerals of reference indicate corresponding parts in the various figures,

FIGURE 1 shows an isometric view of an assembling machine according to my invention;

FIGURE 2 is a side view of FIGURE 1, as seen from south-east to north-west in FIGURE 1;

FIGURE 3 is an end view of FIGURE 2, as seen from right to left in FIGURE 2;

FIGURE 4 is a fragmentary section as on line 4—4 in FIGURE 1;

FIGURES 5 and 6 are diagrammatic views showing, respectively, the "securing" flange in partly-bent position, and in fully-bent position;

FIGURE 7 is a fragmentary isometric view of FIGURE 1; and,

FIGURE 8 is a diagrammatic view of the air operating system.

Referring now by numerals to the drawings, 10 shows the frame or table of the machine, which is supported horizontally above the floor as by uprights 11. The frame includes four horizontal parts. Two (parallel) such parts are shown as 12; a third part is shown as 13. The upper faces of these three parts are formed or shaped to fit the contour of the areas or portions of the two superimposed panels which are laid and rest upon the frame 10, preparatory to assembling one panel to the other. The panels (only partially shown in FIGURE 4) bear reference numerals P1 and P2.

In practice, the panels are not planar, but are curved both longitudinally and transversely, so that when the panels are laid upon the frame, they are easily manipulated into their proper or intended operative, relative position upon the table.

Supported above the table 10, more particularly above the parts 12, 13 and 12, in a manner to be described later, are the flange-bending members 15, 15A and 15. As previously stated, the function of the flange-bending members is slidable to engage the flange F2 of the panel P2 (see FIGURE 4), bend it about 45° (see FIGURE 5), and then bend the flange further to a flat position overlying and engaging the flange F1 of the other panel P1 (see FIGURE 6).

To each such member 15, 15A or 15, of rectangular cross-section, is secured a pair of longitudinally-spaced brackets 17. Extending from each of the members 12, 13 and 12 of the frame 10 are two spaced brackets 20, these brackets lying vertically below the brackets 17. Pivotaly connected to the brackets 17 and 20 are the members 22 of a U-shaped lever 23 from which extends an arm 24. In effect, the arrangement provides a lever unit by which one side of the member (15, 15A or 15A) is supported by the brackets 20, and therefore, by the frame 10.

The lever unit, more particularly the arm 24, is operatively, pivotally connected at its lower end as at 25 to the piston rod of the piston of an air cylinder D1 which is pivotally supported as at 55 in a fixed bracket 56.

Pivotally supported as at 26 in brackets 27 secured to the underside of the table, are the two members of a lever device 28. One end of the device 28 is pivotally connected as at 29 to the rod 30 of the piston of an air cylinder D2. The cylinder is pivotally supported as at 57 in a fixed bracket 58.

Pivotally supported at their lower ends to the other ends of the levers 28, as at 35, are rods 36. The rods 36 extend upwardly through apertures 28 through the member 13, or 12 as the case may be, of the table, and through slotted apertures 18 made through the flange-bending member 15, or 15A as the case may be, aforesaid (see FIGURE 4).

The upper portion of the rod 36 is reduced in diameter as at 37 to present a shoulder 41. Compressed between the shoulder 41 and a plate 42 slidably secured to the upper face of the member 15, or 15A as the case may be, is a coil spring 44. The plate 42 is formed with a central aperture through which the reduced portion of the rod 36 passes, to extend beyond the plane of the plate 42.

The plate 42 is secured to the member 15 as by cap screws 45 the shanks of which pass through slots 46 (see FIGURE 1) of a length in excess of the distance between adjacent such cap screws, so that the member 15, or 15A as the case may be, may be free to be displaced relatively to the plate 42 in a direction at right angles to the length of the member 15, or 15A as the case may be. Thus, the member 15 is in effect resiliently suspended from the plate 42 and is movable horizontally relatively to and under the plate 42, moving from right to left (as in FIGURE 4) to engage and bend the securing flange F2 of the panel P2.

To the upper end of the reduced portion of the rod 36 is threaded a nut 50 the lower face of which is spherical, engaging in a correspondingly-formed recess 52 formed into the upper face of the plate 42 (see FIGURE 4). A lock nut 53 is preferably used, as shown.

As will be clearly seen, when the cylinder D1 is energized, its piston rod tends to rise, and rises slightly to rotate the lever 22 (anti-clockwise, as seen in FIGURE 2) on its pivot in the bracket 20 and shift the bending member 15A against the flange (F2) to be bent (in practice 45°). Then, when the cylinder D2 is energized to raise the piston rod and rotate the lever 28 (clockwise, as seen in FIGURE 2) and lower the rod 36, the bending member 15A is pulled downwardly. As one side of the member 15A is pivotally supported by the lever 22, the member lowers, more particularly, describes an arc, so that the operative, horizontal surface of the member 15A progressively engages and completes the bending and flattening of the flange.

Both of the cylinders D1 and D2 associated with each of the bending members 15, 15A and 15 operate in like manner, serving first to move the members horizontally, and then downwardly to complete the bending of the flange (F2).

As already stated, and again referring to FIGURE 6, it will be seen that a machine in accordance with my invention is such that the flange is bent in two stages. It is first bent 45°, and then bent another 45° in a second operation. In the last operation, the bending is effected by moving the bending member, not in a true vertical movement but in a rotative movement, so that the flange is well and truly bent progressively, in the sense that the flange is wholly in engagement with its companion, underlying flange.

It has been found that to provide such a true contact between the companion flanges, lowering the member 15 vertically was not satisfactory. On the other hand, a completely satisfactory job is achieved by, as just previously explained, rotatively lowering the die member so as progressively to engage and press the flange from its 45° position to its completely bent, final position.

In practice, I prefer to bend two oppositely-disposed flanges (say, the flanges to be bent by the oppositely-disposed members 15—15) and then bend the third flange (the flange to be bent by the member 15A). This requires that the two air cylinders D1₁ and D1₂ be operated to bend the flange 45°, and the two air cylinders D2₁ and D2₂ operated to complete the bending of these two flanges. The third air cylinder D1₃ is then operated to move the member 15A to bend the third flange, and the air cylinder D2₃ operated to complete the bend.

The three cylinders D2 are then operated to return all three members to their normal raised position, and then the three cylinders D1 are operated to return the members to their initial position.

FIGURE 8 illustrates in schematic form the system of valves by means of which the D1 and D2 cylinders of the apparatus illustrated in FIGURES 1, 2 and 3 may be operated in the manner previously described. The symbols used throughout FIGURE 8 are the standard pneumatic symbols for industrial equipment. The system illustrated in FIGURE 8 consists of a pair of manually operated control valves 71 and 72 which when operated supply air pressure to a valve 73. The valve 73 is so constructed that it will open only if valves 71 and 72 are simultaneously operated. Thus the machine operator must operate these two valves with his hands and accordingly cannot actuate the air cylinders D1 and D2 when his hands are positioning panels in the press. When valve 73 opens it supplies air pressure to an air operated valve 74 which then opens and supplies pressure to the air operated valve 75 and to the timing valve assembly 96. It will be noticed that the timing valve assembly 96 is not actuated by the air pressure from the valve 74. Air actuated valve 75 includes a restricted passageway from

the outlet of the valve to the air control which maintains the valve in the on condition until the timing valve assembly 96 releases air pressure from the valve 75. When valve 75 closes it supplies pressure from the pressure line P to the pistons of cylinders D1₁ and D1₂ to operate these two cylinders. As the piston of cylinder D1₁ moves it actuates cam operated valve 77 and then cam operated valve 76. When valves 76 and 77 are closed pressure is passed from the pressure line P to the valve assembly 78. The incoming pressure in the assembly 78 is passed through the check valve 80 to actuate the valve 81 which remains open for a time determined by setting of the variable restriction valve 79. Valve 81 passes air pressure to the valve 83 which when actuated permits pressure from line P to actuate the pistons of the cylinders D2₁ and D2₂. It will be noticed that cylinders D2₁ and D2₂ are thus operated after cylinders D1₁ and D1₂ have been actuated as required for the proper bending of the flanges on the panels being assembled. After a period of time controlled by the variable restriction valve 79 the valve 81 will return to its unoperated position which de-energizes valve 83 admitting pressure to the push rod end of cylinders D2₁ and D2₂ returning these two cylinders to their previous position. On the return of the push rod of cylinder D2₁ cam operated trip valve 84 is actuated and pressure is connected to the air operated valve 85. Air operated valve 85 closes momentarily and applies air to operate air operated valve 86. It will be noticed that there is a connection from one outlet of the air operated valve 86 through a restriction to the control of this valve and accordingly the valve will remain actuated until pressure is released from the line between valve 85 and valve 86. When valve 86 is operated pressure is supplied to the piston end of cylinder D1₃ and the push rod is extended. Cam operated valve 87 is actuated by the push rod of cylinder D1₃ and supplies pressure to the inlet of valve 91 in valve assembly 88 and via the check valve 90 to actuate valve 91. Valve 91 will remain energized for a period of time controlled by the variable restriction valve 89. The valve 91 when operated supplies pressure to operate valve 92 which then supplies working pressure to the piston end of air cylinder D2₃ causing this cylinder to extend and complete the bending of the flanges.

When valve 91 is actuated it supplies pressure to valve assemblies 93 and 97. The pressure applied to assembly 93 is passed through the check valve 95 and actuates the valve 96 which then bleeds air from the control valve 86 which is then de-energized and supplies pressure to the push rod end of cylinder D1₃ to return this cylinder to its initial position. The pressure applied to valve assembly 97 is passed through the check valve 99 to operate valve 100 which then bleeds air from the control of valve 75 so this valve returns to its unactuated position and supplies air to the push rod end of cylinders D1₁ and D2₁ to return these two cylinders to their initial position. The period of time which valves 96 and 100 remain actuated is governed by the setting of the variable restriction valves 94 and 98 respectively.

Thus cylinders D1₁ and D1₂ and D1₃ remain in their actuated positions until they are de-energized by the operation of valve assemblies 93 and 97 which are variable delay valves and cylinders D2₁, D2₂, and D2₃ remain actuated for a period of time controlled by the variable restriction valves 79 and 89.

Thus the sequence of operation of the system described is that the cylinders D1₁ and D1₂ are first actuated and held on; cylinders D2₁ and D2₂ are then actuated momentarily and then released after a predetermined length of time, then cylinder D1₃ is actuated and held on, and finally cylinder D2₃ is actuated momentarily.

The sequence of operation of the apparatus may be summarized as follows:

- (1) Energize valves 71 and 72. This will provide air to the valve 73 which in turn will energize valve 74.
- (2) When valve 74 opens, it will provide pressure to valve assembly 97 and actuate valve 75.

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(3) As valve 75 actuates, cylinders D1₁ and D1₂ will extend. At the end of its stroke cylinder D1₁ will actuate valves 76 and 77.

(4) When valves 76 and 77 are energized pressure will flow through valve assembly 78 to energize valve 83 extending cylinders D2₁ and D2₂. After a set period of time valve assembly 78 will close exhausting valve 83, returning cylinders D2₁ and D2₂.

(5) As cylinder D2₁ returns it will momentarily actuate valve 84 which in turn will actuate valve 85.

(6) Valve 85 will supply air to valve assembly 93 and actuate valve 86 extending cylinder D1₃.

(7) At the end of cylinder D1₃'s stroke, valve 87 will actuate valve 92 through valve assembly 88. Cylinder D1₃ will remain extended holding valve 87 open.

(8) Cylinder D2₃ will extend as valve 92 is actuated.

(9) After a set time valve assembly 88 will reverse returning valve 92 and retracting cylinder D1₃. Pressure will also be supplied to valves 96 and 100 actuating them.

(10) As valve 96 opens, valve 86 will be returned to normal, retracting cylinder D1₃.

(11) As valve 100 opens, valve 75 will be returned to normal retracting cylinders D1₁ and D1₂.

Valve assemblies 78, 88, 93 and 97 include variable restriction valves 79, 89, 94 and 98 respectively which may be adjusted to effect the correct timing of the sequence of operation. Valves 79 and 89 are adjusted for the time required for actuation and valves 94 and 98 are timed for the release time only. The time on valves 79 should be just long enough to extend cylinders D2₁ and D2₂ (approximately one second) and valve 89 should be set for time from 3 to 5 seconds. Valves 94 and 98 should be set to approximately one second.

What I claim is:

1. In a machine for securing two preformed metal panels together into a unitary hollow structure, the combination of a table upon which the panels are laid in superimposed nested relationship with an upstanding locking flange of one panel encompassing a marginal edge of the other panel; a flange engaging and bending member; means to resiliently support said member above said table, comprising a rod passing through said member and a spring between said member and said table; means to laterally move said member relative to said table to partially bend said flange, comprising a bracket on said table,

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and a lever pivoted about an intermediate point to its ends to said bracket, and pivoted at one end to said member; and means for lowering said rod to thereby lower said member in an arcuate path to complete the bending of said flange.

2. In a machine for securing two preformed metal panels together into a unitary hollow structure, the combination of a table upon which the panels are laid in superimposed nested relationship with an upstanding locking flange of one panel encompassing a marginal edge of the other panel; a flange engaging and bending member; means to resiliently support said member above said table, comprising a rod passing through said member and a spring between said member and said table; means to laterally move said member relative to said rod to partially bend said flange, comprising a bracket on said table, and a lever pivoted about an intermediate point to its ends to said bracket, and pivoted at one end to said member; and means for lowering said rod to thereby lower said member in an arcuate path to complete the bending of said flange.

3. A machine as in claim 1 wherein said lever is pivotally connected to said bracket at a point laterally spaced from the axis of said rod and wherein said means for lowering said rod includes another lever operatively connected to said rod.

4. A machine as in claim 2, wherein said lever is pivotally connected to said bracket at a point laterally spaced from the axis of said rod and wherein said means for lowering said rod includes another lever operatively connected to said rod.

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