June 4, 1957 F. J. MARKEY 2,794,444

WEB EDGE POSITION DETECTOR

Filed Aug. 22, 1955

FIG. 1

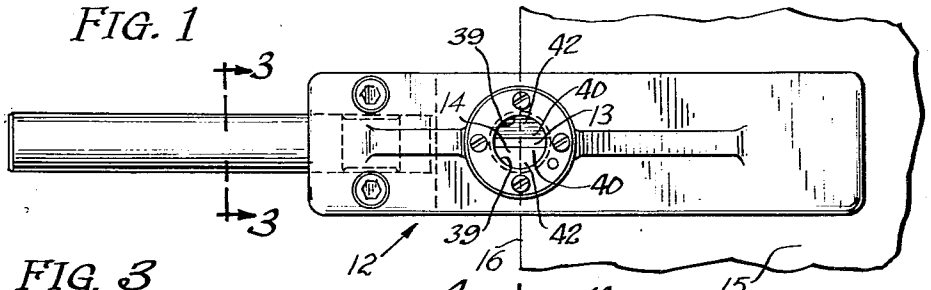
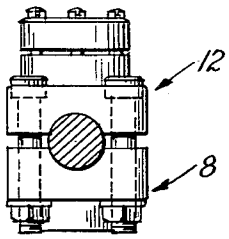


FIG. 3



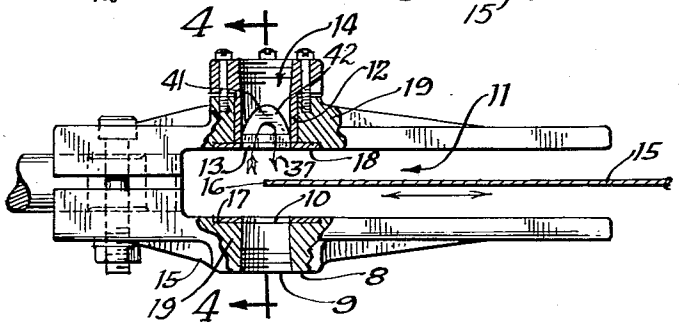


FIG. 2

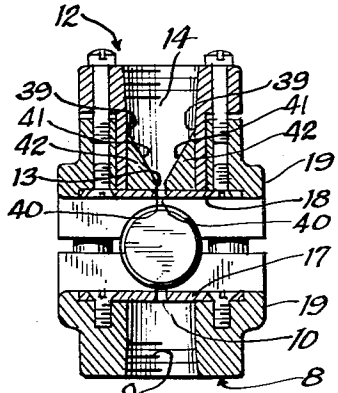


FIG. 4

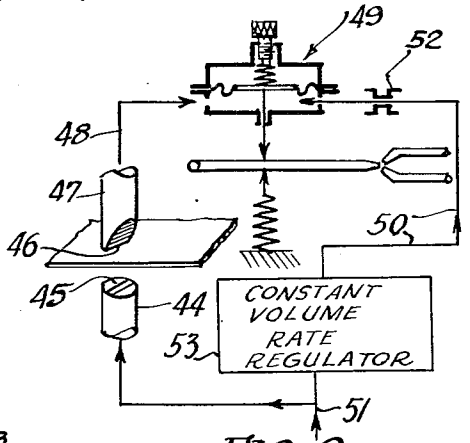
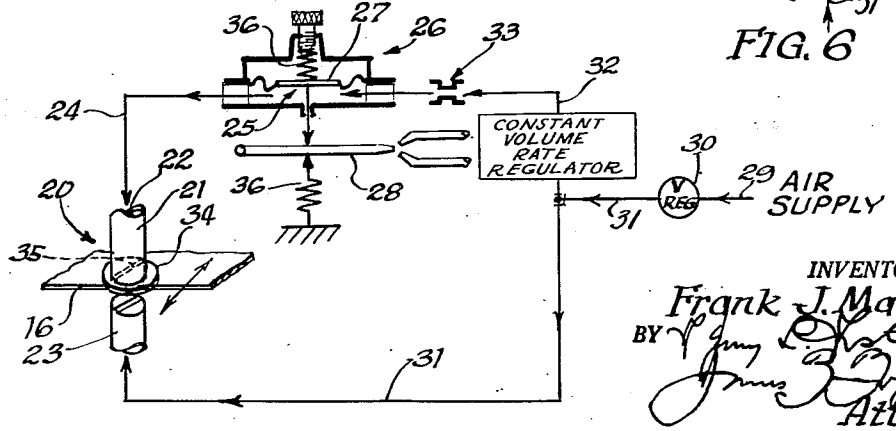


FIG. 6

FIG. 5



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WEB EDGE POSITION DETECTOR

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4 Claims. (Cl. 137—83)

The present invention relates to fluid pressure detection of the lateral positions of edges of bodies, typified by detectors that sense the position of the edge of longitudinally traveling webs, as textile, paper or other fabric webs or strips or sheets of metal, to develop a signal pressure that varies in magnitude with lateral change of position of the sensed edge, which signal may be used for automatic guiding to maintain the sheet, strip or web in a selected path, or as a control signal for automatically accomplishing some other function that desirably is related to the edge position. More specifically the invention relates to edge detectors of the type wherein fluid under pressure is discharged as a stream toward the region of location of the edge, as the intended path of the edge of the traveling web, and toward a receiver having an internal chamber and a port spaced from and opposed to the nozzle orifice from which the stream is discharged, to receive such portion of the stream as passes the edge; which is determined by the portion of the cross section of the stream that is intercepted by the marginal portion of the body adjacent to the edge, to develop in the receiver chamber a signal pressure the magnitude of which is determined by the percentage of the fluid stream content received, and therefore by the position of the edge.

A successful type of detector for such service has included nozzle and receiver structures respectively provided with an elongate, narrow discharge slot and an opposed similarly shaped receiver port slot, with the major dimensions of the slots disposed transverse to the edge of which the lateral position is to be sensed. Since the receiver is provided with a coupling connection adapted to engage the end of a signal pressure transmission pipe, such receivers heretofore have been provided with an internal cylindrical bore extended through the receiver body, with a plate attached to the receiver structure, extended across one end of the bore and provided with a receiver port that is much smaller in at least one cross dimension than the corresponding cross dimension of the bore, and with provision for coupling the signal pipe into the opposite end of the bore.

The signal pipe of such a detector is connected with a relay regulating signal pressure translating device in the form of an expansible chamber motor or force balance assembly, generally of the type wherein a flexible diaphragm closes one or separates two signal pressure chambers. Since such a system is subject to substantial changes in volume by reason of flexing movement of the diaphragm, and the receiver port acts to restrict fluid flow to and from the system as its volume changes, sometimes internal pressure conditions arise that result in impairment of relay control in proportional response to variation in the intercepted and passed percentages of the detector stream. In some cases even negative pressure, that is pressures less than atmosphere or other surrounding medium, may develop in the signal system, resulting in complete loss of relay control, and over-shoot and hunting may develop. Such misoperation is particularly troublesome in detection or guiding of flexible webs traveling at such speeds as to produce fluttering in the detector region, webs having irregular edges or widths, or in any situation tending to produce substantial and sudden or high frequency changes in the percentage of detector stream intercepted by the body subject to edge position detection.

The present invention insures maintenance of positive internal signal system pressure and variation of that pressure in proportional response to the degree of detector stream interception, while retaining the advantage of the high sensitivity and substantial operating range afforded by a restricted receiver port, particularly of slot form, by pressurizing the entire signal system. This is accomplished by continuous introduction into the system of pressurizing fluid, most conveniently the same fluid that is used to form the detecting stream, at a constant volume rate sufficiently high with respect to the discharge path area afforded by the receiver port, the proper range of signal pressure of the system, and the character of the body to be detected, to insure maintenance of the signal pressure within the proper magnitude range. Although the fluid so introduced is discharged through the receiver port as a counterflow against entry of the unintercepted portion of the detector stream, it has proven not to interfere with sensitivity of the system or proper proportional response of the signal pressure translating device.

Improvement of operating characteristic and stability is not the only valuable result of introduction of pressurizing fluid into the signal system.

In certain types of service, as in the detection of the positions of edges of webs of certain kinds of textiles and paper, lint and fine particles of material are present in loose condition in the region of the detector. The flowing stream of detection fluid, usually air, tends to carry such loose material to the receiver, in some instances tending to cover the port at the outer side of the receiver, but also tending to drive such material into the internal chamber of the receiver. Due to variation in the pressure developed in the chamber, and a pumping action resulting from movement of the movable wall of the expansible chamber signal-responsive motive assembly connected with it, such material tends to accumulate against the internal shoulders provided by the port plate.

Any such accumulation of material in the region of the port, and particularly if the material blocks any portion of the port, reduces sensitivity of the detector system. The introduction to the signal system of pressurizing fluid, and its discharge through the receiver chamber and its port continuously purges the chamber and port, as well as restricting entry of foreign material. In certain installations, as will be explained more fully, it has been found that such purging, of itself, is insufficient to prevent entry of lint, paper debris, etc. into the receiver chamber and its accumulation in blocking relation to the port, and, as a refinement, the invention embraces the combination with purging of the chamber of a specialized internal chamber configuration that eliminates shoulders that could mechanically trap such material or produce eddies in the flowing fluid carrying it and tending to cause its deposit in the regions of such eddies, so that the purging fluid in moving through the chamber and emerging from the port carries out any material that may have entered, as well as opposing its entrance and preventing its accumulation over the port at the exterior side of the receiver.

In the accompanying drawings:

Fig. 1 is a plan of the rear or output side of a typical receiver assembly of the type herein involved, with signal pipe removed and showing the opening of the bore into which the signal pipe is inserted, and provided with an

internal signal pressure chamber with configuration arranged for operating in accordance with the invention.

Fig. 2 is a partially broken, side elevation.

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

Fig. 4 is a section on line 4—4 of Fig. 2.

Figs. 5 and 6 are schematics respectively disclosing different system arrangements embodying different aspects of the invention.

Describing the drawings in detail, and first referring to Figs. 2 and 4, an edge position detector comprises a nozzle structure **8**, to which fluid, typically air, is supplied under pressure through a line that may be connected to the rear of the nozzle, at **9**, for discharge as a stream through an orifice **10**. Spaced from nozzle **8** across a throat **11** is a receiver structure **12** that is provided with a port **13** and an internal chamber **14** at the rear of which a signal pressure transmission pipe may be connected. Receiver port **13** is opposed, across throat **11**, from nozzle discharge orifice **10**, so that pressure developed in chamber **14** depends on the percentage of stream fluid impinging on port **13**, and in turn on the degree of interception of the stream by a body such as **15**, entered into throat **11**, and the position of the edge **16** of which is to be sensed with development of signal pressure of magnitude corresponding to that position.

It is assumed that the edge **16** is variably movable laterally, that is in the directions of the arrows. To provide a range wherein the position of edge **16** may be measured, and to provide linearly responsive variation of signal pressure developed in chamber **14**, discharge orifice **10** and receiver port **13** preferably are elongate slots with their major dimensions disposed transverse to edge **16**. Conveniently, and since the internal passage of nozzle structure **8** and receiver chamber **14** are cylindrical bores, for reasons of manufacturing as well as of ready coupling of fluid delivery and signal transmitting pipes, orifice **10** and port **13** are formed as apertures in cover plates **17**, **18** that are mounted to the supporting structures **19** of nozzle member **8** and receiver member **9**, and that otherwise extend across and block the bores.

In the system of Fig. 5, a detector **20** for sensing the position of an edge **16** includes a receiver **21**, having an internal chamber **22** for developing a pressure from a fluid stream discharged by a nozzle **23**. Connected with receiver chamber **22** by a pipe line **24** is the expansible chamber **25** of a motor device **26**, shown as comprising a movable diaphragm **27** that partially encloses chamber **25** and that is mechanically connected with the control element **28** of a relay regulator. Nozzle **23** is supplied with fluid, usually air, under pressure, from a source **29**, usually through a pressure regulating valve **30** by a pipe line **31**.

As has been indicated, a system of the type so far described, and with a simple, unbroken pipe connection coupling the receiver chamber with an expansible chamber translating device is a system that is completely closed except for the receiver port. In certain types of service such a system in subject to impairment of proper response or loss of control as described before.

For introduction of pressurizing fluid in accordance with the invention to avoid such malfunctioning, a branch line **32** is connected between the regulated pressure supply line **31** and a convenient point in the signal pressure system **22**, **24**, **25**. Since pressure in the signal system is to be determined by the position of edge **16**, and supply pressure in pipe **31** is regulated for constant magnitude, an isolating flow restriction **33** is provided in line **32**, as by structure forming an orifice of less area than that of the internal cross-section of the remainder of the line. Also, since the system must respond solely to changes in pressure developed by the air stream impinging on the receiver port, it is preferable to provide a device, conventionally indicated, which may be, for example, a constant volume flow rate regulating assembly such as that shown in United States Patent 2,132,338, for maintaining a constant volume rate of delivery of the pressurizing fluid.

In case there is fine, loose material in the region of throat **11** and the vicinity of the detecting stream, which the latter tends to carry toward and into receiver port designated **35** in Fig. 5, and chamber **22**, the pressurizing fluid discharge through the port resists its approach to and entry into the port and chamber and prevents its lodging against the outer port defining surfaces across the port. Advantageously, the pressurizing fluid is introduced into the signal system at such a location that it purges the entire system of foreign matter, and as shown, it preferably is introduced by connection of delivery line **32** to discharge into the expansible chamber, as **25**, of the signal translating device, as **26**, so that it flows through the signal pipe as well as through the receiver chamber and port.

In the system of Fig. 5, the detector receiver **21** is shown as comprising only the structure described above relative to Fig. 2, that is, structure having an internal cylindrical passage providing chamber **22**, and a plate **34** closing the receiving end of chamber **22** and having therein the elongate, slot-like port **35**, whereby internal shoulders alongside port **35** are presented by portions of the inner surface of plate **34**. While purging a receiver having this structural arrangement will in certain services eliminate obstruction of the receiver port, and apparently will reduce it in practically any service, there are certain situations where obstruction of the receiver port will occur if the receiver is of the type shown by Fig. 5. Such obstruction may result from at least several conditions. For example, in detection of the lateral position of a longitudinally traveling web, a pumping action may occur which will periodically reverse flow of air through the receiver port. Such action may be caused by fluttering of the web between the nozzle and receiver, or by sudden lateral shifts of the web or by irregularities in its edge that result in rapid changes in the degree of stream interception and the magnitude of pressure within the signal system. Since the movable wall of motor **26** is usually spring biased to a zero position, as by a return spring **36**, such pressure changes normally result in changes in the volume of space enclosed by the system, which accounts for the pumping action. Furthermore, there may be a circulation effect, with fluid entering through part of the port exposed to the stream by the edge **16** and emerging through the part of the port that is masked by the body that presents edge **16**, as indicated by the arrow **37** in Fig. 2. Thus it is quite possible that in certain services particles of loose material may enter the receiver port, accumulate against the internal surfaces of the end plate, and obstruct the receiver port.

A second aspect of the invention relates to combination with the system for pressurizing and purging the receiver of a receiver structure that is specialized to eliminate trapping in the receiver chamber of particles of loose material that may enter in spite of the purging action of the pressurizing fluid and that will eliminate eddies in the fluid currents, which tend to deposit such material in the regions of the eddies. Figs. 1 to 4 disclose a specific arrangement of such a receiver combined with a pressurizing and purging fluid supply.

In order to eliminate material-trapping and eddy-forming shoulders in the region of the inner opening of receiver port **13**, the internal receiver chamber is provided with a configuration adjacent the port, wherein the chamber-defining surfaces extend smoothly from chamber wall surface portions, as **39**, that are spaced laterally outward from corresponding port edges, as **40**, and that are spaced away from the port along the internal chamber from the port **13**, such surfaces being inclined inward to the corresponding internal edge margins defining the port which they meet at angles sufficiently obtuse to present no mechanical lodgement for fluid-carried material or to cause eddies in the flowing fluid. In the specific receiver

shown the elongate port 13 extends lengthwise between opposite surface portions of the cylindrical chamber 14, so that there are no shoulder-providing surfaces of plate 18 at the port ends. The long edges 40 of the port, however, lie inward from the corresponding portions of the cylindrical chamber surface. Consequently, in accordance with the invention, chamber 14 is provided with a throat portion 41 that tapers inward, without shoulders or projections, from the chamber surface portions 39 to the corresponding inner port margins 40, and meets the plate edges defining the sides of the port at the indicated obtuse angles.

For ready manufacture and assembly, an internal configuration of the portion of a receiver chamber adjacent the port, suitable to practice of the invention, may be provided by insert structure, fitting the chamber bore surface portions and presenting the obtuse angular relation between the meeting surfaces that prevent lodging within the chamber of any loose material that may be carried in through the port. A pair of inserts comprising such structure are designated 42 in Figs. 1, 2 and 4. Obviously, such structure can be secured in many ways within the receiver chamber.

Fig. 6 shows a system including a nozzle 44 having a slot-like discharge orifice 45 that is opposed to the similarly shaped port 46 of a receiver 47 provided with the desirable internal configuration of surfaces in the region of the port. As in Fig. 6 the internal chamber of Fig. 5 is connected by a signal pressure line 48 with the expansible chamber of a motor 49. Pressurizing and purging air is supplied to the signal pressure system 47, 48, 49 through a branch line 50 that is connected with the nozzle supply line 51, and that has structure 52 providing a flow-restricting orifice, and a constant volume flow rate device 53.

From the foregoing, the principles, concepts and mode of operation of the herein disclosed invention will be readily apparent, and it will be evident that many changes in and departures from the exemplary specific disclosures may be resorted to without departing from them, and within the invention as defined by the appended claims.

I claim:

1. A detector system for sensing the position of an edge of a body and developing a signal pressure of magnitude corresponding to that position, said system comprising a detector having means for delivering a stream of fluid under pressure toward the region of said edge, a receiver having a port disposed opposite to and spaced from said means for receiving fluid discharged thereby and passing said edge, and a signal pressure passage communicating with said port, and means for delivering fluid under pressure and at a constant volume rate to said passage and including structure providing a flow-restricting orifice in the path thereof.

2. A system for sensing the position of an edge of a body and developing a signal pressure of magnitude corresponding to that position, said system including a detector comprising a nozzle for discharging a stream of fluid toward the region of location of said edge and a receiver having a port opposed to and spaced from said nozzle for receiving fluid discharged thereby and passing said edge and a fluid pressure passage communicating with said nozzle, a supply line for delivering fluid under pressure to said nozzle, a branch line connecting said receiver port with said supply line, means for maintaining a constant volume rate of fluid flow through said branch line, and structure providing a flow-restriction between said means and chamber.

3. In a system for sensing the position of an edge of a body and developing a signal pressure of magnitude corresponding to that position, and said system including a detector comprising a nozzle for discharging a stream of fluid toward the region of location of said edge, and a supply line for delivering fluid under pressure to said nozzle; in combination, a receiver having a port disposed in opposition to and spaced from said nozzle and an internal chamber from which said port opens and having a cross-section larger than said port whereby lateral surface portions defining said chamber lie outwardly spaced from corresponding edge portions of said port, and said structure having surfaces that extend continuously from said surface portions at locations spaced axially from said port and inwardly to said corresponding port edge portions, a branch line connecting said supply line and said chamber and provided with means defining a flow-restricting orifice between them, and means for maintaining a constant volume rate of fluid delivery to said orifice.

4. In a system for sensing the position of an edge of a body and developing a signal pressure of magnitude corresponding to that position, and said system including a detector comprising a nozzle for discharging a stream of fluid toward the region of location of said edge, and a supply line for delivering fluid under pressure to said nozzle for discharge; in combination, a receiver having a wall spaced from and facing said nozzle and provided with a port opposed thereto for receiving fluid passing said body edge, and said receiver having an internal signal pressure chamber from which said port opens and having at a location spaced from said port a transverse cross-section larger than the said port and adapted for connection of a signal pressure pipe and defined by surfaces having portions that are disposed in outwardly spaced relation to corresponding edge portions of said port, and said receiver having inner wall surfaces extended smoothly and continuously between said surface portions and said corresponding port edge portions, and means for supplying fluid under pressure and at a constant volume rate to said chamber and including structure providing a flow-restricting orifice in the path thereof.

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