Aug. 31, 1954 R. J. KROTH 2,687,885

WEB EDGE POSITION DETECTOR

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Fig. 1

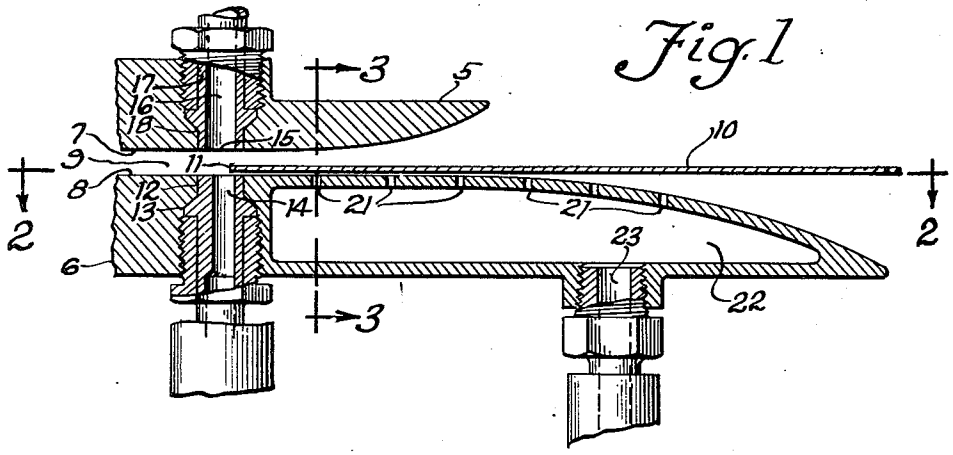


Fig. 2

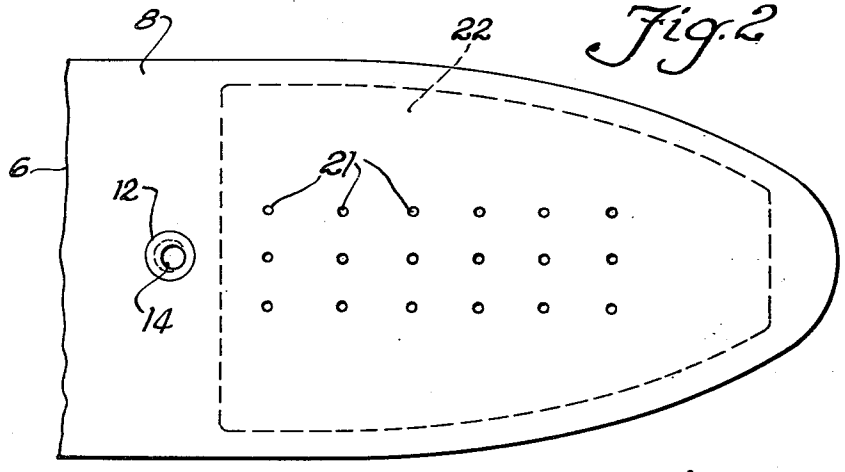


Fig. 4

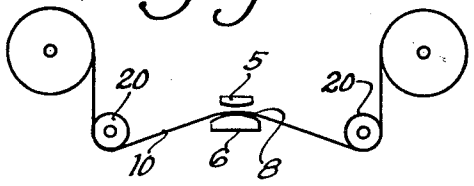
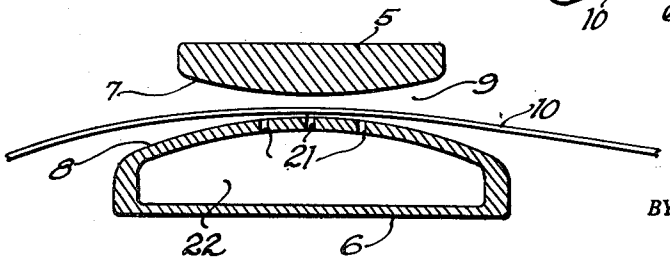


Fig. 3



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Fig. 5

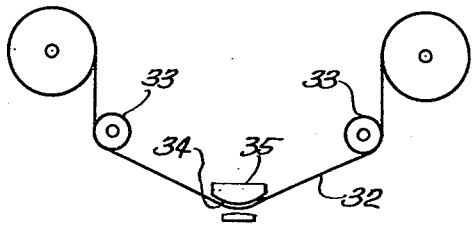
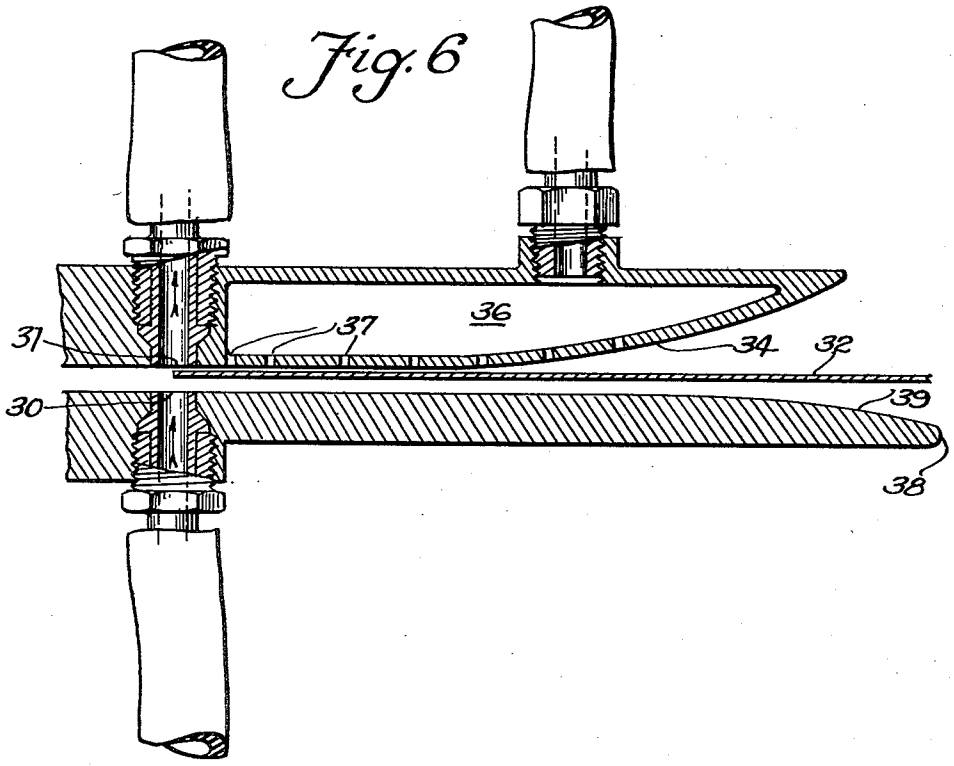


Fig. 6



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WEB EDGE POSITION DETECTOR

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Application December 5, 1950, Serial No. 199,175

10 Claims. (Cl. 271—2.6)

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The present invention relates to detection of the lateral position of the edge of a traveling web of material, particularly to accomplishment of such detection by means of a jet of air that is directed substantially at right angles to the web and toward a receiver port, in such arrangement that more or less of the cross sectional area of the jet is intercepted by the marginal portion of the web, depending on the position of the edge of such portion, with consequent development in the receiver port of a pressure that corresponds in magnitude with the unintercepted part of the jet and therefore affords a measure of the position of the web edge. More particularly the invention is directed to improvement of detector devices arranged to support a jet-discharging nozzle and receiver structure, and specifically to improvement of the nozzle-supporting structure of such a detector.

As heretofore arranged, web edge detectors of the kind in question have comprised a pair of support arms with adjacent opposed surfaces spaced apart to provide a slot through which a marginal portion of the web is to travel, with bores for containing the jet-discharging nozzle and receiver structure in the respective arms and opening through such adjacent surfaces. Such arrangement has been developed with the idea that the marginal web portion in the slot should travel in materially spaced relation to both such surfaces, as in a plane located substantially midway between them. It has developed from actual commercial employment of such devices that marked improvement of the accuracy of relation of receiver port pressure magnitude to web edge position is effected when the plane of the web is in close proximity to either the receiver port or discharge orifice of the jet nozzle. This is exemplified by a marked reduction in hunting in a system wherein the detector controls a web edge positioning mechanism, such improvement resulting from the mere deflection of the web from its intended plane of travel approximately midway between the opposed surfaces of the respective support arms to a position actually contacting the surface of the support surrounding the jet discharge orifice or receiver port. The obvious expedient to take advantage of this characteristic would be to so relatively arrange the web path and the detector that a web traveling in such path would contact the surface surrounding the jet-discharging orifice or receiver port, but such an expedient is not acceptable in commercial practice. In certain situations the webs involved have abrasive qualities sufficient to

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quickly damage the surfaces surrounding the discharge orifice or port, thereby materially and adversely affecting the form of the jet and the measuring quality of the detector. In other situations travel of the web in contact with a stationary surface, even though the latter be highly polished, results in marring of the web.

The present invention avoids contact between the web and the surfaces of the detector, but provides for travel of the web at a minimum spacing from the surface adjacent which it is to travel, and so makes use of the improved characteristics resulting from arranging the web path close to such surface. The arrangement is such that the web tends to contact such surface of the detector, but an air cushion is formed between that surface and the web surface so that the web is floated over the surface. In this way, by making the air cushion very thin, extremely close spacing of the web from the detector surface, but spacing that is extremely stable and safe, can be accomplished.

A primary object of the invention is the provision in a pneumatic air jet type of web edge position detector equipment of a novel arrangement for maintaining a traveling web in a position of minimum practical spacing, but safely out of contact with the surface surrounding a jet discharging orifice or a receiver port.

Another object is the provision of a novel arrangement of a jet nozzle-supporting structure in a detector of the type in question.

Another object is the provision of a novel arrangement for forming an air cushion between a surface surrounding an air jet discharge orifice and the marginal portion of a web traveling over and past such surface.

Another object is the provision of a novel arrangement of a receiver port-forming structure for a web edge position-detector.

Still another object is the provision of a novel arrangement for discharging cushion-forming air between a surface surrounding a jet discharge orifice or a receiver port and a web having a marginal portion traveling over and past such surface, for maintaining such web portion in safe but close spacing therefrom.

In the accompanying drawings:

Fig. 1 is a fragmentary median sectional view of a pneumatic web edge position detector embodying a form of the invention.

Fig. 2 is a section on line 2—2 of Fig. 1, showing the nozzle-supporting structure of such detector in top plan.

Fig. 3 is a section on line 3—3 of Fig. 1.

Fig. 4 is a somewhat exaggerated schematic diagram of a web path-forming arrangement suitable for use with the invention.

Fig. 5 is a schematic view similar to Fig. 4, showing application of the invention to the receiver port-containing structure in a modified form of the invention.

Fig. 6 is a section similar to Fig. 1 through a detector of a type used with a system such as that of Fig. 5.

Describing the drawings in detail, the disclosed detectors comprise a pair of supporting arms or structures 5 and 6 having adjacent opposed surfaces 7, 8 that are spaced apart to provide a throat or slot-like channel 9 through which is intended to travel the marginal portion of a web 10, the position of an edge 11 of which is to be detected by the device. A pneumatic jet type detector comprises a pair of tubular pneumatic elements including nozzle structure 12, supported in a bore 13 of one of the structures, here shown as 6, and having a discharge orifice 14 that opens through the surface 8 of such support and through the end surface of the nozzle structure, the latter lying substantially in the plane of surface 8 of the support. A receiver port 15 is formed by the opening of a bore 16 in the other tubular pneumatic element 17, to be exposed through surface 7 of the other support arm structure, the receiver element 17 being supported in a bore 18 of the latter structure.

As indicated above, the present invention is based on the discovery that very marked improvement in accuracy of the relation of magnitude of pressure, developed in receiver bore 16 by the part of the air jet passed by the web edge 11 to receiver port 15, to the position of such web edge is accomplished by positioning the surface of the web in contact with the surface surrounding the discharge orifice 14 or that surrounding receiver port, depending on the specific arrangement of the jet nozzle and receiver port. Such improvement is chiefly one of stability of such pressure, possibly arising from either or both elimination of the tendency of the web to move irregularly back and forth in a direction generally parallel to the axis of the air jet, and/or a better control of the cross sectional area of the jet that is effective in the receiver port 15 when the web is maintained close to the jet discharge orifice 14 or the receiver port.

According to one of its aspects, the invention resides in so arranging the travel path of the web that the latter tends to contact either surface 7 of the receiver port 5 or the surface 8 of the nozzle support 6, and in forming an air cushion between that surface and the web to provide a very small but effective and safe spacing of the web surface from the support surface. The web path may be so arranged very simply by means arranged to tend to fix the path of a reach of the web in a substantially fixed plane, and slightly offsetting with respect to such plane the surface adjacent which the web is to travel, so that a web in that reach is deflected from the plane by such surface. As shown by Fig. 4 wherein the web 10 is to travel over and adjacent surface 8, such an arrangement may comprise a pair of guide rolls 20 in fixed positions, the surface 8 of the nozzle support structure being so offset from the plane of the web-guiding surface of rolls 20, shown somewhat exaggerated in the drawing, as to cause web 10 to contact such surface.

First referring to the arrangement of Figs. 1 to 4, it will be noted that the axis of the jet discharge orifice 14 is displaced from the axis of the receiver port 15 in the direction in which lateral movement of the web 10 increases the interception of the jet. This offset arrangement forms the subject matter of the United States patent to Daniel T. Gundersen and Lawrence A. Weinecke, No. 2,539,131, dated January 23, 1951. Experiment tends to show that when this offset arrangement of discharge and receiver port axes is employed, the present invention may be practiced most successfully by training the web path closest to the surface 8 surrounding the jet discharge orifice.

For maintaining the marginal portion of web 10 from actually contacting surface 8 during travel of the web, an arrangement is provided for forming between the web and that surface an air cushion. Conveniently such arrangement takes the form shown, of one or more air discharge ports 21, the number and arrangement of such ports depending on the configuration and size of surface 8, for discharge between the web and surface 8 of cushion-forming air. Air may be supplied to the port or ports from a chamber 22 enclosed by structure 6, to which it is supplied under suitable pressure by a supply line 23.

It is regarded as desirable, for aid in threading a web in the detector, as well as to provide structure enclosing air supply chamber 22, to make surface 8 quite extensive, both in directions of longitudinal travel of the web path and transversely thereof in a direction extended inwardly of its edge. Advantageously surface 8 is curved, particularly in its marginal regions, smoothly receding from the plane of the web path, as indicated in Figs. 1 and 3. Surface 8 also preferably is smoothly polished to avoid web damage during threading and to reduce friction in case of accidental contact of surface 8 by a traveling web.

Arrangement of the discharge ports 21 may vary widely depending on characteristics of webs with which a particular detector assembly is to be used, or on the particular arrangement of the nozzle-supporting structure 6. Magnitude of air pressure suitable to discharge through the ports 21 in a given situation of web characteristics and arrangement of ports 21 may be ascertained readily. It is to be noted, with respect to pressure at which air is discharged from ports 21, that such pressure may be very low with relation to pressure at which the jet air is discharged from nozzle orifice 14, so that adequate air cushioning for purposes of the invention can be accomplished without disturbance of the measuring jet by air escaping transversely past the edge of the web in the region of the jet.

In the form of detector shown in Fig. 6, instead of the offset arrangement of jet discharge orifice and receiver port of Figs. 1 and 2, the discharge orifice 30 and receiver port 31 are disposed coaxial. Experiment tends to show that when this arrangement is adopted, best web edge position detection may be accomplished by training the web, designated 32 in Figs. 5 and 6, closely adjacent the receiver port opening. The invention may be practiced in this type of detector by arranging the web path as shown in Fig. 5, with the detector assembly so displaced relative to a web path defined by fixed guide rolls 33, that the surface 34 of a receiver structure 35, surrounding port 31, tends to contact and deflect the web from the path. The receiver structure, quite similar to the jet discharge structure 6 of Figs. 1 to 4, is formed with an enclosed air chamber 36,

from which cushion-forming air discharge ports 37 open through surface 34. As shown in Fig. 6, wherein the jet discharge structure 32 again is below and vertically spaced from the receiver support, the former is provided with a surface 39 of substantial area upon which a web may be supported in threading. Obviously the receiver structure may be the lower structure and its surface 34 arranged for this sort of support.

The above-described arrangements provide marked improvement of measurement accuracy of a pneumatic jet type web edge position detector, arising from stable positioning of the web closely adjacent the discharge orifice of the jet nozzle or the receiver port, but without danger of abrasive damage of the surface surrounding such orifice or port, and without danger of marring the web by its contact with such surface. The structural arrangements of the detector disclosed above afford simple, convenient and inexpensive devices for practice of the invention.

I claim:

1. In a pneumatic jet type web edge position detector that includes structure defining side surfaces of a slot for passage of a web and said surfaces respectively surrounding a jet-delivering opening and a receiver port in at least partial opposition; in combination, guide means positioned to direct a web toward contact with one of said surfaces, and means for supplying cushioning air under pressure between said one surface and a web traveling over and tending to contact it.

2. In a pneumatic jet type web edge position detector that includes structure defining side surfaces of a slot for passage of a web and said surfaces respectively surrounding a jet-delivering opening and a receiver port in at least partial opposition; the combination of claim 1, wherein said cushioning air-delivering means include an air-delivery opening in said one surface, and conduit structure communicating with said opening for delivering air under pressure thereto.

3. In a pneumatic jet type web edge position detector that includes a surface having an air stream opening, and web guide means arranged to position a web in contact with said surface; structure providing an extension of said surface from said opening in a direction extended inward of and from the edge of the path of such a web, said extension having a surface curving smoothly from the plane of the opening away from the plane of such web path, and said structure providing an enclosed air supply chamber and discharge ports opening from said chamber through said surface and in spaced relation to said opening.

4. A pneumatic jet type web edge position detector comprising a supporting structure including a pair of arms having opposed surfaces separated by a slot through which the marginal portion of a web is to travel, a first one of said arms being arranged to support a jet nozzle having an orifice for discharging an air jet and opening through the said surface of the first arm, the second said arm being arranged to support a receiver arrangement for developing pressure from such an air jet, one of said arms having cushioning air-supply means arranged to discharge air between the said surface thereof and the marginal portion of a web in said slot.

5. A pneumatic jet type web edge position detector according to claim 4, wherein said cushioning air supply means comprises an air supply chamber enclosed by the arm having it and an air discharge port opening from said chamber through said surface of that arm.

6. A pneumatic jet type web edge position detector jet arm structure comprising a body having a surface over which a web is to travel, said arm having a bore opening through said surface for supporting a tubular pneumatic element and a cushioning air discharge port opening through said surface and spaced from said bore in a direction extended inward of the edge of the path of such a web, and said arm also enclosing passage means for supplying air to said port.

7. A pneumatic jet type web edge position detector arm structure according to claim 6, wherein said arm is provided with plural cushioning air discharge ports opening through said surface and distributed in a region thereof lying spaced from said bore in a direction extended inward from the adjacent edge of the path of such a web.

8. A pneumatic jet type web edge position detector arm structure according to claim 6, wherein said surface extends from said bore both in the longitudinal directions of the path of such a web and transversely of such path in the direction extended inward from its edge, and said arm is provided with plural cushioning air discharge ports opening through and distributed over a region of said surface spaced from said bore and lying inward of the edge of the path of such a web.

9. A pneumatic jet type web edge position detector arm structure according to claim 6, wherein said surface extends from said bore both in directions extended longitudinally of the path of travel of such a web and transversely thereof and inward of the edge of such path, and the marginal portions of said extended surface curve smoothly away from the plane of opening of said bore through said surface.

10. In a pneumatic jet type web edge position detector that includes structure defining a surface extended alongside an intended travel path of the marginal portion of a guided web, and said structure having an air passage opening through said surface for delivery of a jet of air toward the edge region of said path; in combination, guide means positioned to direct a web toward contact with said surface, and means for supplying cushioning air between said surface and a web traveling over and guided toward contact with it, and the latter said means comprising an air-delivery opening in said surface, and conduit means communicating with the latter said opening for delivering air under pressure thereto.

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