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APPARATUS FOR MOVING AND ALIGNING LIMP PIECES OF MATERIAL

Filed June 16, 1966

2 Sheets-Sheet 1

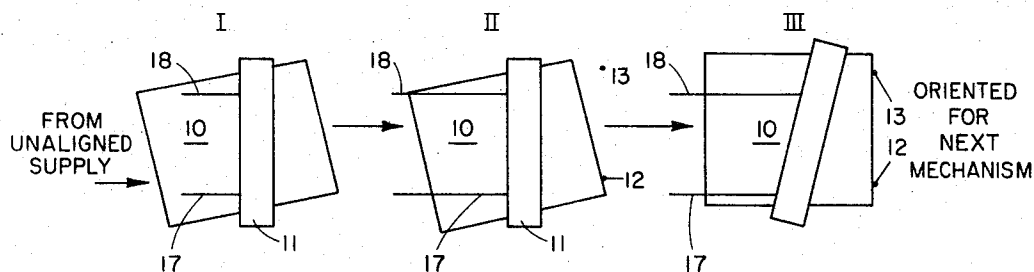


Fig. 1

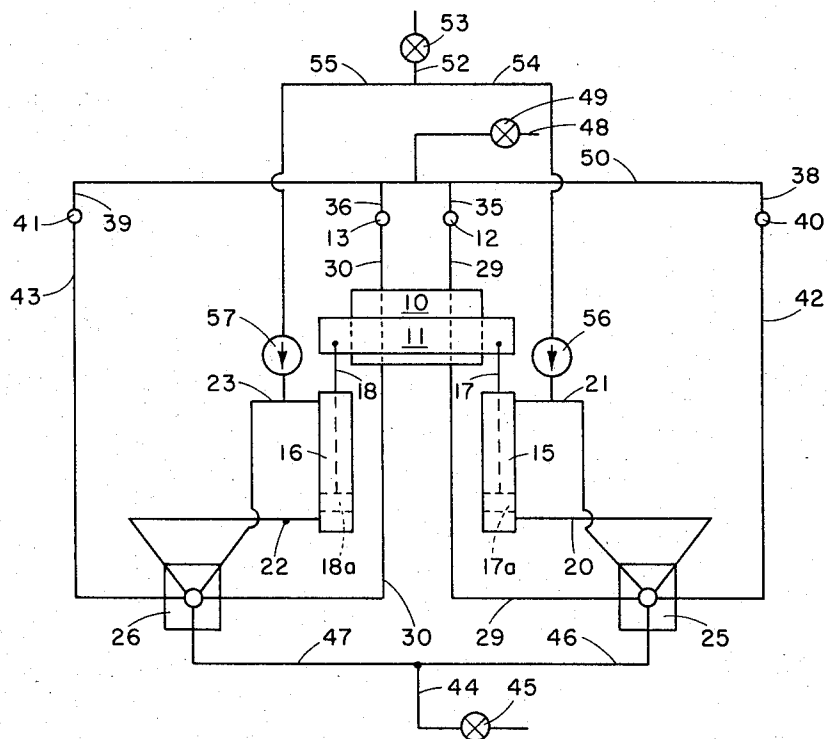


Fig. 2

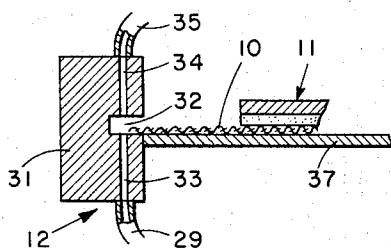


Fig. 3

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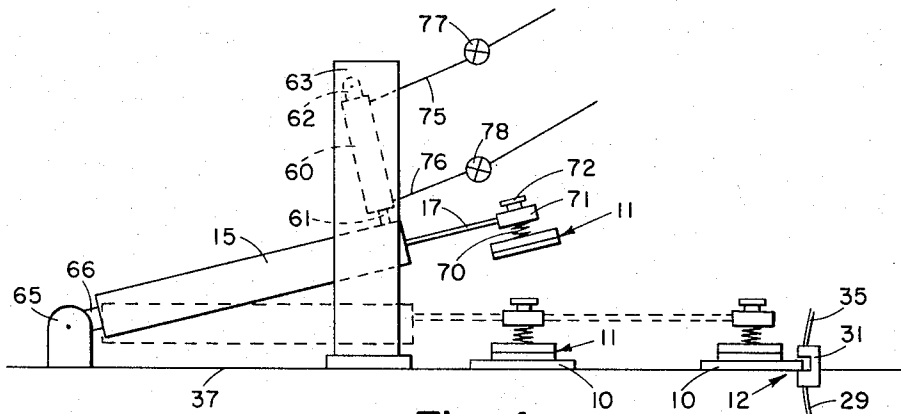


Fig. 4

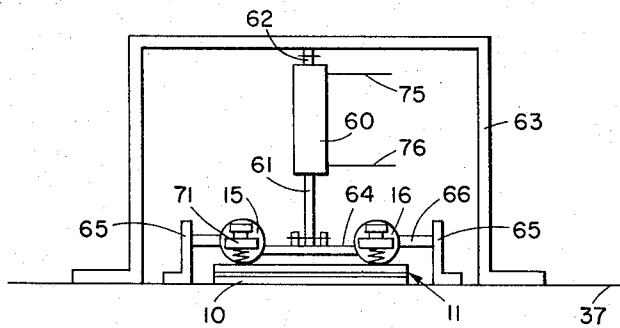


Fig. 5

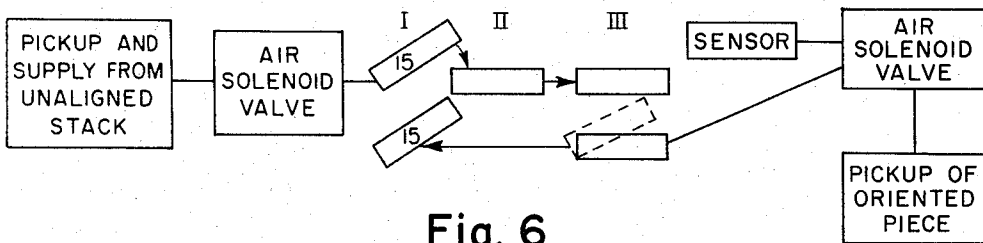


Fig. 6

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APPARATUS FOR MOVING AND ALIGNING
LIMP PIECES OF MATERIAL

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10 Claims. (Cl. 271—63)

This invention relates to the automatic handling and processing of fabrics and particularly to the positioning of pieces of flexible material, such as limp pieces of fabric, cloth, or paper, to move and orient them into a desired location.

In manufacturing certain items formed from woven or nonwoven fabrics or knit fabrics, cloth, or paper it is desirable to be able to perform a number of steps automatically. For example, to place one or more work pieces in a position before the needle of a sewing machine for stitching it is necessary to pick up, move, orient, and align the piece or pieces for stitching. The order of these steps may vary from operation to operation and one or more of them may be omitted or repeated depending upon the work pieces, the manner in which they are supplied, and the operation or operations to be performed. This invention is concerned with the moving and orienting or aligning of one or more pieces of limp material such as a piece of cloth, fabric, or paper. The method and apparatus of this invention are particularly well adapted for incorporation in automated sewing devices.

In the prior art devices the moving of a piece of flexible material has been accomplished through the use of such apparatus as endless belts, suction devices, and adhesive surfaces. Orientation of the piece or pieces during movement from one location to another has not received serious consideration, the solution normally used being to rely upon the original placement by a human operator of the piece within or on the moving mechanism to insure proper orientation at the delivery point.

If such an operation as sewing either on a single piece of material (e.g., hemming) or on two or more pieces of material (e.g., seaming) is to be fully automated, it is necessary that the piece or pieces be presented at the work point, e.g., sewing machine needle in a properly aligned condition. Such alignment must be completely reproducible and subject to continuous control.

It is therefore a primary object of this invention to provide an apparatus which is capable of moving a limp piece of material through a substantially horizontal plane in a manner to orient the piece within the plane to present it at a desired point in a predetermined alignment. It is another object of this invention to provide an apparatus of the character described which lends itself to monitoring which in effect is a final determination of the achievement of delivery and orientation of the piece just prior to its being picked up or worked on directly. It is another object of this invention to provide such apparatus which is capable of moving limp pieces of material without wrinkling or buckling them, so aligned that a straight or contoured edge is positioned where desired and in a manner such that the edge is flat and ready to be worked on. Other objects of the invention will in part be obvious and will in part be apparent hereinafter.

The invention accordingly comprises features of construction, combination of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the follow-

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ing detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic drawing showing the movement and orientation of a limp piece;

FIG. 2 is a schematic drawing of the apparatus of this invention, showing the fluid control lines and connections;

FIG. 3 is a detailed cross-section of a positive-pressure sensor of this apparatus;

FIG. 4 is a side elevational view of the apparatus showing the movement of a limp piece;

FIG. 5 is an end elevational view of the apparatus of FIG. 4; and

FIG. 6 is a schematic diagram illustrating the incorporation of the apparatus in, and its relation to, other mechanisms of an automatic device.

In the apparatus of this invention positive-pressure sensors are used in conjunction with fluid amplifiers of the proportional type. The controlled flow of fluid achieved by the fluid amplifiers is used to move pistons within parallel fluid-operated driving cylinders, which in turn actuate a mechanically-operated moving pad to contact the limp piece and move it over a horizontal platform. Suitable sensing and actuating means are provided to time the operation of the mechanical pad and, if desired, to incorporate actuating means for the pickup of the finally oriented limp piece.

FIG. 1 is a diagrammatic representation of the manner in which the apparatus of this invention operates. A limp piece 10 is deposited from an unaligned supply onto a horizontal receiving platform. The mechanical pad 11, the operation of which will be subsequently discussed in detail, makes frictional contact with the limp piece 10 as shown in position I. The mechanical pad 11 is moved forward by rods of the driving cylinders (represented as lines 17 and 18) as shown in position II until the leading edge of the limp piece comes in contact with a first pressure sensor 12 (to be described below). The mechanical pad 11, however, continues to move, now through an angle because only one driving cylinder rod 18 functions, until the leading edge of the limp piece 10 is also brought into contact with a second pressure sensor 13. A plurality of these pressure sensors is arranged on the horizontal platform to establish the desired orientation of the limp piece. It will be appreciated that the leading edge of the limp piece need not be straight but may be contoured, the position of the sensors being determined by the configuration of the leading edge.

FIG. 2 is a schematic diagram of the apparatus of this invention showing in particular the fluid flow lines and the manner in which the pistons in the fluid-operated driving cylinders are actuated to move the driving pad. As will be seen in this figure, the pad 11, in a light pressure-applying relationship with the limp piece 10, is moved by parallel, separately functioning fluid-operated driving cylinders 15 and 16 through rods 17 and 18 which are in turn driven backward and forward by pistons 17a and 18a actuated by differential fluid pressures maintained in the fore and after chambers of each driving cylinder. Thus, by properly controlling the introduction or withdrawal of a pressurizing fluid, e.g., air, into the two opposite ends of the cylinder the driving pad 11 is moved. Pressurized driving fluid is introduced into the after end of driving cylinder 15 through line 20 and into the front end through line 21. In a similar manner, pressurizing fluid is introduced into the after end of driving cylinder 16 through line 22 and into the front end through line 23. Fluid lines 20 and 21 are connected to the two sides of a proportional type fluid amplifier 25. It is termed "proportional" because fluid introduced through a widened channel is divided into two columns forming the legs of

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a Y, the legs in this case being connected to fluid lines 20 and 21. The relative strength of the respective fluid input signals into opposite sides of the fluid amplifier determines the ratio of fluid flow through the two legs of the fluid amplifier, and thus the amount of fluid which enters the after and front chamber of the driving cylinder 15. In like manner, the fluid lines 22 and 23, associated with driving cylinder 16, are connected with the two legs of the Y in fluid amplifier 26.

One of the fluid streams forming the fluid input signals into the fluid amplifier is derived from a positive pressure sensing device, the fluid lines conducting these fluid streams being indicated as lines 29 and 30 in FIG. 2. Such a positive pressure sensor is shown in cross-sectional detail in FIG. 3. The pressure sensor head 31 has a recess 32, the floor of which is flush with the horizontal platform 37 over which the limp piece 10 is moved by the driving pad 11. Head 31 has two holes 33 and 34 drilled through it, and these holes are in axial alignment. They terminate in the recess which forms a controllable and variable fluid connection between them. In the absence of any obstruction within recess 32 which would cover a portion of the opening of hole 33, fluid from line 35 is free to flow into line 29 and hence into the left-hand side of fluid amplifier 25 of FIG. 2. However, when the flow of fluid through the pressure sensor head is partially obstructed by the presence of the edge of the limp piece 10 over a portion of the opening of hole 33, the amount of pressure conducted into line 29 and hence into the fluid amplifier 25 is reduced thus shifting the balance of fluid flow within fluid amplifier 25.

Returning to FIG. 2, it will be seen that in like manner the balance of fluid flow in fluid amplifier 26 is controlled by the amount of pressurized fluid which flows from fluid conduit 36 across pressure sensing head 13 through line 30 and hence into the right side of fluid amplifier 26. In order to provide the second fluid stream forming the other fluid input signal into the fluid amplifiers and properly to adjust the fluid flow therein, there are supplied two pilot positive-pressure sensors 40 and 41 which are constructed in a manner similar to that shown in FIG. 3. However, they are equipped with means, e.g., plates having apertures smaller in area than the opening of the bottom hole 33, which can block off a controlled amount of pressurized fluid entering them. This in turn means that the flow of fluid entering pilot pressure sensor 40 by way of fluid line 38 is less than that entering line 29 associated with pressure sensor 12 during that period of the cycle when the limp piece is approaching the pressure sensor and before its edge has covered over any part of the opening of hole 33. Hence, the flow of fluid entering fluid amplifier 25 through line 42 is less than that entering through line 29 and the net result is that with these fluid input signals prevailing, the larger amount of fluid entering fluid amplifier 25 through line 46 is directed through the right-hand leg into line 20 and then into the after chamber of driving cylinder 15. The force differential existing across the two surfaces of piston 17a drives the piston, the rod 17, and the pad 11 forward. When, however, the leading edge of limp piece 10 enters recess 32 of the sensing head (FIG. 3) and covers over a portion of the hole opening, a point is reached when the area of the partially covered hole is almost equal to the area of the partially blocked comparable hole in pressure sensing pilot 40. At this point, the two fluid input stream signals entering fluid amplifier 25 are, for practical purposes, of equal intensity, the fluid flow from the fluid amplifier 25 into lines 20 and 21 is identical, the fluid force in the fore and after chambers of driving cylinder 15 are equalized and the forward movement of piston 17a, and hence of rod 17 and pad 11 is halted. (It will be appreciated that the area of the backside of piston 17a, for example, is greater than the front side due to the absence of the rod, therefore, somewhat less

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pressure is required on the backside of the piston to equalize the force with the front side. This can be readily adjusted for.) In a similar manner, pressure sensor 13 and pilot sensor 41 function to operate rod 18, the fluid lines to pilot sensor being identified by numerals 39 and 43.

If the inertia of the system causes pad 11 to push the limp piece of fabric past the orifices associated with sensors 12 and 13, the system being analog will cause the cylinders 15 and 16 to back up and null out with the fabric edge accurately aligned in position at sensors 12 and 13.

The pressurizing fluid required to drive pistons 17a and 18a is supplied through line 44 (controlled by line 45) which in turn is in fluid communication with branch lines 46 and 47 connected to the fluid amplifiers and provided to furnish the main fluid flow stream. In a similar manner, the fluid to the sensors is supplied through line 48 (controlled by valve 49) to the four fluid branch conduits 35, 36, 38 and 39 which are associated with the two sensing heads 12 and 13 and the pilot sensing heads 40 and 41, respectively. Finally, there is provided a series of fluid lines which supply the necessary pressurized fluid to return the pistons in the driving cylinders to their original back position after the limp piece has been moved and oriented. This is accomplished through fluid line 52 (controlled by valve 53) which leads to branch lines 54 and 55 which in turn, through check valves 56 and 57, are in fluid communication with fluid lines 21 and 23 associated with the front end chambers of the driving cylinders 15 and 16. Opening valve 53, after positioning and alignment of the limp piece, drives fluid into the front chambers of driving cylinders 15 and 16. Alternatively, valve 53 may remain open if the fluid pressure in lines 54 and 55 is properly controlled and valves 56 and 57 set to respond thereto.

FIGS. 4 and 5 are side and front elevational views of an apparatus embodying this invention. It will be appreciated that this embodiment is illustrative only and not limiting in its scope. It is, of course, necessary to provide a way in which the pad 11 can be raised and lowered so that it may make and break contact with the limp piece which it is responsible for moving. In the apparatus of FIG. 4, this is accomplished by moving the cylinders 15 and 16 through a small arc using a fluid-pressurized cylinder 60 which has a suitable piston (not shown) and rod 61. The rod 61 is pivotally attached to a horizontal mounting piece 64 (FIG. 5) which in turn is affixed to the two cylinders 15 and 16. Cylinder 60 is also pivotally mounted at its upper end through a suitable member 62 in a supporting framework 63. The two cylinders 15 and 16 are, in turn, grounded by means of a support 65 in which they are pivotally mounted through members 66. With the controlled introduction and discharge of fluid into the upper and lower chambers of cylinder 60, through suitable fluid lines 75 and 76 which are controlled by valves 77 and 78, the piston rod 61 is given an upward and downward motion to move two driving cylinders 15 and 16 as illustrated in FIG. 4.

The pad 11 preferably comprises an upper support piece 68 which is covered on its contacting surface with a suitable friction, resilient material 69 such as rubber. The pad 11 is joined through a spring member 70 to a pad support 71 which is conveniently mounted through a suitable screw 72.

FIG. 6 illustrates in diagrammatic fashion the use of the device of this invention in one stage of an automated sewing cycle. As pointed out previously, the purpose of the apparatus of this invention is to take an unaligned limp piece of material, move it and orient it to a desired degree of alignment so that it may be picked up and through precise mechanization moved to a desired work point. It is therefore desirable to incorporate the apparatus of this invention in an automated sequence so that it may be automatically actuated and operated, FIG. 6

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shows one way in which this may be done. The pickup mechanism which transfers the limp piece from the unaligned stack to the horizontal platform on which the apparatus operates may be any suitable device such as a vacuum apparatus, an endless belt, or a device which incorporates some type of adhesive surface. Subsequent to the time that the pickup device deposits the limp piece on the platform 37 (see FIG. 4) it actuates an air solenoid valve which, in turn, may open valve 77 (FIG. 4) introducing pressurized fluid into cylinder 16, driving piston rod 61 downwardly and thus causing pad 11 to make contact with the unaligned limp piece which has been delivered. It also may actuate valves 45 and 49 thus causing pressurized fluid to enter the fluid amplifiers 25 and 26 through lines 46 and 47 and (with the proper fluid flow balance) to enter the after chambers cylinders 15 and 16 through lines 20 and 22, respectively. This in turn drives pistons 17a and 18a forward until position III (FIGS. 1 and 6) is reached. (In FIG. 6 the mechanism of this invention is represented diagrammatically by a single driving cylinder 15.) Alternatively, valves 45 and 49 may be left open and the fluid in the system balanced to maintain the pistons where desired.

With the attainment of proper alignment at position III, a suitable sensing device is actuated. It may be of any type known in the art which is suitable for sensing the presence of the limp piece or an edge thereof. This sensing device in turn may then actuate an air solenoid valve which actuates first the upper movement of the driving cylinders 15 and 16 (by building up pressure in the bottom chamber of cylinder 60) and then their backward motion brought about by the actuation of valve 53 which introduces fluid into lines 54 and 55 and subsequently into the forward end of cylinders 15 and 16 through one-way check valves 56 and 57. With the withdrawal of the driving cylinders from their forwardmost position, the air solenoid valve actuates a suitable pickup device which removes the oriented piece from the platform to a predetermined desired location. Thus, with the return of the driving cylinders to their backmost position and the raising of their forward end through a small angle, they are in position to contact, move, and orient the succeeding piece of limp material.

It will be apparent from the above description that there is provided an apparatus which is capable of moving and accurately aligning a piece of limp fabric to place it in a desired position for subsequent operations. The apparatus is particularly well suited to the handling of limp pieces without introducing any curling or wrinkling therein. Moreover, by the simple adjustment of the location of the pressure sensors, the apparatus is adaptable to aligning pieces of various configurations. It also lends itself to incorporation into a complete automated cycle.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained; and, since certain changes may be made in the above constructions, without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

We claim:

1. An apparatus for moving and aligning a limp piece of material over a horizontal plane, comprising in combination

- (a) a smooth surface defining said horizontal plane over which said limp piece may be caused to slide;
- (b) movable pad means adapted to make contact with said limp piece and in moving to move said limp piece in a flat unwrinkled condition;

(c) a plurality of sensing means located in positions corresponding to the positions of selected points of the leading edge of said limp piece when it has attained its predetermined alignment, said sensing means being capable of developing a signal which is responsive to the arrival of said leading edge;

(d) a plurality of separately actuatable pad moving means adapted to move said pad means in said horizontal plane;

(e) signal transmitting means connecting each of said sensing means with an associated pad moving means and being adapted to control the motion of said pad moving means; and

(f) means for lowering said pad means into contact with a limp piece delivered to said surface for moving and alignment and for raising said pad means subsequent to the attainment of the alignment of said limp piece.

2. An apparatus in accordance with claim 1 wherein said sensing means comprises

(a) a sensing head defining a recess adapted to receive said leading edge of said limp piece;

(b) first and second fluid conduits opening into said recess, said first fluid conduit being connected to a source of pressurized fluid and said second fluid conduit being in fluid communication with said signal transmitting means.

3. An apparatus in accordance with claim 1 wherein said pad moving means are fluid-actuated pistons connected through piston rods to said pad moving means.

4. An apparatus in accordance with claim 1 wherein said signal transmitting means are fluid amplifiers of the proportional type.

5. An apparatus for moving and aligning a limp piece of material over a horizontal plane, comprising in combination

(a) a smooth surface defining said horizontal plane over which said limp piece may be caused to slide;

(b) movable pad means adapted to make contact with said limp piece and in moving to move said limp piece in a flat unwrinkled condition;

(c) duplicate sensing means located in positions corresponding to the positions of selected points of the leading edge of said limp piece when it has attained its predetermined alignment, each of said sensing means defining a recess adapted to receive said leading edge of said limp piece and having first and second fluid conduits opening into said recess which serves as a fluid communication therebetween, said fluid communication being controlled by the presence or absence of said leading edge in said recess;

(d) duplicate pilot sensing means each of which is associated with a corresponding one of said sensing means, each of said pilot sensing means having first and second fluid conduits communicating through an opening of controllable size;

(e) duplicate proportional fluid amplifiers each of which is in fluid communication with said second fluid conduit of an associated one of said sensing means and with said second fluid conduit of an associated one of said pilot sensing means whereby said fluid amplifier is responsive to fluid stream signals from said associated sensing means and pilot sensing means;

(f) means for supplying a pressurized fluid to said sensing means and said pilot sensing means through said first fluid conduits thereof;

(g) duplicate cylinder means having fluid-actuable pistons connected through piston rods to the ends of said pad means, each of which is associated with a corresponding one of said fluid amplifiers;

(h) means for supplying pressurized fluid to each of said cylinder means through its associated fluid amplifier;

(i) fluid communicating means connecting said fluid

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amplifier with its associated cylinder means whereby the flow of fluid into said cylinder means is controlled by said fluid stream signals into said fluid amplifier and the movement of said piston is responsive to the movement of said limp piece; and

(j) means for lowering said pad means into contact with a limp piece delivered to said surface for moving and alignment and for raising said pad means subsequent to the attainment of the alignment of said limp piece.

6. An apparatus in accordance with claim 5 further characterized by having fluid-actuated means for returning said pistons to their starting position subsequent to the attainment of said alignment.

7. An apparatus in accordance with claim 5 wherein said means for raising and lowering said pad means comprises a fluid-driven piston connected to said pad means.

8. An apparatus in accordance with claim 5 wherein

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said pad means comprises an elongated member having that surface which makes contact with said limp piece covered with a friction, resilient material.

9. An apparatus in accordance with claim 5 including sensing means adapted to sense the alignment of said limp piece and to generate a signal when said alignment is attained.

10. An apparatus in accordance with claim 9 wherein said signal is adapted to actuate said means for raising said pad means and for returning said piston to their starting position.

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