Feb. 21, 1956 H. ZIEBOLZ 2,735,630

LAMINATING WEB GUIDE

Filed Sept. 14, 1953 2 Sheets-Sheet 1

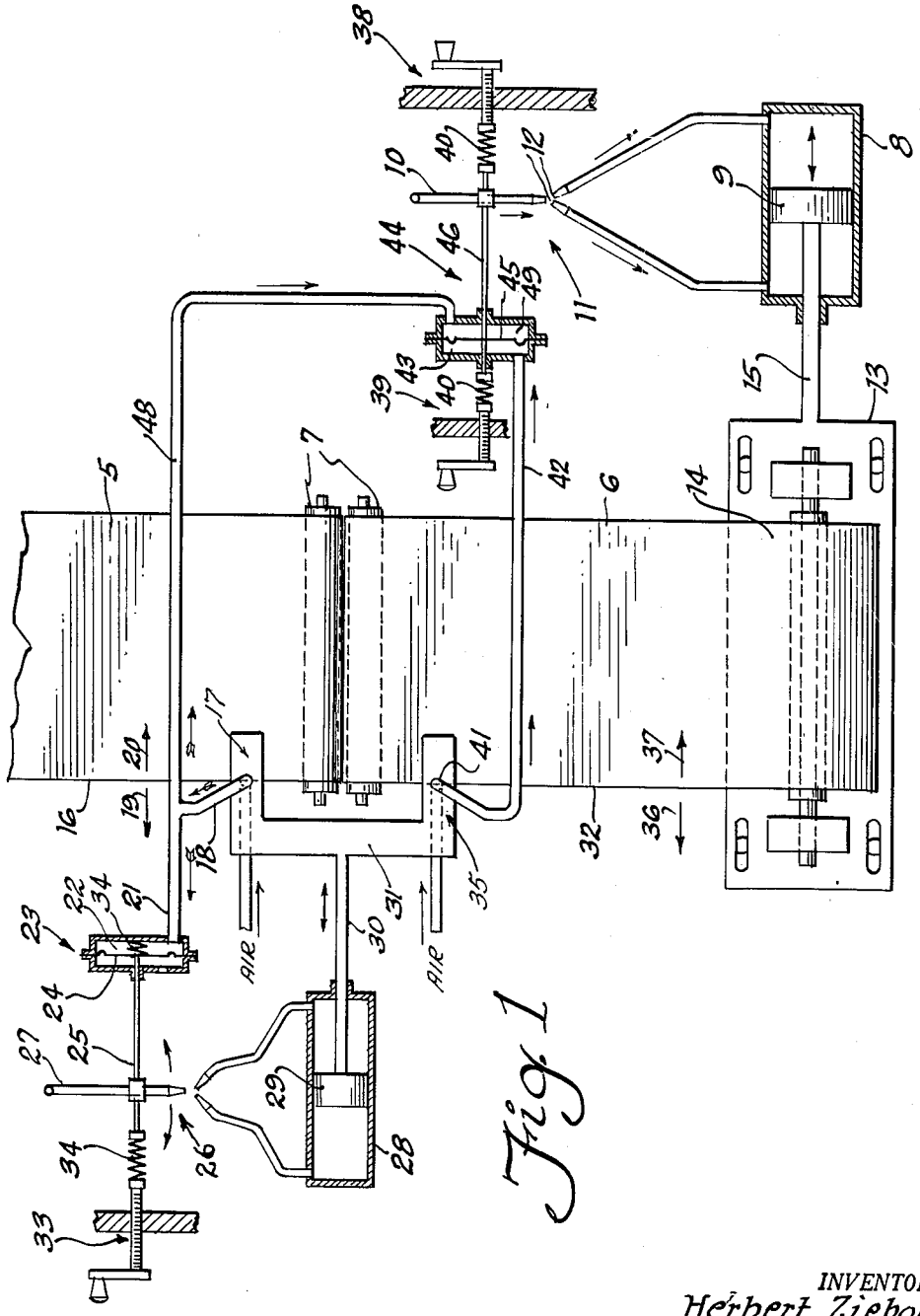


Fig. 1

INVENTOR.
Herbert Ziebolz
BY Henry R. Hunt
Jerome B. Bugg
Att'ys

Feb. 21, 1956 H. ZIEBOLZ 2,735,630

LAMINATING WEB GUIDE

Filed Sept. 14, 1953 2 Sheets-Sheet 2

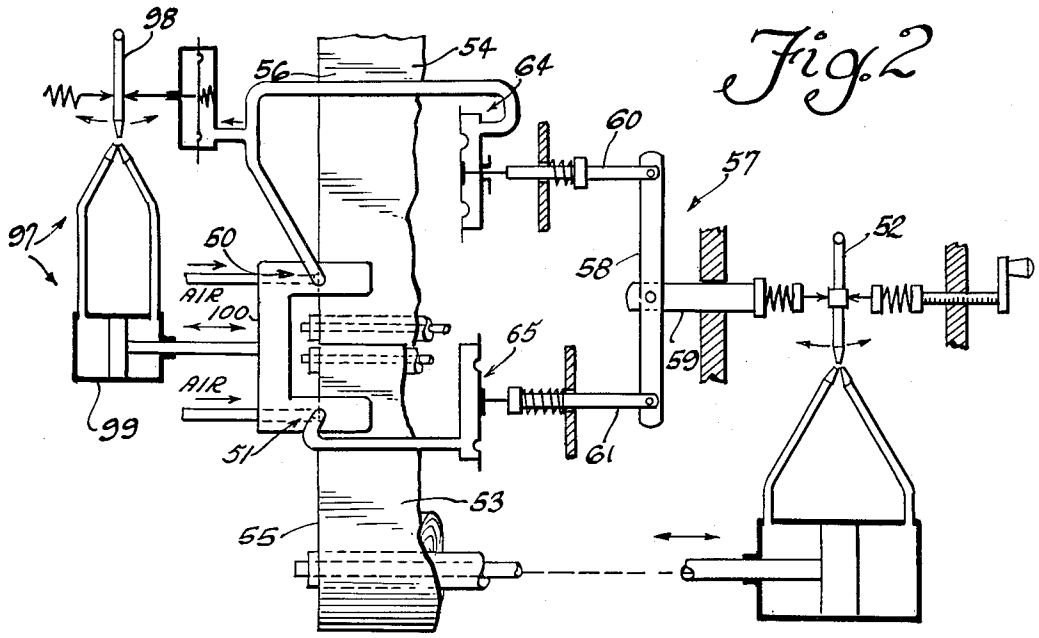


Fig. 2

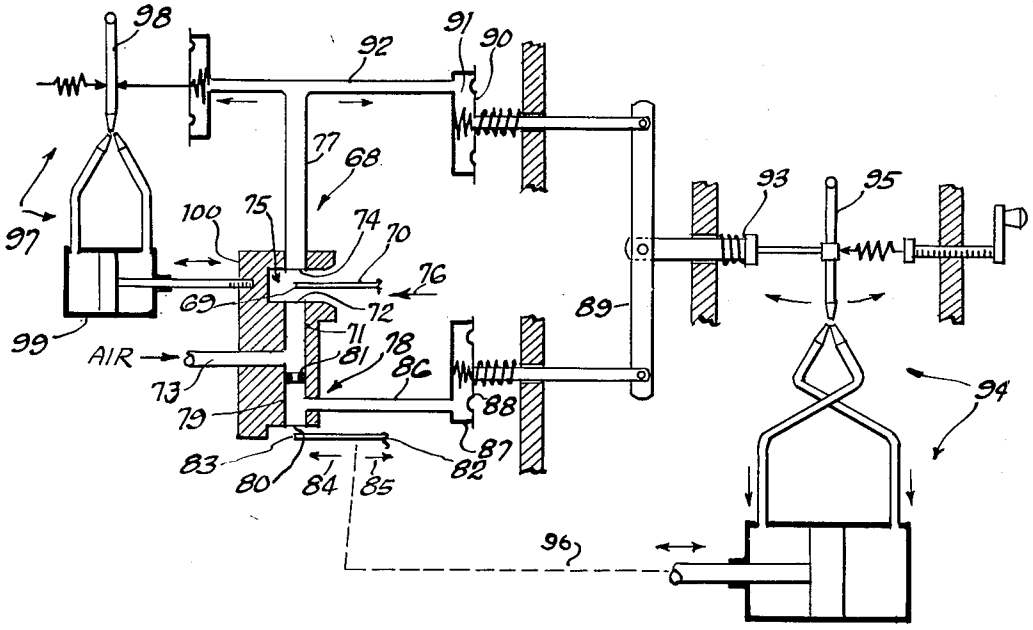


Fig. 3

INVENTOR.
Herbert Ziebolz
BY
Attys

United States Patent Office 2,735,630 Patented Feb. 21, 1956

2,735,630

LAMINATING WEB GUIDE

Herbert Ziebolz, Chicago, Ill., assignor to Askania Regulator Company, Chicago, Ill., a corporation of Illinois

Application September 14, 1953, Serial No. 379,812

6 Claims. (Cl. 242—76)

The present invention relates to laminating apparatus of the type wherein a plurality of webs are continually fed longitudinally into a combining device, typically a system of rolls between pairs of closely adjacent ones of which adjacent webs are fed in face to face relation, whereby they become adhesively joined. More particularly the invention relates to automatic web-guiding systems by means of which an edge of a slave, or second web is maintained in continuous substantial registration with a corresponding edge of a master or first web, by laterally moving the second web to correct its lateral displacement from such registration.

A problem that is involved in guiding plural webs with corresponding edges maintained in continuous registration arises from the fact that it is common for commercially wound rolls to have a so-called "telescopic" formation, that is, with succeeding laps of the wound web progressively displaced axially of the roll. In high speed unwinding apparatus, such as is used in laminating machinery, comprising duplicate unwinding devices respectively for unwinding different rolls and feeding webs that are stripped from them to combining rolls, it has proven impossible to maintain a satisfactory approximation to continuous registration of the webs, or of single corresponding edges of each, by means of stationary detectors that develop signals of senses indicative of opposite lateral web movement, either by attempting to guide each web in a zero path leading to registration at the combining mechanism, or by attempting to shift the slave web in response to the signal output of a detector that senses the lateral position of the master web.

A better approach to solution of the problem is one disclosed by United States Patent No. 2,641,416, granted June 9, 1953, to McLeary and Lowey. In the system disclosed by that patent, both of a pair of web edge lateral position detectors are mounted on a common support that is movable laterally of, and inwardly and outwardly relative to the paths of corresponding edges of a pair of webs that are being fed to combining rolls, and which corresponding edges are to be maintained in registration. The different detectors are positioned on the movable support respectively for sensing the positions of the different web edges, and each produces an operating signal upon a departure from a preselected positional relation between itself and the web edge with which it is cooperative. A first servomechanism is connected to the movable detector support, and is operated by the signal output of a first one of the detectors, which is cooperative with an edge of the first or master web, to move the support (and both of the detectors thereon supported) to establish or restore the preselected positional relation of the first detector to the first web edge, upon generation by the first detector of a signal output indicative of a variance from that relation. In other words, the first detector and servomechanism operate to make the support and both detectors follow lateral shifts of the first web.

A second servomechanism is arranged to laterally shift

the second web in response to a signal generated by the second dectector that is indicative of a variance from the preselected positional relation between the second detector and second web edge. In other words, the second detector and second servomechanism causes the second web to follow the support and the second detector when the latter are moved in response to a signal from the first detector. In the system, the sequence of operation is that the support and both detectors follow lateral shift of the first web edge, and the second web is thereupon shifted to follow the second detector, to register its edge with the first web edge.

The present invention is an improvement of the patented apparatus described briefly above, and its primary object is to minimize lag of initiation of the second web shifting operation, after an operation-initiating lateral movement of the first web, occurring due to the time lapse during which occur response of the first servomechanism, movement of a commencement of generation of a signal by the second detector, and initiation of response to that signal by the second servomechanism. In brief, the invention proposes employment of an anticipatory control signal, generated by the first detector, and applied to the second servomechanism to initiate operation thereof upon sensing by the first detector of a lateral shift of the first web edge, and effective to initiate operation of the second servomechanism to shift the second web to follow the first web edge substantially simultaneously with the movement of the support and detectors, to follow the first web edge. Since the signal output of the first detector is dependent solely on the positional relation between the first detector and the first web edge, as their preselected positional relation is established, that signal is eliminated, and thereafter the second servomechanism is controlled solely by the second detector. As suggested by the following exemplary disclosures, the specific arrangement of apparatus embodying the invention may take a wide variety of forms.

In the accompanying drawings:

Fig. 1 is a schematic plan showing a preferred embodiment of the invention.

Fig. 2 is a similar view showing a modification.

Fig. 3 is a schematic vertical section showing a third embodiment of the invention.

First referring to Fig. 1, a first web 5 and a second web 6 are illustrated as being continuously fed between a pair of combining rolls 7, that secure them together adhesively under pressure. Provision is made for laterally shifting the second or slave web 6 by a reversible servomechanism, which, for convenience and since it shifts the second web is termed a "second" servomechanism. This "second" servomechanism includes a power unit shown as a hydraulic cylinder and piston assembly 8, 9, and a relay regulator having a control element moveable in oposite directions from a neutral position wherein the power unit or servomotor 8, 9 is maintained stopped, respectively to operate the latter in opposite directions. The control element is shown as the jet pipe 10 of a conventional hydraulic jet pipe regulator assembly 11. In such a regulator, the jet pipe, which continuously discharges a jet of liquid under substantial pressure toward a pair of receiver ports 12, is pivoted to swing from a neutral postion wherein it is equally in registration with ports 12, to increase and decrease its registration with the different ports in a sense depending on the direction of its swing. In the neutral position of jet pipe 10, equal pressures are developed in the receiver ports 12, and in the opposite ends of cylinder 8, which are connected to those ports, and piston 9 is maintained stationary. Upon swing of the jet pipe from its neutral position, a higher pressure is developed in the port 12

toward which it swings and with which it has the greater degree of registration, and piston 9 is moved away from the cylinder and connected to that port.

The means for laterally shifting the second web 6 is shown as a slidable support 13 for the roll 14 from which that web is stripped, support 13 being connected to piston 9 by an operating rod 15.

In accordance with the system of the above-identified patent, the position of a certain edge 16 of the first web 5 is continually sensed by a first detector 17. This detector is shown as being of a pneumatic discharge type, a detailed description of different forms of which will be made with respect to Fig. 3, and which is of a kind to which a gaseous medium under pressure is continuously supplied and discharged across the path of lateral positional variation of the web edge 16, to develop a signal pressure the magnitude of which depends upon, and varies with changes in the positional relation between detector 17 and web edge 16, in directions extended laterally of the latter, and by reason of greater or less interception of the discharged air stream by the marginal portion of web 5 adjacent its edge 16. The signal pressure is developed in a tubular element or chamber 18 of the detector 17. In pneumatic discharge web edge detector systems, and guide systems employing such detectors, it is usual to regard a certain magnitude of developed signal air pressure as a neutral condition, which may be established by a system of return springs biasing a motor of a relay controller to a neutral position in opposition to pressure of that magnitude. Such pressure magnitude represents and accompanies a certain preselected zero or neutral positional relation between the air discharge orifice of the detector and the web edge, as crossing of the center axis of the former by the latter, and increase and decrease of the signal pressure from that preselected magnitude respectively indicates displacements of detector and web edge from the preselected one, respectively in opposite directional senses, and in directions that extend laterally of the web edge, as indicated by the arrows 19, 20 of Fig. 1.

In Fig. 1 it is assumed that detector 17 is of a type that develops pressures of magnitudes greater than the neutral or "no-signal" pressure magnitude when the sense of displacement of web and detector from their preselected zero positional relation is such that the web is displaced rightward from the zero relation and relative to the detector, or in the direction of arrow 20, while opposite relative displacements, wherein the web edge is displaced leftward from its zero positional relation to detector 17, or in the direction of arrow 19, result in development of pressures of less magnitude than the neutral magnitudes. As will appear, another type of detector develops pressure changes of opposite sense to those assumed in cases of displacements in similar directions.

The pressure-developing tube or chamber 18 is connected by a signal pressure line 21 to an expansible chamber 22 of a fluid pressure responsive signal motor 23, which chamber is partially enclosed by a movable wall in the form of a diaphragm 24. Diaphragm 24 is coupled by a link 25 to operate a servomechanism, conveniently termed a "first" servomechanism. Similar to the "second" servomechanism 10, 9, 8, it may comprise a jet pipe regulator 26, including a jet pipe 27 that controls operation of a power unit in the form of a cylinder and piston assembly 28, 29. Jet pipe 27, as jet pipe 10, constitutes a relay control element that is movable, from a neutral position wherein the servomotor, cylinder and piston assembly 28, 29 is maintained stopped, in opposite directions respectively to move piston 29 in opposite directions. Piston 29 is connected by a piston rod 30 to a support 31 that is mounted for movement laterally of and toward and away from the paths of the first web edge 16 and the corresponding edge 32 of the second web 6. This servomechanism and its manner of connection are such that the signal developed upon departure of the first web edge 16 and first detector 17 from their preselected zero positional relation, and appearing as a departure from neutral magnitude of the pressure developed in detector chamber 18 and exerted in chamber 22 of signal motor 23, swings jet pipe 27 and operates piston 29 to move support 31 in a direction to move detector 17 to reestablish the zero positional relation, whereupon jet pipe 27 is restored to its neutral position and piston 29 is stopped. The zero or no-signal magnitude of the developed pressure may be set by a device 33 for selecting the magnitude of zeroing force exerted by one of the jet pipe centering or return springs 34.

The detector support 31, that carries first detector 17, and that is by the relay system 23, 27, 29 moved to cause detector 17 to follow lateral variations in the position of the first web edge 16, also has mounted thereon a second detector 35 that is arranged for cooperation with the second web edge 32, to sense the lateral position thereof relative to itself, and to develop a signal that varies oppositely with relative displacement in opposite senses between itself and web edge 32, from their preselected zero positional relation, in directions that extend laterally of web edge 32, which are indicated by arrows 36, 37 of Fig. 1. As in the case of detector 17, detector 35 is assumed to be of a type that develops a preselected zero-signal magnitude of air pressure, which may be selected by adjustment at 38 or 39 of the zeroing force exerted on jet pipe 10 by its return spring 40, and which is developed while web edge 36 and detector 35 occupy their preselected zero positional relation. Detector 35 also is arranged to develop operating signal pressures of magnitudes other than the zero signal pressure during displacement of the detector and web edge from their preselected zero positional relation, and which operating pressures are greater and less than the zero signal magnitude respectively when the web is displaced from zero relation to detector 35 in the directions of arrows 37 and 36.

The signal pressure output of detector 35 is developed in a tube or chamber 41 that is connected by a signal pressure line 42 to a chamber 43 of a second pressure-responsive signal motor 44, which chamber 43 is partially enclosed by a movable wall, shown as a diaphragm 45, and that is linked by a rod 46 to swing jet pipe 10 in opposite directions respectively as the signal pressure developed by detector 35 exceeds or is less than the zero-signal pressure, respectively to operate the escond power unit 8, 9, and move web 6 to establish the preselected zero positional relationship between the latter and detector 35.

The mechanism so far described, which is arranged substantially in accordance with the above-identified patent, acts to cause web edge 32 to follow lateral positional changes of web edge 16, by first moving support 31 and both detectors 17, 35 to follow web edge 16, displacing detector 35 from zero positional relation to web edge 32, and shifting web 6 to reestablish that positional relation, which corresponds to registration with the corresponding edge 16 of web 5.

In accordance with the present invention, the laminating apparatus described above is provided, as an improvement, with means for imposing on the second servomechanism 44, 10, 9 an anticipatory operating signal from the first detector. Such signal, generated and so applied upon occurrence of a relative displacement from the preselected zero positional relation between the first detector 17 and the first web edge 16, is effective to operate the second servomechanism in spite of the fact that at that time the preselected zero positional relation may exist between the second detector 35 and second web edge 32. The arrangement for transmitting the signal from the first detector 17 to the second mechanism is such that, in response to the directional sense of the displacement between the first detector and first web edge and the consequent sense of the signal, the second servomechanism will act to shift second web 6 in the same direction as the detector support 31 and the two detectors 17, 35 are moved by the first servomechanism in response to the same signal from the first detector 17. Thereby,

shift of web 6 by detector 17 anticipates a later shifting by detector 35 as a consequence of a displacement thereof from zero positional relation to second web edge 32, which would occur upon movement of detector 35 with support 31.

Referring once more to the mode of operation of the prior art system, without the anticipatory control means of the present invention, it will be recalled that a spontaneous lateral movement of first web edge 16, say in the direction of arrow 19, results in a displacement of the web edge from zero relation to detector 17 in the directional sense of arrow 19. This results in a movement of support 31 and both detectors 17, 35 in the direction of arrow 19 to follow edge 16. Such movement of detector 35 results in displacement of the second web edge 32 from zero relation to detector 35 in the directional sense of arrow 37, that is, in the opposite directional sense to that of the operation-originating displacement of first web edge 16 from zero relation to first detector 17. This opposite directional sense of displacement of second web edge 32 serves to generate in second detector 35 a signal of the sense that is effective to shift second web 6 in the direction of arrow 36, the same direction in which support 31 and detectors 17, 35 previously have been shifted to follow the first web edge. Thus, relatively opposite directional senses of displacements of the different web edges from their zero positional relations to the cooperating detectors cause movements of the detectors and of the second web 6 in the same direction.

The same characteristic mode of directional operation applies to the auxiliary or anticipatory system of the present invention, for actuating the second servomechanism by a signal generated by the first detector. The anticipatory signal and the signal output of the second detector are so related and so applied to the control member 10 of the second servomechanism in respect to direction-indicating senses of the signals, that during relative displacements between the different web edges and the respectively cooperative detectors, which are paired as 16, 17 and 32, 35, wherein the directional senses of displacement of the different web edges are in opposite directions, indicated by pairing 19 with 37 and 20 with 36, the signal from each detectors, as applied to the second servomechanism, is effective to operate the second servomechanism to shift web 6 in the same lateral direction.

In the specific arrangement of Fig. 1, the anticipatory signal system comprises a branch signal pipe 48 that is connected to the signal pressure chamber of the first detector 17, and to second expansible chamber signal motor means linked to the second servomechanism control member, here jet pipe 10. In Fig. 1, since detectors 17, 35 are of the same type, and therefore generate operating signals of opposite senses during web edge displacements from zero positions relative to them that are of opposite directional senses, and since in the case of such opposite directional displacements between web edge 16 and detector 17, and web edge 32 and detector 35, web 6 is to be shifted in the same direction, the signal motor devices that respectively respond to the signals from the different detectors may be connected direct to control member 10, to exert forces thereon in the same direction when energized by signals of opposite senses that is, pressures respectively greater and less than zero signal pressures. In other words, with the assumed type of detectors, if web edge 16 moves relative to detector 17 in the direction of arrow 19, signal pressure transmitted by line 48 will drop. If detector 35 moves relative to web edge 32 in the direction of arrow 36, so that web edge 32 is displaced in the opposite direction, indicated by arrow 37, pressure transmitted by pipe 42 will rise. These signals of opposite senses must, in accordance with the intended mode of operation, both be effective to shift web 6 in the same direction, that of arrow 36.

Therefore, they are so transferred to control element 10, as to move it in the same direction. This is readily accomplished by connection of the auxiliary signal pipe 48 to a second signal motor expansible chamber 49 having a movable wall so related to that of the first chamber 43, and so connected to the servomechanism control element that variations in pressures of opposite senses in the two chambers 43, 49 move element 10 in the same direction. In the case of the assumed similar type of detectors this is accomplished conveniently by arranging the second chamber 49 to the opposite side of diaphragm 45 from chamber 43.

Fig. 2 shows a modification wherein a summarizer type of signal transmitting device is arranged to transmit to a second servomechanism the signal outputs developed by signal motors respectively responsive to the first and second detectors 50, 51. Control element 52 of the second servomechanism, that operates to shift the second web 53, relative to the first web 54 to register its detected edge 55 with the corresponding first web edge 56 is connected to the summarizer output. The summarizer, designated 57, is of conventional whiffletree arrangement having a floating bar 58 pivotally connected at a point between its ends to an output transmitting link 59, and its different arms pivotally connected to connecting links 60, 61 that respectively are longitudinally moved by the respective movable walls 62, 63 of the different expansible chamber, pressure responsive signal motors 64, 65.

Again assuming detectors 50, 51 to be of the same type, and to generate signal pressures of opposite operating senses during displacements from zero relation of the respective cooperative web edge-detector pairs 50, 56 and 51, 55 that are of relatively opposite directional senses, the motors 64, 65 are arranged relative to whiffletree bar 58 to move the arms of the latter in the same direction during opposite variations of the signal pressures delivered to them respectively. Such arrangement is shown as a relatively reversed disposition of motors 64, 65 with respect to directions in which their movable walls are moved by the same senses of variations of pressures exerted within them. Similar to the auxiliary signal system of Fig. 1, the first detector 50 delivers to motor 64 a signal that is effective to move member 52 in the direction to shift second web 53 in the same direction as detectors 50, 51 are moved in response to the same signal.

Fig. 3 shows a system that in general is similar to that of Fig. 2, but, in illustration of the wide flexibility in specific arrangements that may be employed, includes fluid discharge detectors of different types for detecting the positions of the corresponding edges of the different webs, and that generate signals of the same sense when directional senses of displacements between the respective cooperative web edge-detector pairs are opposite.

Th first detector 68, which senses the position of the edge 69 of a first web 70, is shown as being of the type assumed to be used in Fig. 1, including a discharge tube 71 having an orifice 72 for discharging a stream of air under pressure, delivered by a supply line 73, to a receiver port 74 that is spaced from it across a throat 75 that provides clearance for passage of the marginal portion of web 70 adjacent its detected edge 69. In this type of detector it will be apparent that as the web edge 69 moves in the direction of arrow 76, the marginal portion of the web will progressively increase interception of the air stream directed toward receiver port 74, and result in progressively decreasing pressure developed in the signal pressure pipe 77, while lateral web edge movement in the opposite direction will result in increasing signal pressure. It is this type of detector that has been assumed to be used in Figs. 1 and 2, and the relay and servomechanism systems are illustrated as connected for operation by such detectors.

The second detector 78 comprises a discharge tube 79

the interior of which provides a signal pressure chamber, having an orifice 80 and it is supplied, as from line 73, through a pressure differential-developing, or isolating orifice 81. A marginal portion of the second web 82, adjacent the edge 83 thereof that corresponds to the first web edge 69, overlies orifice 80 to a greater or less extent depending on the lateral position of edge 83, thereby more or less blocking free discharge of air from orifice 80, and increasing and decreasing pressure in tube 79 respectively as edge 83 moves in the direction of arrows 84, 85. By a signal pressure tube 86, pressure developed in tubular chamber 79 is exerted in an expansible signal motor chamber 87, the movable wall 88 of which is linked to one arm of a whiffletree summarizer 89. The other arm of the summarizer is linked to the movable wall 90 of an auxiliary or anticipating signal motor 91, the expansible chamber of which is connected by a signal pressure line 92 with the receiver orifice 74 of the first detector 68. Since both detectors 68, 78 produce pressures greater than the zero signal pressure when displacements of the cooperative web edge-detector pairs 69, 68 and 83, 78 are in opposite directional senses, in order to provide proper directional shift of web 82 by them respectively, the motors 91, and 87, 88 are connected to move the output element 93 of the summarizer in the same one direction upon increase of the pressures in both motor chambers and in the opposite same direction upon decrease of those pressures. Output member 93 is coupled to operate the oppositely movable control element of a second servomechanism 94, such element again being shown as the regulator jet pipe 95 of a hydraulic relay system. The output member 96 of this servomechanism is connected to shift web 86 laterally upon operation of the servomechanism.

In each of Figs. 2 and 3, as in the case of Fig. 1, a first servomechanism 97, having a control element 98 that is movable in opposite directions from a neutral position, respectively to effect opposite operation of a power unit or servomotor 99, is arranged to move a support 100, that carries both the first and the second detector, in directions, selected by the sense of signal output of the first detector, to follow lateral movements of the detected edge of the first web.

It will be understood that there are many possible variations and modifications of the specific structural arrangements herein disclosed, without departing from the spirit of the invention, and to obtain the advantages thereby, and that the scope of the invention is to be determined solely from the appended claims, rather than by reference to the above-described exemplary disclosures.

I claim:

1. In apparatus for the continuous lamination of a plurality of webs between combining rolls, and including a system for maintaining an edge of a second web substantially in registration with a corresponding edge of a first web as both are fed to said rolls, and wherein said system comprises a support movable laterally of and toward and away from the travel path of said first web edge, a first detector mounted on and movable with said support for cooperation with said first web edge to develop a signal of a sense corresponding to the direction of displacement of said support and detector from a preselected positional relation to said first web edge, a first servomotor system controlled by signals developed by said first detector and operatively connected with said support to move it and said detector to said positional relation upon development of a signal by the latter, a second detector mounted on and movable with said support for cooperation with said second web edge to develop a signal of a sense corresponding to the direction of displacement of said second web edge from a preselected positional relation to said second detector which corresponds to registration of said web edges, and second servomotor mechanism controlled by a signal developed by said second detector and operable thereby to move said second web laterally to establish said positional relation and registration of its said edge; the improvement comprising signal transmitting means connected with said first detector and second servomotor mechanism to transmit to the latter a signal for operating it to move said second web in the direction of movement of said support and detectors that coresponds to the sense of the signal developed by said first detector.

2. In apparatus for the continuous lamination of a plurality of webs between combining rolls, and including a system for maintaining an edge of a second web substantially in registration with a corresponding edge of a first web as both are fed to said rolls, and wherein said system comprises a support movable laterally of and toward and away from the travel path of said first web edge, a first detector mounted on and movable with said support for cooperation with said first web edge to develop a signal of a sense corresponding to the direction of displacement of said support and detector from a preselected positional relation to said first web edge, a first servomotor system controlled by signals developed by said first detector and operatively connected with said support to move it and said detector to said positional relation upon development of a signal by the latter, a second detector mounted on and movable with said support for cooperation with said second web edge to develop a signal of a sense corresponding to the direction of displacement of said second web edge from a preselected positional relation to said second detector which corresponds to registration of said web edges, and second servomotor mechanism controlled by a signal developed by said second detector and operable thereby to move said second web laterally to establish said positional relation and registration of its said edge; the improvement comprising signal summarizing and transmitting means having a pair of inputs respectively connected with the different said detectors for energization by signals that the latter develop, and a signal output connected with said second servomotor mechanism for operating the latter upon development of a signal by either of said detectors, and said signal summarizing and transmitting means being arranged to produce at its said output upon development of simultaneous signals by said detectors, a servomotor mechanism operating signal comprising components respectively having senses corresponding to the sense of the signals developed by the respective detectors.

3. In apparatus for the continuous lamination of a plurality of webs between combining rolls, and including a system for maintaining an edge of a second web substantially in registration with a corresponding edge of a first web as both are fed to said rolls, and wherein said system comprises a support movable laterally of and toward and away from the travel path of said first web edge, a first detector mounted on and movable with said support for cooperation with said first web to sense displacement of said first detector and web edge from a preselected zero positional relation and to develop signals during displacement of said detector from said zero positional relation, which signals are of opposite senses respectively as displacement of said detector is in directions extended outward and inward of said first web edge, a first servomotor mechanism controlled by signals developed by said first detector and operatively connected with said support to move it to return said detector to said positional relation upon development of a signal thereby, a second servomotor mechanism operable by signals of opposite senses respectively to move said second web laterally in opposite directions, and a second detector mounted on and movable with said support for cooperation with said second web edge to sense displacement of the latter from a preselected zero positional relationship to said second detector that corresponds to registration of said second web edge from its said zero positional relation to said second detector and which are of opposite senses respectively as such displacement is in inward and outward directions with respect to said second web edge;

the improvement comprising signal transmitting means having a pair of signal inputs respectively connected with the different said detectors and an output connected with said second servomotor mechanism for controlling it, said means being arranged to impose on said second servomotor mechanism signals of the same sense as developed by each of said detectors during their relative displacements from their said zero positional relations to the web edges with which they respectively are cooperative, and which displacements are in relatively opposite senses with respect to directions that extend laterally of said web edges.

4. In apparatus for the continuous lamination of a plurality of webs between combining rolls, and including a detector support mounted for movement laterally of and toward and away from corresponding edges of first and second such webs, which edges are to be maintained substantially in registration as the webs travel to said rolls, first and second fluid discharge web edge position detectors, both mounted on said support for respective cooperation with marginal portions of the different said webs adjacent their said corresponding edges, and each of said detectors being arranged to develop a fluid pressure that is of a preselected magnitude during existence of a preselected zero positional relation between itself and the web edge with which it is cooperative, and that decreases and increases respectively during displacements from said relation in opposite directions extended transverse to the web edge, a servomechanism including a reversible power unit operatively connected with said support and controlled by pressure developed by said first detector for moving said support and detectors, in response to variance from said preselected magnitude of the latter said pressure, to position said first detector in said zero relation to said first web edge, a fluid operated reversible servomotor that is operable to shift said second web laterally, and a relay regulator connected to control delivery of operating fluid to said servomotor and having a control element that is movable from a neutral position wherein said servomotor is maintained stopped in opposite directions respectively to operate said motor in opposite directions; a control system for said regulator, comprising first pressure sensitive motor means connected with said first detector, having a movable output member connected with said control element and operable by changes in pressure developed by said first detector to move said control element and operate said servomotor in directions to shift said second web in the same direction as said support and detectors are moved by said servomechanism in response to the same change in pressure, and second pressure sensitive motor means connected with said second detector, having a movable output member connected with said control member, and operable in response to variance of the pressure developed by said second detector from said preselected magnitude accompanying displacement of said second web edge from its preselected zero positional relation to said second detector, to move said control element and operate said servomotor in directions to shift said second web to said positional relation to said second detector.

5. In apparatus for the continuous lamination of a plurality of webs between combining rolls, and including a detector support mounted for movement laterally of and toward and away from corresponding edges of first and second such webs, which edges are to be maintained substantially in registration as the webs travel to said rolls, first and second fluid discharge web edge position detectors, both mounted on said support for respective cooperation with marginal portions of the different said webs adjacent their said corresponding edges, and each of said detectors being arranged to develop a fluid pressure that is of a preselected magnitude during existence of a preselected zero positional relation between itself and the web edge with which it is cooperative, and that decreases and increases respectively during displacements from said relation in opposite directions extended transverse to the web edge, a servomechanism including a reversible power unit operatively connected with said support and controlled by pressure developed by said first detector for moving said support and detectors, in response to variance from said preselected magnitude of the latter said pressure, to position said first detector in said zero positional relation to said first web edge, a fluid operated reversible servomotor that is operable to shift said second web laterally, and a relay regulator connected to control delivery of operating fluid to said servomotor and having a control element that is movable from a neutral position wherein said servomotor is maintained stopped, in opposite directions respectively to operate said servomotor to shift said second web in opposite directions; the combination with a signal motor for operating said regulator in response to variance in pressure developed by said second detector from said preselected magnitude, said motor having an expansible chamber connected with said second detector, a movable wall partially enclosing said chamber and an output member movable by said wall, of anticipatory control means for operating said regulator in response to changes in pressure developed by said first detector, comprising an auxiliary motor having an expansible chamber connected with said first detector, a movable wall partially enclosing the latter chamber, and an output element connected with said movable wall, and mechanical summarizer means having a movable output element operatively connected with said control element and a pair of movable input members each coupled with a different one of said output members in relationship to move said output and control elements in the same directions as a result of changes in pressures developed by the different detectors upon their displacement, relative to the web edges with which respectively they are cooperative, in opposite directions from their respective said zero positional relations to said edges.

6. In laminating apparatus that includes first and second web edge position detectors mounted for movement laterally of and toward and away from corresponding edges of a pair of webs traveling to combining rolls, and which edges are to be maintained substantially in registration, a reversible servo-mechanism connected with both said detectors for moving them simultaneously and equally, controlled by a first of said detectors that is cooperative with a first one of said web edges, and operated by a signal developed by said first detector to move both said detectors to follow lateral movements of said first web edge, and a reversible servomotor operable in opposite directions to shift said second web in opposite directions and relative to said first web; in combination, a first control system energized by signals developed by said first detector and operating said servomotor to shift said second web in the directions of movement of said detectors as they follow said first edge, and a second control system energized by signals developed by said second detector and operating said servomotor to shift it to a preselected positional relation to said second detector wherein said second web edge is positioned substantially in registration with said first web edge.

References Cited in the file of this patent

UNITED STATES PATENTS

2,641,416 McCleary et al. ---------- June 9, 1953