

[54] APPARATUS FOR MANUFACTURING HEAT EXCHANGERS

29/211 D, DIG. 1, DIG. 3; 113/1 C, 118 D;
156/216, 226, 443, 551

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[56]

References Cited

UNITED STATES PATENTS

[73] Assignee: Associated Engineering Limited, Leamington Spa, England

2,719,807	10/1955	Steele	156/226
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Related U.S. Application Data

[62] Division of Ser. No. 179,958, Sept. 13, 1971, abandoned.

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Sept. 25, 1970 Great Britain 45900/70

[57]

ABSTRACT

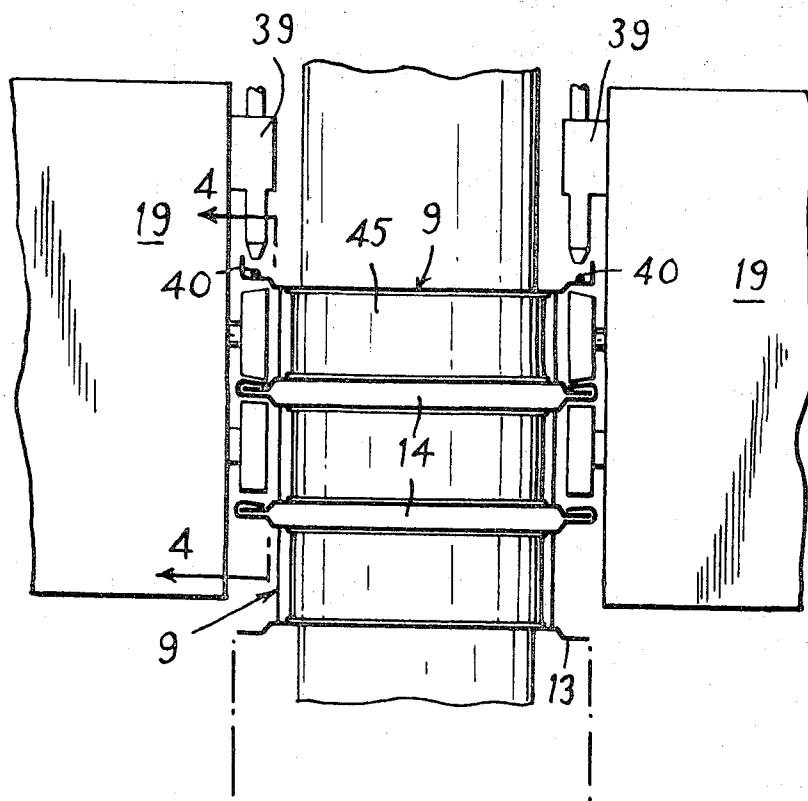
An apparatus for manufacturing heat exchangers wherein means are provided for locating an element comprising a corrugated metal strip bonded between two sheet-like metal members on top of a similar element and forming seams between adjacent ones of the sheet-like members of the adjacent elements.

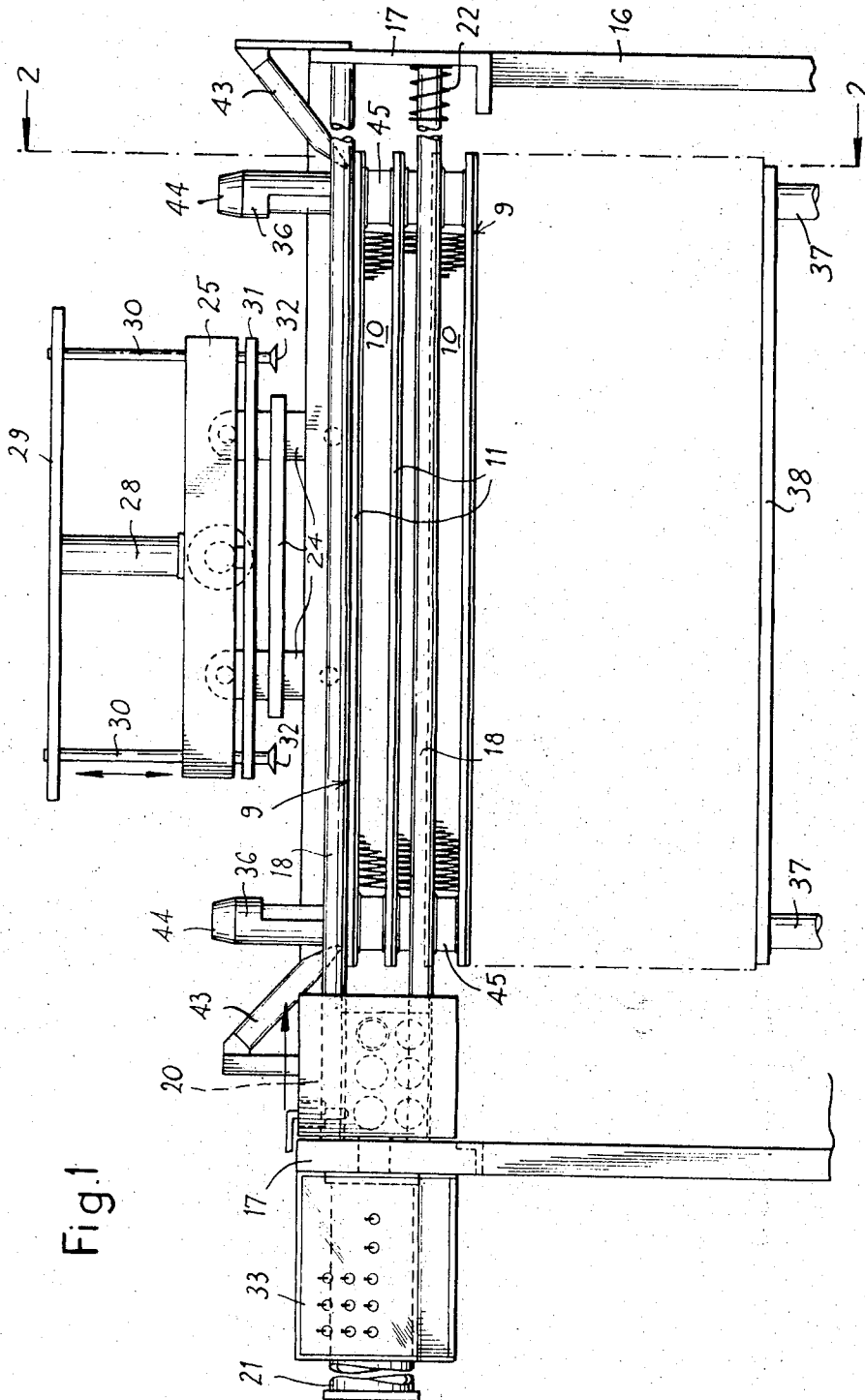
9 Claims, 6 Drawing Figures

[52] U.S. Cl. 29/202 D, 29/157.3 D, 29/211 D, 29/DIG. 1, 29/DIG. 3, 113/1 C, 156/443, 156/551

[51] Int. Cl. B23p 15/16

[58] Field of Search 29/157.3 D, 202 D, 33.6,





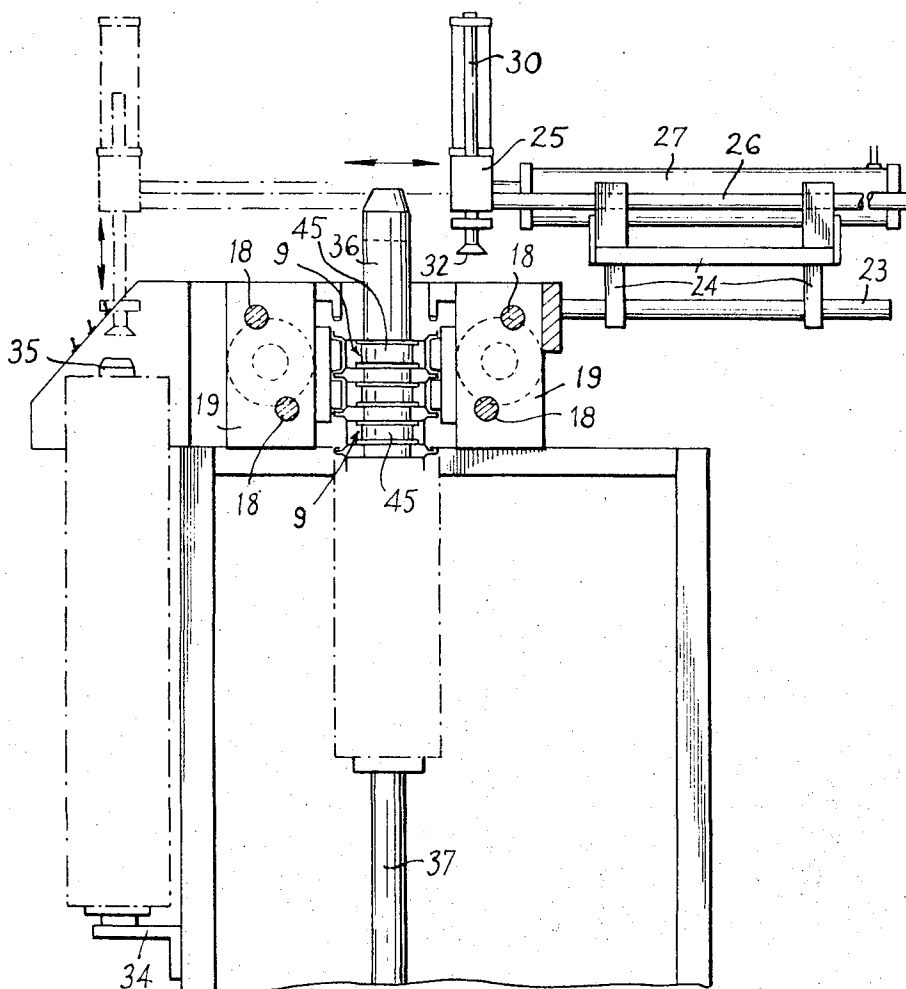


Fig. 2

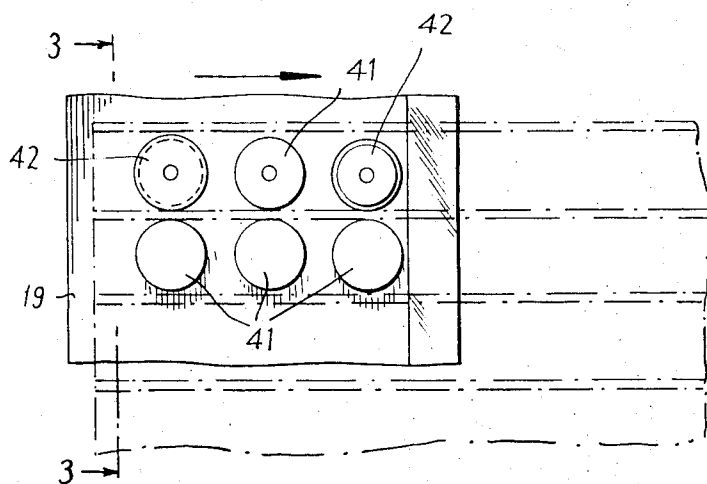


Fig. 4

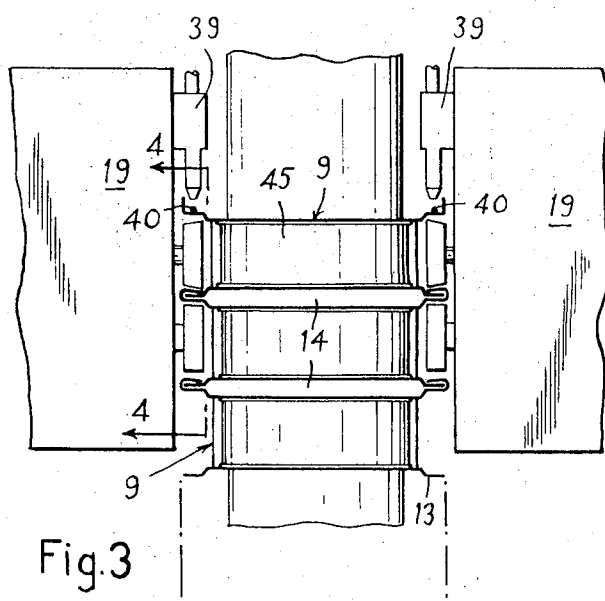


Fig. 3

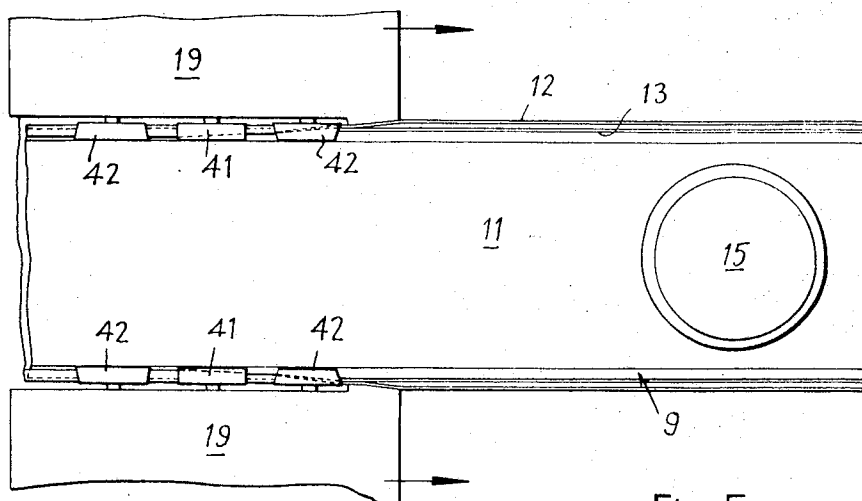


Fig. 5

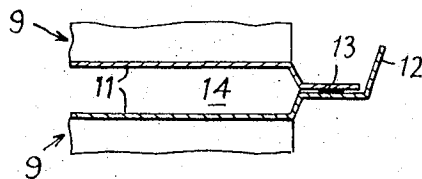
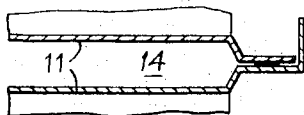
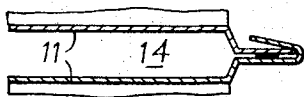
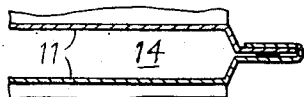
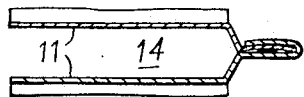


Fig. 6

APPARATUS FOR MANUFACTURING HEAT EXCHANGERS

This application is a division of our prior application Ser. No. 179,958, filed Sept. 13, 1971, now abandoned.

This invention relates to a method and apparatus for the manufacture of a heat exchanger. It may be applied to the heat exchanger described and claimed in our co-pending application Ser. No. 775,077, filed Aug. 26, 1968, now U.S. Pat. No. 3,521,707.

According to one aspect of this invention there is provided a method of manufacture of a heat exchanger having a plurality of elements, each of which includes a corrugated strip of metal bonded to two sheet-like members, one on each side of the strip, including the steps of locating two of the elements adjacent to one another and forming joints between adjacent ones of the sheet-like members of the adjacent elements.

Preferably the joints are formed by folding the edge of the one member which is associated with one element over the edge of the other and adjacent member which is associated with the adjacent element.

According to a feature of the invention the folding is performed by drawing a roller assembly parallel to the edge of the members. Preferably a bead of adhesive is spread along the edge of one member of an element bonded to one side of a strip at the same time as the edge of the other member of that element is being joined to the co-operating and adjacent member of the adjacent element.

According to another aspect of the invention there is provided apparatus for manufacturing a heat exchanger having a plurality of elements, each of which includes a corrugated strip of metal bonded to two sheet-like metal members, one on each side of the strip, including means of locating two of the elements adjacent to one another, and means for forming joints between adjacent ones of the sheet-like members of the adjacent elements.

One embodiment of the invention will now be described, by way of example only with reference to the accompanying drawings, in which:

FIG. 1 is an elevation of a machine used in the manufacture of heat exchanger,

FIG. 2 is a section along the line 2—2 in FIG. 1,

FIG. 3 is an enlarged view of part of FIG. 2, being a part section along the line 3—3 in FIG. 4,

FIG. 4 is a section along the line 4—4 in FIG. 3,

FIG. 5 is a plan view of FIG. 3, and

FIG. 6a to e illustrates successive stages in the formation of part of a heat exchanger in the machine.

One object of the machine is to provide for the automatic assembly of a number of sandwich elements made from metal foil to form a part of a heat exchanger. The sandwich elements are indicated generally at 9 in FIGS. 1, 3, 5 and 6. Each sandwich element includes a corrugated strip 10 of metal foil and two sheet-like metal members 11. The strip 10 defines, in longitudinal section, a plurality of triangles, the sides of which provide fins and the bases of which are bonded to the surfaces of the sheet-like metal members 11. Each member 11 is of channel section, one of the members of each adjacent pair being formed with edge flanges 12 longer than the edge flange 13 of the other member, and the longer edge flanges being capable of being bent over to embrace the shorter edge flanges of

the adjacent member 11 which forms a part of an adjacent element. It will be apparent that between the two adjacent metal members 11 of adjacent elements there is formed a tubular passageway 14 for one working fluid, e.g., water, which flows in a direction at right angles to that of the other working fluid which flows parallel to the fins of the corrugated strip 10. Each sandwich element 9, which, as has been mentioned above, includes a corrugated strip 10 and a pair of metal members 11, is formed at each end with a circular hole 15 and tubular spacers 45 are situated between the corresponding holes 15 in the members 11 of each element. This construction enables a manifold to be formed in the completed heat exchanger.

The machine includes a rigid frame structure 16 having end plates 17 in which four parallel guide bars 18 are fastened. A carriage is slidable along the guide bars 18 and consists of a block 19 on each pair of guide bars 18, joined by an unshown bridging member. A pneumatic ram 21 or other suitable actuator acts between the frame structure 16 and the carriage for moving the latter from end to end of the guide bars 18. If required buffer springs 22 may be provided.

Two parallel bars 23 fastened to the frame structure 16 and protruding from the rear of the machine carry a subframe 24 in an adjustable manner. An auxiliary head 25 is fastened to two parallel bars 26 which are slidable in bores in the sub-frame 24. A pneumatic ram 27 is also mounted on the sub-frame 24 and operates on the auxiliary head 25 to move the latter in a fore and aft direction.

A vertical operating pneumatic ram 28, carried by the auxiliary head 25, is operable to raise or lower a cross bar 29, at each end of which there is fastened a vertical bar 30, which is slidable in bores in the auxiliary head 25 and joined by a further cross bar 31. At the lower end of each vertical bar 30 there is mounted a suction pad 32, the suction of which can be switched on or off. To one end of the machine there is provided a control panel 33 which includes a sequence means for the proper operation of the machine.

On the front of the machine there is a bracket 34 on which a magazine having two parallel upright mandrels 35 can be mounted, each magazine being arranged to hold sufficient of the sandwich elements 9 to make a heat exchanger. The mandrels 35 pass through the holes 15 near to the ends of the sandwich elements.

Two vertically movable parallel mandrels 37, which are joined by a cross bar 38, are arranged to extend between the blocks 19.

In operation, a loaded magazine is placed on the bracket 34 and the cycle of operation is started. The pneumatic ram 27 extends to position the auxiliary head 25 over the sandwich elements 9 in the magazine. The pneumatic ram 28 then lowers the suction pads 32 until they contact the uppermost sandwich element in the magazine. Suction is applied and the pneumatic ram 28 raises the uppermost sandwich element from the magazine. Next the pneumatic ram 27 withdraws the auxiliary head 25 until it is positioned over the space between the blocks 19 of the carriage. Two parallel tubes 36 which are to be bonded into the holes 15 to form part of the heat exchanger manifolds, are mounted on the two parallel mandrels 37 which are joined by the cross bar 38.

The next stage in the sequence of operations occurs when the mandrels 37 and the cross bar 38 are raised,

by an unshown pneumatic or other suitable actuator, so that the tubes 36 pass through the holes 15 in the sandwich element until the cross bar 38 presses against the underside of the sandwich element, thereby causing the suction of the pads 32 to be discontinued. At this position the mandrels 37 and the cross bar 38 are brought to rest.

The pneumatic ram 21 then causes the carriage comprising the blocks 19 to be traversed along the length of the guide bars 18 and adhesive distributors 39 (FIG. 3), provided on each block 19, are arranged to deposit a bead of adhesive 40 along the length of the upper flange 12 of the sandwich element.

The cross bar 38 carrying the sandwich element is next lowered out of the way and the carriage is returned to its starting position. The sequence can then be repeated from the beginning, means (not shown) being provided to cause the next sandwich element to be raised to the top of the magazine on the bracket 34. It should be noted that the mandrels 37 and the cross bar 38 only rise to a position at which the uppermost metal member 11 of the top sandwich element is at the same height each time.

When the second sandwich element is placed on the first sandwich element, the former's shorter edge flanges 13 lie between the latter's longer edge flanges 12 as shown in FIG. 6 at *a*.

On each of the inwardly facing sides of the blocks 19 there are fastened three pairs of studs which are arranged in two rows one above the other. On each of the studs in the lower row a cylindrical roller 41 is mounted. A cylindrical roller 41 is also mounted on the centre stud of the upper row, whilst rollers 42, mounted on the end studs of the upper row, are conical as shown in FIG. 4. The position and spacing of the rollers 41 and 42 is such that, as the carriage travels along the guide bars 19 from its starting position, the rollers progressively fold the longer edge flanges 12 over the adjacent shorter edge flanges 13, as shown in the sequence of FIGS. 6 *a* to 6 *e*, the adhesive, which had been deposited on the longer edge flanges 12 on the previous pass of the carriage, serving to seal the joint.

While the carriage is traversing about the assembly between the tubes 36, two further adhesive dispensers 43 (FIG. 1) are moved downwardly by actuators to deposit a quantity of adhesive 40 across each end of the uppermost metal member 11 and between the ends of adjacent members 11, so as eventually to seal the ends of the tubular passageways 14 and bond the tubes 36 in position. It may also be arranged that rollers, similar to those shown at 41, pass across the ends of the tubes 14 and fold the longer flanges over the shorter flanges of the members 11 to seal the ends of the tubes 14 using the same steps as those set out in FIG. 6 for the sides. On the last pass of the carriage, for each heat exchanger, a taper 44 on the top of each mandrel 37 is detected by unshown means and the deposition of adhesive from the dispensers 43 is inhibited on that pass.

We claim:

1. Apparatus for the manufacture of heat exchangers from a plurality of elements, each element including a corrugated strip of metal and first and second sheet-like members, one member being bonded to each side of the corrugated strip, at least one of said sheet-like members being of channel section and both of said members having parallel edge portions which project beyond said corrugated strip on opposite sides thereof,

said edge portions including longer edge portions and shorter edge portions, said apparatus comprising:

means for holding at least two of said elements together in a parallel position, so that an adjoining pair of members form a tube with a longer edge portion abutting against a shorter edge portion on each side of a pair of members and so that said longer edge portions extend beyond said shorter edge portions,

carriage means carrying two pairs of opposed cam means, one pair of cam means being positioned to engage each pair of juxtaposed edge portions, and

means for driving said carriage means along said elements while said cam means progressively fold both said longer edge portions back over both said shorter edge portions simultaneously whereby joints are formed between adjacent sheet-like members of the adjoining pair of members.

2. Apparatus as claimed in claim 1, comprising an adhesive dispenser mounted on said carriage means and positioned to apply adhesive to said longer edge portions as said carriage makes a first pass along said elements, said carriage means being mounted to make successive passes therealong and to fold back said longer edge portions over the abutting shorter edge portions only on the second pass along a given pair of elements.

3. Apparatus as claimed in claim 2, including a magazine for storing a plurality of said elements and transfer means for transferring said elements one at a time from said magazine to be located in said parallel position with respect to a preceding element for the application of said adhesive and folding of said longer edge portions.

4. Apparatus as claimed in claim 3, wherein said transfer means comprises a hydraulic mechanism including suction pads to engage and hold each element during the transfer operation.

5. Apparatus as claimed in claim 2, wherein as said carriage means makes a second pass along a pair of elements to fold back said longer edge portions of one element of the pair over the abutting shorter edge portions of the second element of the pair, the same pass serves to apply adhesive to the longer edge portions of said second element of the pair.

6. Apparatus as claimed in 2, including a support member extending longitudinally below the path travelled by said carriage means, and a mechanism for raising said support member to a position at which it supports two elements to be joined together at a height for engagement of said edge portions to be bonded together by said cam means as said carriage means makes a pass along said elements, and such that the uppermost member of the top element is always at the same height with respect to said carriage means.

7. Apparatus as claimed in claim 7, including a circular hole adjacent each end of each member, a tubular spacer situated coaxially between the corresponding holes in the members of each element and a mandrel adjacent each end of the support member and adapted to extend through the correspondingly located holes and tubular spacers.

8. Apparatus as claimed in claim 7, including a tube located over each mandrel and means for bonding the tubes into said holes and tubular spacers.

9. Apparatus as claimed in claim 2, including further adhesive dispensers to apply adhesive across the ends of said members and means for closing together two adjacent members at their ends so as to form a closed tube between said members.

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