Nov. 10, 1970 J. E. ULLMAN ET AL 3,539,420

ADHESIVE APPLYING APPARATUS

Filed Jan. 15, 1968 5 Sheets-Sheet 1

FIG. 1

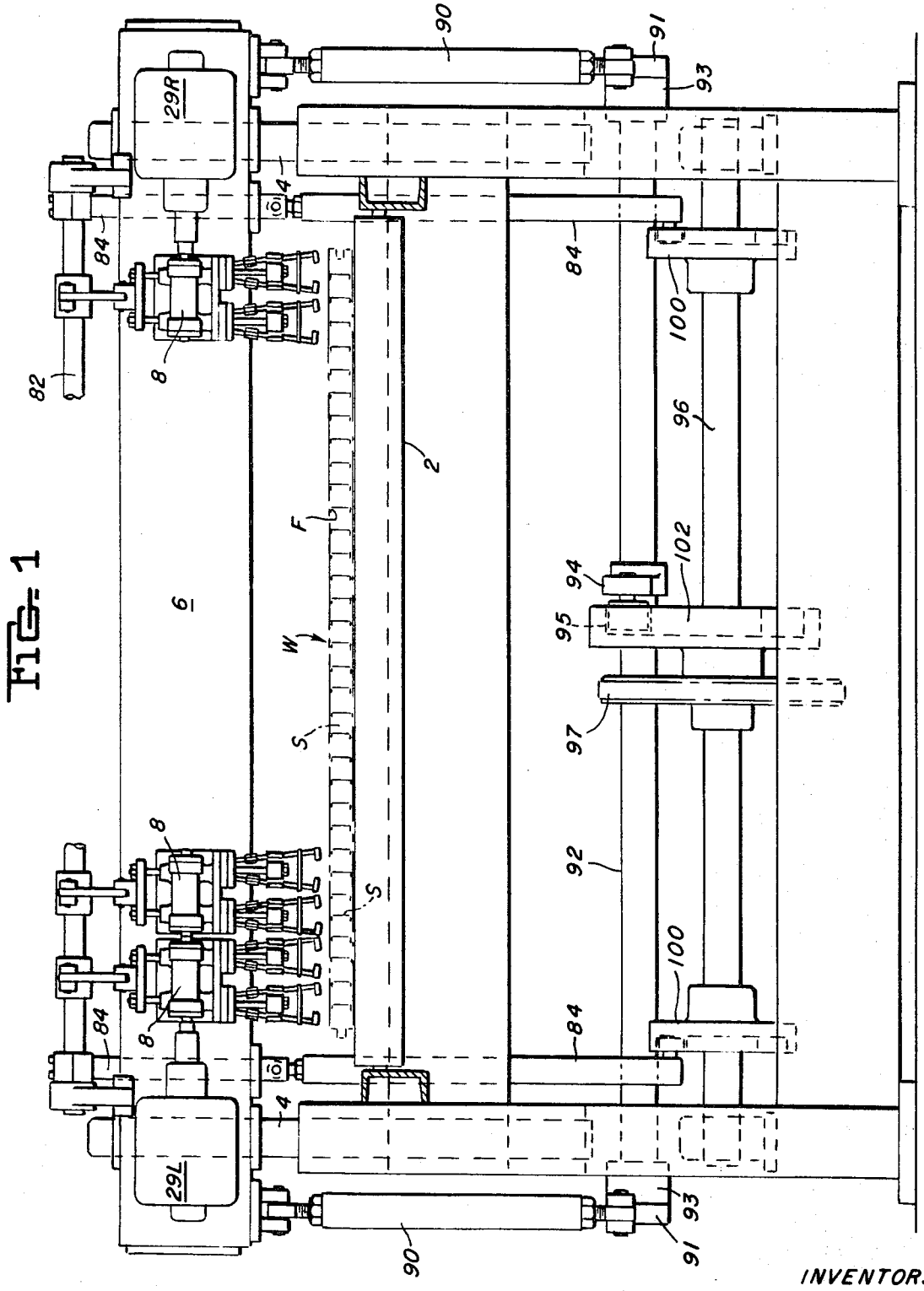

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FIG. 2

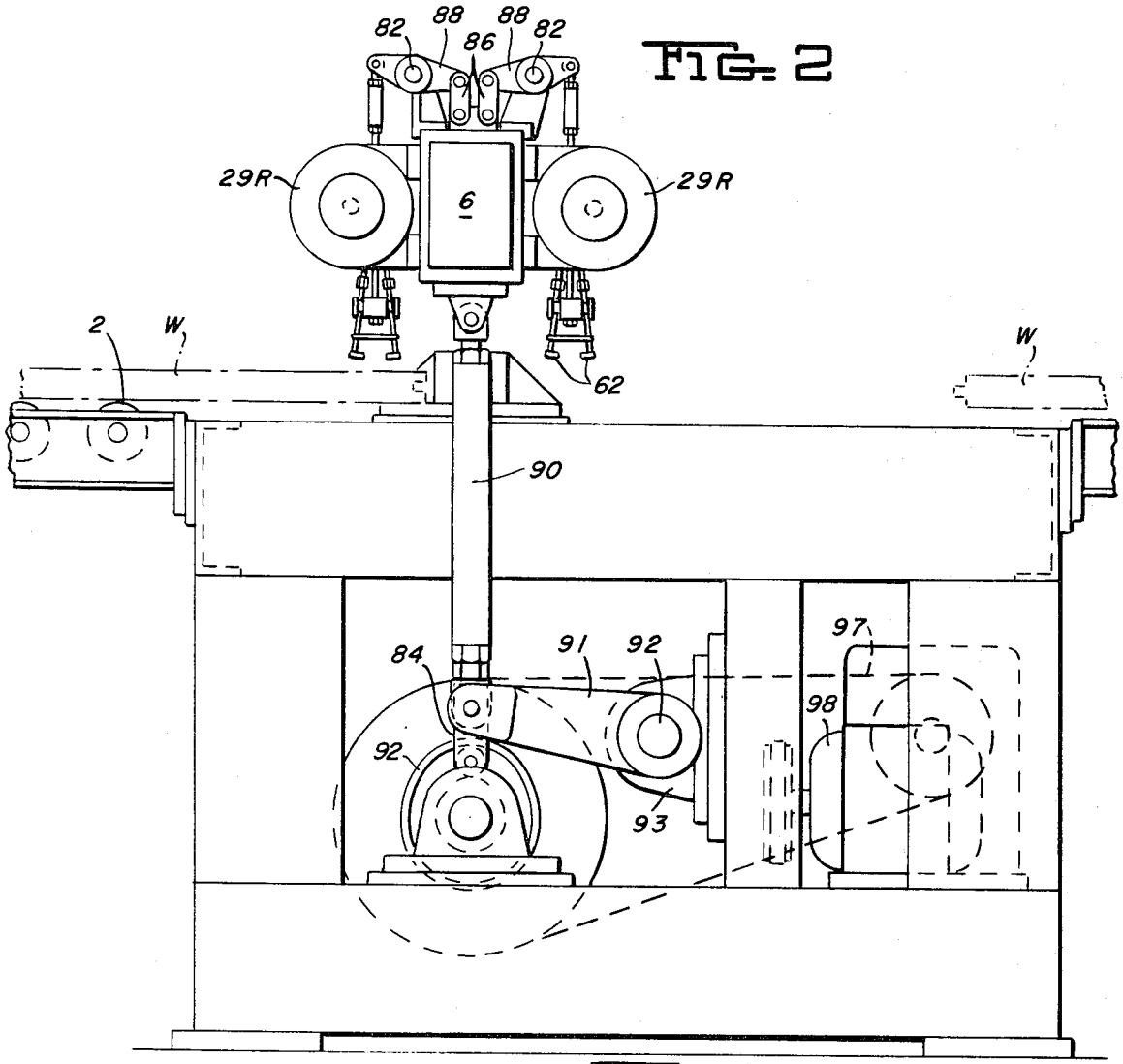

FIG. 8

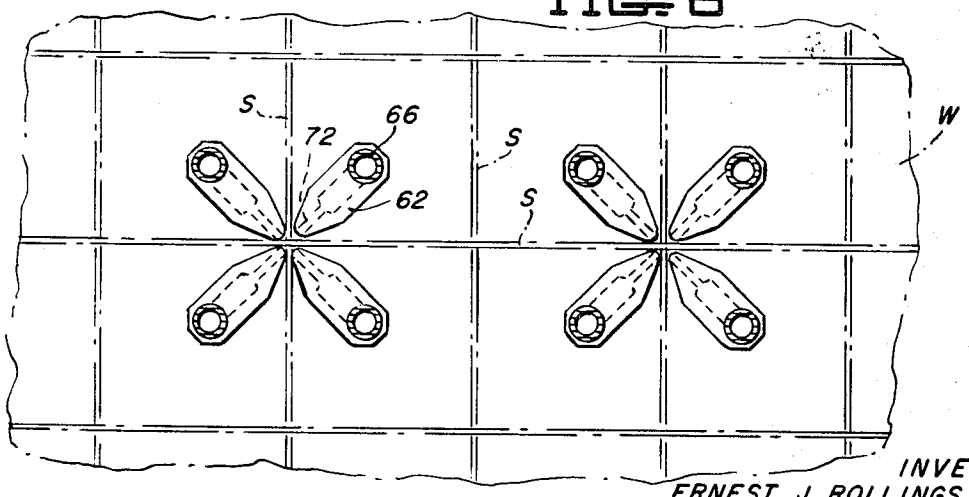

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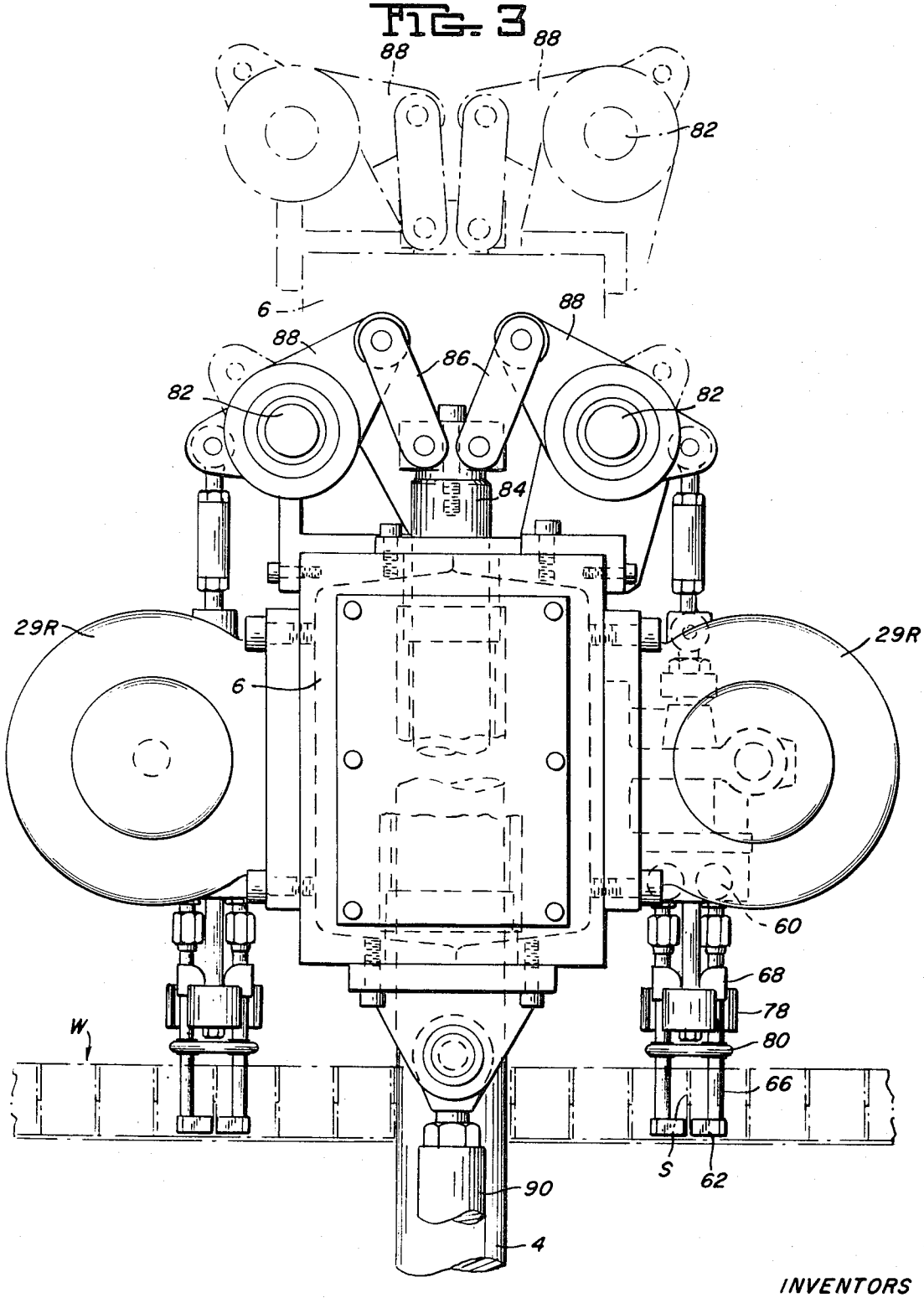
FIG. 3



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ADHESIVE APPLYING APPARATUS

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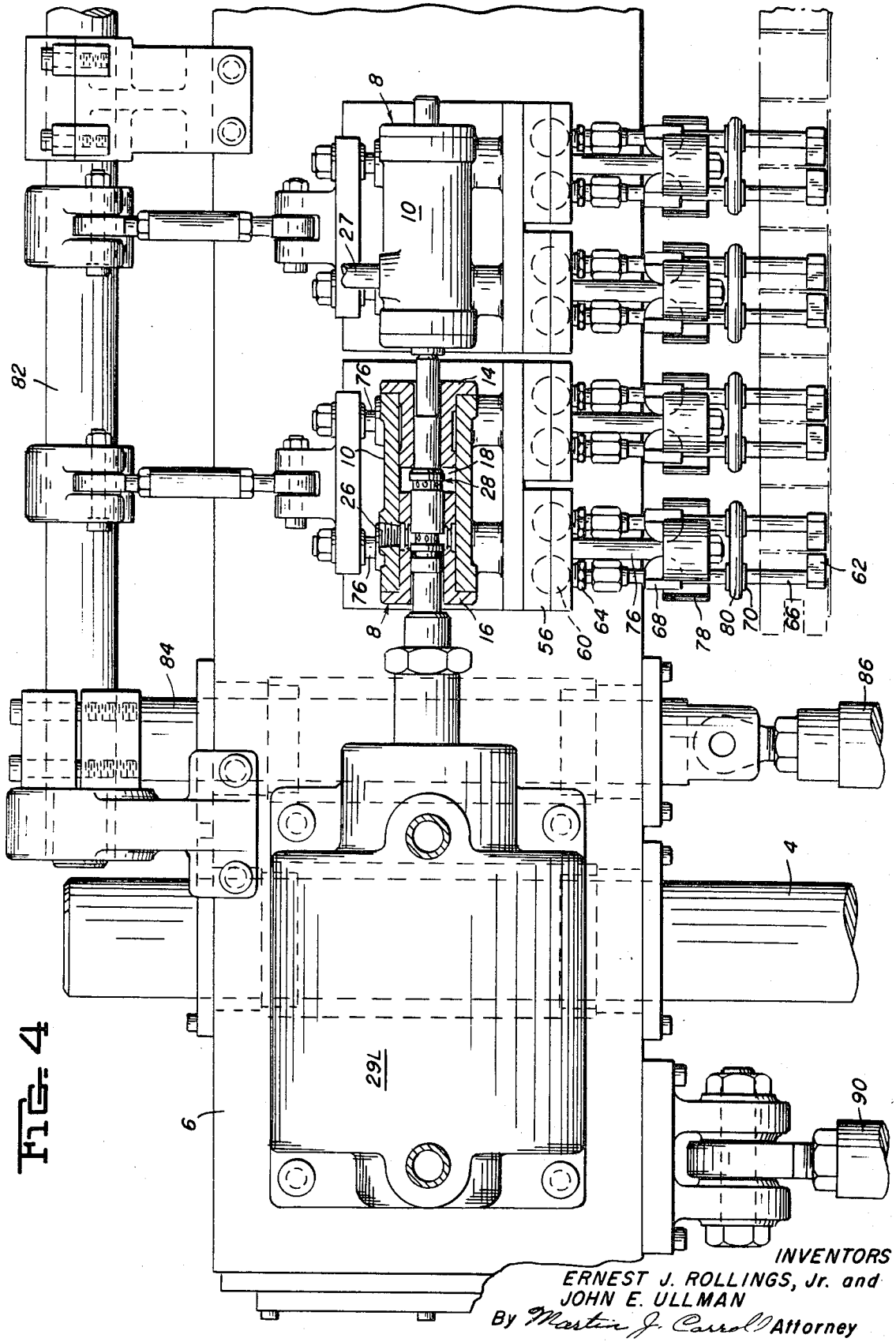

FIG. 4

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ADHESIVE APPLYING APPARATUS

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FIG. 5

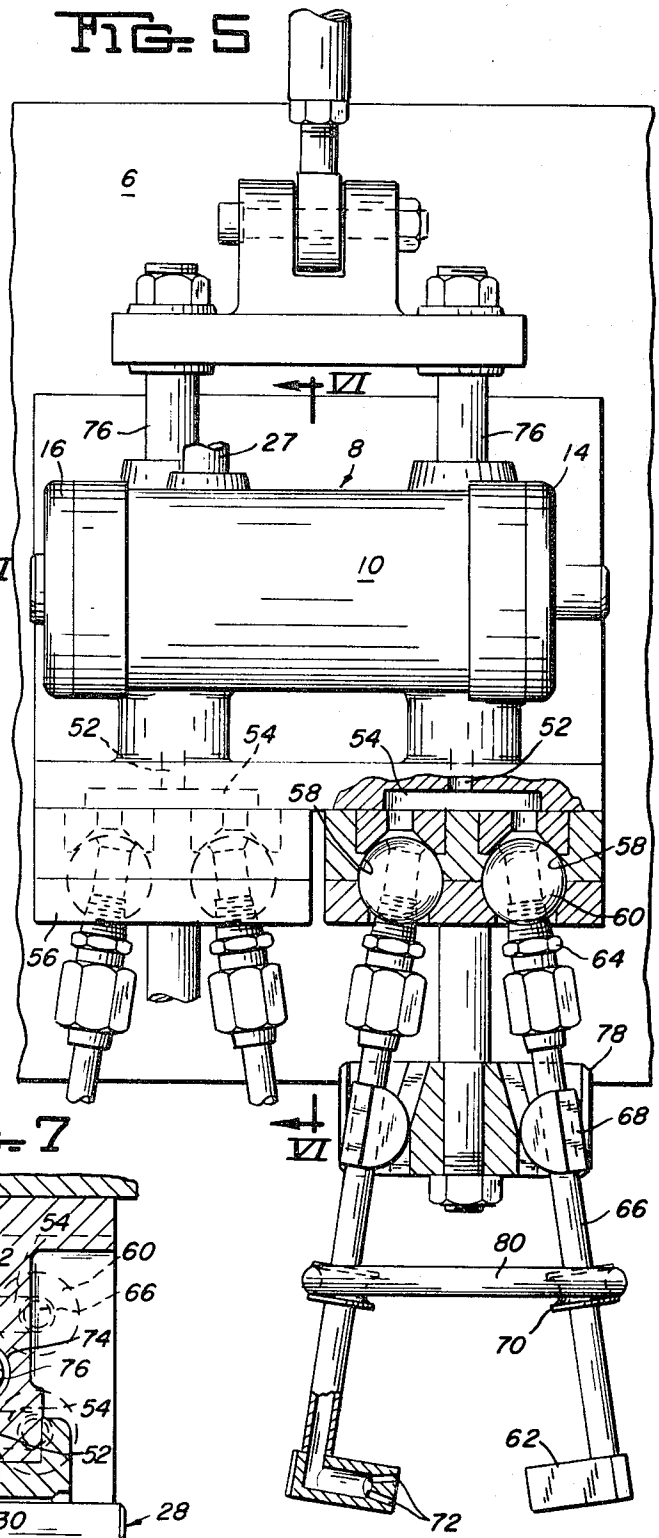


FIG. 6

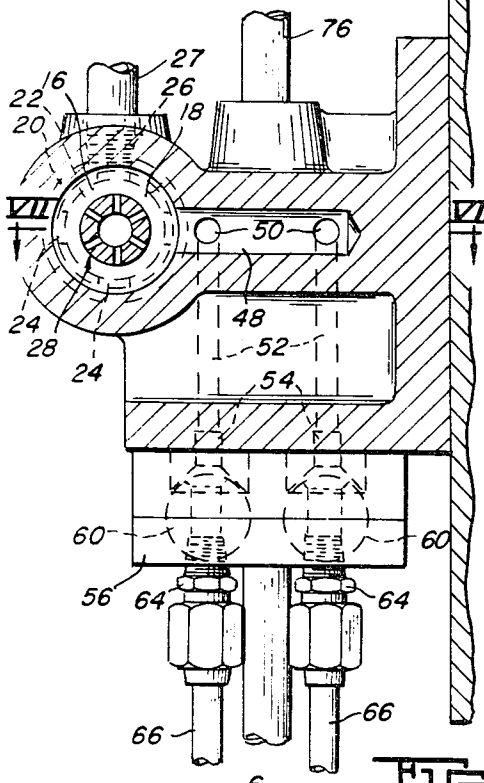
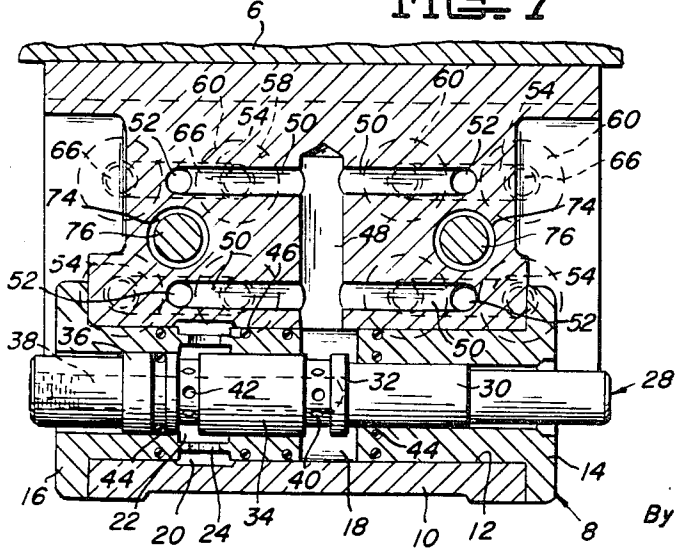


FIG. 7



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3,539,420

ADHESIVE APPLYING APPARATUS

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Int. Cl. B32b 31/12
U.S. Cl. 156—578 3 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for applying adhesive to the vertical joints of a workpiece having interlocking sheets in which a plurality of groups of four adhesive tips are pivotally mounted and fed from an upper retracted position inwardly to the four vertical joints of each intersection and then downwardly as adhesive is applied. The tips are retracted as they move upwardly so as to clear upper flanges at the intersection. A new valve of the spool type is provided to supply adhesive rapidly to the adhesive tips and to prevent dripping of the adhesive from the tips when the valve is closed.

This invention relates to adhesive applying apparatus and more particularly to such apparatus for applying epoxy adhesives such as disclosed in Box Pats. Nos. 3,301,149 and 3,315,577. The Box patents disclose a mat having interlocking flanged sheets which are closely spaced so that it is very difficult to apply adhesive to the four vertical joints at each intersection. The adhesive is also difficult to handle since it does not flow readily and yet tends to drip after flow is shut off. Prior to our invention no practical way had been found for commercially applying the adhesive to the mat.

It is therefore an object of our invention to provide apparatus that will apply uniform amounts of adhesive to joints at closely spaced intersections of plates.

Another object is to supply such apparatus including a valve that applies the adhesive rapidly and yet prevents dripping of the adhesive after flow is shut off.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIG. 1 is a side elevation of the machine of our invention showing the parts prior to operation;

FIG. 2 is an end elevation of the machine of FIG. 1 looking from the right;

FIG. 3 is an enlarged view of a portion of FIG. 2 with the parts shown in operative position in solid lines and upper parts also shown in inoperative position in broken lines;

FIG. 4 is a plan view with parts shown in section;

FIG. 5 is an enlarged detail view, partly in section;

FIG. 6 is a view taken on the line VI—VI of FIG. 5;

FIG. 7 is a view taken on the line VII—VII of FIG. 6; and

FIG. 8 is a schematic plan view of the workpiece with the adhesive tips in position to supply adhesive to the four vertical joints of each of two intersections..

Referring more particularly to the drawings, reference numeral 2 indicates a workholder for the workpiece W which consists of interlocking flange sheets S such as shown in the above mentioned Box patents. Two supporting posts 4 slidably support a beam 6. A plurality of aligned valves 8 are mounted on each side of beam 6. Each valve 8 includes a body 10 having an axial bore 12 in which are secured hollow sleeves 14 and 16 with a space 18 between their ends. The internal diameter of sleeve 14 is smaller than the internal diameter of sleeve 16 with the portions of the inner diameters forming the

bearing surface being cylindrical. Sleeve 16 has a peripheral outer groove 20 and a peripheral inner groove 22 connected by openings 24. An inlet 26 through valve body 10 is in alignment with the groove 20. Adhesive epoxy is fed to inlet 26 through a conduit 27 under high pressure, such as 500 lbs. per sq. inch. A spool 28 is slidably received in sleeve 14 and 16 and has spaced bearing portions 30, 32, 34 and 36. The valve spools 28 are actuated by fluid motors 29R and 29L one at each end of each row of valves. Bearing portion 30 slides within sleeve 14 and bearing portions 32, 34 and 36 within sleeve 16. An axial opening 38 closed at both ends is provided in spool 28 intermediate its ends and has generally radial openings 40 extending into the outer surface of spool 28 between portions 32 and 34 and similar openings 42 between portions 34 and 36. Inner and outer packing rings 44 and 46 are provided as needed. Valve body 10 has an opening 48 at one side which communicates with space 18, four openings 50 extending horizontally from opening 48, and a vertical opening 52 extending downwardly from the end of each opening 50 and terminating in an elongated slot 54 at its lower end.

Attached to the bottom of valve body 10 are two two-part ball retainers 56 each having four spherical openings 58 therein for receiving hollow balls 60. Each ball 60 is connected to a tip 62 through fitting 64 and tube 66. A cam follower 68 is secured to each tube 66 intermediate its ends and a grooved fitting 70 is secured to each tube 66 below follower 68. Each tip 62 has two diverging generally horizontal discharge openings 72 in its end. It will be seen that each valve 8 controls two groups of four tips 62. Openings (not shown) through valve body 10 slidably receive cam rods 76 each having a cam 78 at its lower end. Each cam 78 contacts the four cam followers 68 of each group with a spring 80 passing around the four grooved fittings 70 of each group to hold the followers in contact with the cam. Two rocker shafts 82 are provided one on each side of beam 6 to actuate the rods 76 on the respective sides. Each rocker shaft 82 is actuated about its axis by a vertical arm 84 through arms 86 and 88.

Attached to the underside of beam 6 at each end is a vertical arm 90. The lower end of each arm 90 is pivotally connected to a lever 91 which is attached to a shaft 92 for rotation therewith. The shaft 92 is mounted in bearings 93, and has a lever arm 94 attached thereto intermediate its ends. A cam follower 95 is mounted on the end of arm 94. A cam shaft 96 is mounted parallel to shaft 92 and is rotated through drive 97 from a motor 98. Cams 100 mounted on shaft 96 move arms 84 up and down in timed relationship with the movement of arms 90 which are actuated by a cam 102 mounted on shaft 96 through arms 91 and 94 and shaft 92.

In operation, the workpiece W is positioned beneath the tips 62 in the desired position as shown in FIGS. 1, 2, 3 and 8. At this time the beam 6 is in its upper position, the tips 62 are in their raised retracted position (FIG. 5), and the spools 28 in their extreme left hand position. Operation of motor 98 then causes rotation of shaft 96 and associated cams so that arms 90 cause beam 6 to lower until the tips 62 are in position to move in under the top flanges F of sheets S. The rods 76 are then lowered by movement of arms 84 to move cams 78 out of contact with followers 68 so that the springs 80 will snap each group of four tips 62 inwardly to their position around the associated joints between sheets S. At the same time that inward movement of the tips 62 start, the motors 29L will engage the spools 28 of the first valves on each side and move all spools to the right. In the extreme left position of the spools 28, openings 40 and 42 in the spool are blocked and no flow of adhesive through the spool can take place. At this time adhesive

from previous operations will be in space **18**, openings **48**, **50** and **52**, slots **54**, balls **60**, fittings **64**, tubes **66** and tip openings **72**. Since the adhesive is thixotropic it is very stiff at this time and difficult to move. However, as the spool moves to the right and portion **32** of the spool begins to enter space **18**, it will act as a piston and begin to compress and force adhesive out of space **18** toward tip openings **72**. This piston action overcomes the resistance to flow of the adhesive and gets it moving rapidly just before the main flow of the adhesive begins from groove **22**, openings **42**, axial opening **38**, and openings **40** into space **18** as the spools reach the position shown in FIGS. 4 and 7. The size of openings **72** are such as to meter the flow of epoxy so as to give a desired uniform flow. The beam **6** then moves downwardly so that the tips will lower to the bottom flanges of sheets S after which the beam immediately starts its upward movement. After the tips move upwardly about ¼ to ⅜ in., the motor **29R** will engage the spool **28** of the valve adjacent thereto and move all spools to the left so as to cut off flow of adhesive. At the same time rod **76** moves upwardly and forces the tips **62** outwardly so they can clear the upper flanges. On the back stroke of the spools **28** a vacuum is created because the piston action of portion **32** increases the volume of space **18** immediately after valve shut off. This prevents continued flow of epoxy after the valve is shut off. The operation will then be repeated, either on a new workpiece or where the spacing of joints is too close to cover all joints at once, the workpiece is moved to a new position and additional joints covered.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. Apparatus for applying an adhesive to joints of a workpiece having interlocking sheets, which comprises an adhesive tip for each joint to be supplied with adhesive, a valve for controlling flow of adhesive to said tip, a conduit leading from said valve to said tip, means for moving said tip generally transversely to said joint between positions adjacent to and remote from said joint, means for moving said tip along said joint, and means correlating the movements of the tip to move the tip inwardly at one end of the joint, along the joint to the other end and then outwardly.

2. Apparatus according to claim **1** including means for supporting the workpiece in a generally horizontal position with the joints generally vertical, four adhesive tips for applying adhesive to the four joints at an intersection of interlocking sheets, a vertically movable beam above said workpiece for supporting said valve, the conduit to each tip including a generally vertical tube pivoted at its upper end, the tip being connected to the lower end of said tube, a cam follower mounted on each tube intermediate its length, a vertically movable cam movable into and out of engagement with said cam followers, and resilient means urging said cam followers against said cam.

3. Apparatus according to claim **2** including means causing said cam to move out of engagement with said cam followers when said beam is at its upper position so as to permit said resilient means to move the tips into operative position at said vertical joints, means then causing said beam to first move downwardly with the tips in operative position to the bottom of the joints and then start upwardly, means for shutting off flow of adhesive after the tips start upwardly, and means for moving said cam into engagement with said cam followers to retract said tips after the tips start upwardly.

References Cited

UNITED STATES PATENTS

3,382,530 5/1968 Glesner ---------- 156—578 X

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S. C. BENTLEY, Assistant Examiner