Sept. 2, 1969 S. M. SALOMON 3,464,887

SENSING DEVICE FOR SLICE DELIVERY TO FOURDRINIER WIRE

Filed Sept. 27, 1965

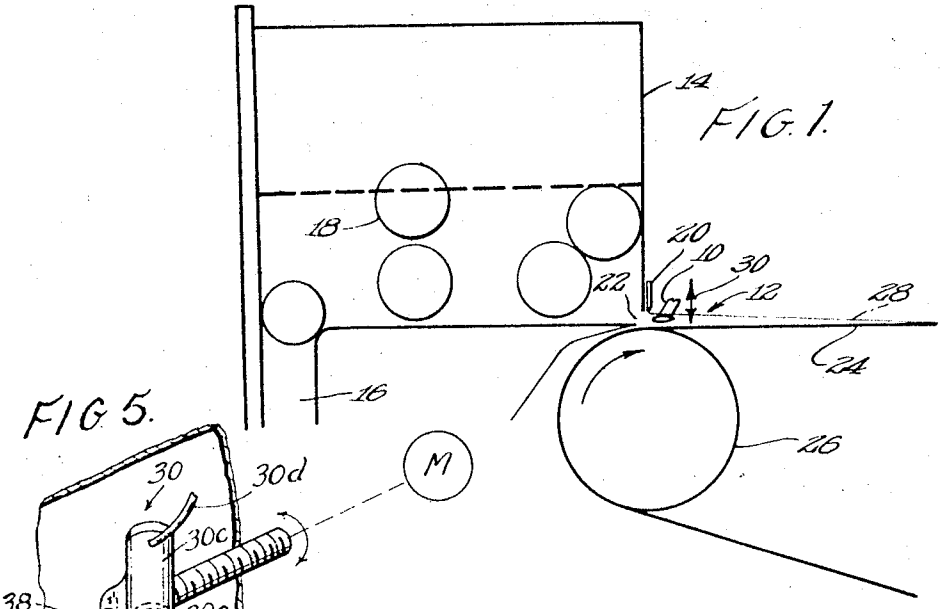


FIG. 1.

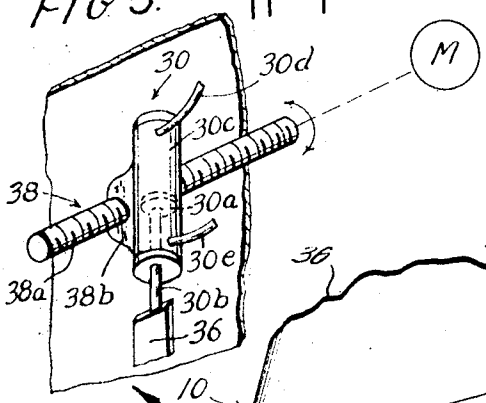


FIG. 5.

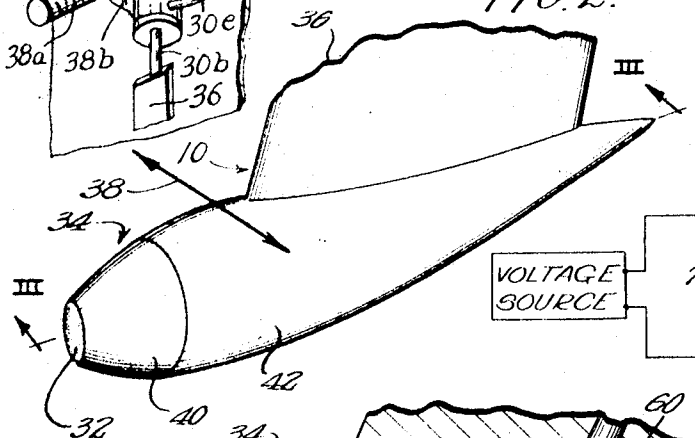


FIG. 2.

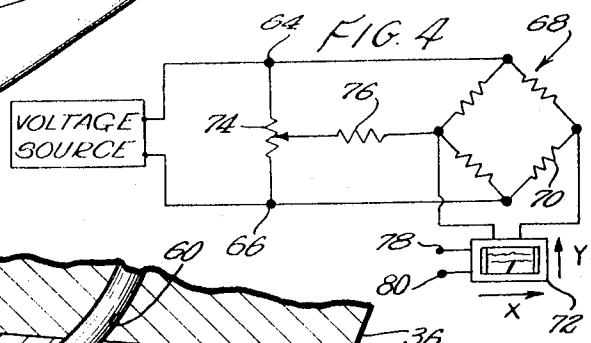


FIG. 4

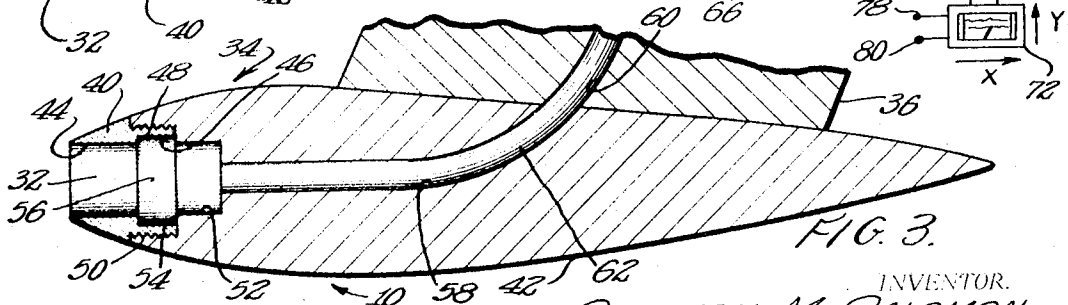


FIG. 3.

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SENSING DEVICE FOR SLICE DELIVERY TO FOURDRINIER WIRE

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U.S. Cl. 162—263 9 Claims

ABSTRACT OF THE DISCLOSURE

A transducer producing an electrical signal as a function of flow stream velocity for positioning in the slice flow stream of a headbox and being movable both vertically and horizontally relative to the slice stream.

This invention relates generally to a sensing device for a slice delivery from a headbox and more particularly to a system for sensing and measuring characteristics of a headbox slice delivery at various points along the delivery path. The present invention has particular application in the papermaking field wherein the slice delivery from a headbox must be maintained uniform at all points along the slice delivery path to provide uniform characteristics of the resultant paper web.

The primary function of a headbox is to deliver paper stock onto a Fourdrinier wire which is evenly distributed across the wire, well disbursed, and delivered at a steady velocity. These results are difficult to attain, and in practice the actual process of supplying the paper stock to the wire is complicated by problems introduced by the particular design of the headboxes. Even distribution of the stock across the wire, disbursement of the constituents of the stock, and the slice delivery velocity, if not maintained within prescribed limits, will produce defects in the resultant paper web.

For instance, friction between the walls of a headbox and the stock flowing therefrom will cause a decrease in the velocity of the stock delivery at the ends of the slice. A difference in velocity or flow pressure across the width of the slice delivery will result in defects in the resultant paper web. The edges may be reduced in thickness as compared to the center portions of the paper web which may cause other difficulties in subsequent operations, such as during the drying and rolling processes. Uniformity of paper thickness, however, is of utmost importance to the customer, since weak spots will often result in holes and tears.

Therefore, a need exists for a system for sensing and measuring the characteristics of a headbox slice delivery at various points along the delivery path and recording such characteristics for comparison of the conditions existent in the slice delivery across the width thereof. In such a system, however, in order to sense the characteristics of a slice delivery, a sensor is required which may interfere with the flow pattern and characteristcs of the slice delivery. Therefore, it is necessary that such a sensing device have an appropriate configuration such that it will not interfere substantially with the flow pattern from the headbox.

In order for a sensor to provide a minimum of interference with the flow pattern and characteristics of the slice delivery stream, the sensor must be relatively small sized and of relatively light weight so that it can be inserted and withdrawn from the slice delivery stream in a relatively short time. However, the sensor and support structure therefor must have sufficient strength in the direction of the forces exerted thereon so as to eliminate any possibility of vibration during its introduction into the slice delivery stream.

Therefore, it is an object of the present invention to provide a system for measuring a characteristic of a slice delivery stream from a headbox.

Still another object of the present invention resides in the provision of a sensing device which will have a minimum adverse affect on the flow pattern of a slice delivery stream from a headbox.

Still another object of the present invention is to provide a system for measuring characteristics of a slice delivery stream which is movable along the flow path of the stream to provide an indication of the characteristics at various stations of the flow path.

Yet another object of the present invention resides in the provision of a relatively light weight and relatively small sized sensor which can be inserted and withdrawn from the slice delivery stream from a headbox in a relatively short time.

Yet another object of the present invention resides in the provision of a relatively light weight and small sized sensor having a support structure for positioning the sensor in a slice delivery stream which will eliminate vibrations and other adverse affects upon the sensor from the forces of the stream thereon.

Still another object of the present invention resides in the provision of a slice delivery stream sensor which will provide a minimum adverse affect on the flow pattern of the stream by virtue of the aerodynamic configuration thereof while possessing sufficient strength to resist forces of the stream tending to produce vibrations and other adverse affects thereon.

These and other objects, features and advantages of the present invention will be more fully realized and understood from the following detailed description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a schematic showing of the sensing device of the present invention illustrated in the slice delivery stream from a headbox;

FIGURE 2 is a perspective view partially broken away of the sensing device of the present invention;

FIGURE 3 is a sectional view taken along lines III—III of FIGURE 2;

FIGURE 4 is a schematic diagram of the electrical circuit and indicating device in cooperation with the sensng device of the present invention; and

FIGURE 5 is a schematic perspective view of a mechanism for moving the sensor.

Like reference numerals throughout the various views of the drawing are intended to designate the same or similar structures.

With reference to the drawing, and in particular to FIGURE 1, there is shown schematically a sensing device **10** positioned in a slice delivery stream indicated generally by the reference numeral **12** from a headbox **14**. The headbox **14** generally includes a stock inlet conduit **16**, a plurality of rectifier rolls **18**, and an adjustable slice **20** positioned at an outlet **22**. A Fourdrinier wire **24** is supported beneath the outlet **22** on a roll **26** which rotates in the direction of the arrow indicated thereon. The Fourdrinier wire **24** receives the slice delivery stream **12** thereon which is formed into a paper web as indicated at **28**.

The sensing device **10** is disposed for being inserted and withdrawn from the slice delivery stream **12** as indicated by the arrow **30**. This vertical movement of the sensing device **10** with respect to the slice delivery stream **12** can be performed by any means well known in the art. As shown in FIGURE 5, the sensing device may be moved by a piston **30***a* having a piston rod **30***b*, and movable within a closed cylinder **30***c*. Compressed air is supplied to either end of the cylinder through flexible air lines **30***d* and **30***e* to lower or raise the strut **36**. The flexible

air lines permit the cylinder **30***c* to be moved along the headbox **14**. The sensing device **10** is better illustrated in FIGURES 2 and 3.

The sensor **10** as illustrated in FIGURES 2 and 3 includes a pressure transducer **32** mounted in one end of a housing generally designated with the reference numeral **34**. The housing **34** is supported in the slice delivery stream **12** by means of a strut **36**. The strut **36** is connected to suitable means for moving the sensor **10** vertically as indicated by the arrow **30** in FIGURE 1. Such suitable means may comprise, for instance, an air cylinder having its actuating arm secured to the strut **36** and having the cylinder thereof fixedly mounted with respect to the headbox **14**. It is to be understood, however, that any suitable structure may be employed for moving the sensor **10** vertically with respect to the slice delivery stream **12** as above stated. It is preferable that such structures, however, be relatively fast acting to permit immediate insertion and withdrawal of the sensor **10** into the slice delivery stream **12**. Therefore, the sensor **10** may be inserted into the slice delivery stream **12** and instantaneously withdrawn therefrom so as to provide a minimum amount of disturbance to the flow of stock onto the wire **24**.

In addition, the sensor **10** may be mounted for horizontal movement as indicated by the arrow **38**. For instance, the strut **36** may be mounted on a screw-threaded rod **38***a* driven by a positioning motor M such that the sensor **10** can be moved horizontally across the outlet **22** of the headbox **14**. The rod **38***a* will carry a traveling nut **38***b* which supports the cylinder **30***c*. Rotation of the rod in either direction will move the strut **36** in either direction along the headbox. Simultaneous horizontal and vertical movement of the strut can be accomplished by rotation of the rod **38***a* at the same time as movement of the piston **30***a*. In this manner, the pressure characteristics of the slice delivery stream **12** can be sensed at various stations along the length of the slice delivery outlet **22**. A comparison of pressure readings taken at various stations along the length of the outlet **22** will provide an indication of the undesirable disturbances created in the slice delivery stream **12** by the headbox **14** and its associated structures. In addition to the adverse affects on the slice delivery stream **12** from the headbox **14**, there will exist a variation in the basis weight of the paper stock exiting from the outlet **22**. This basis weight variation is caused by various factors and can be determined by a measurement of the pressure exerted on a transducer at the outlet **22**.

As shown in FIGURES 2 and 3, the housing **34** is formed of a head portion **40** and a tail portion **42** in threaded engagement with one another. The head portion **40** includes a central aperture **44** therethrough which is slightly enlarged as indicated at **46** to provide a shoulder **48**.

The tail portion **42** of the housing **34** is threadedly engaged to the head portion **40** as indicated by the reference numeral **50**. A cavity **52** is provided in the tail portion **42** and forms a shoulder **54** adjacent thereto. The transducer **32** includes an enlarged portion **56** which abuts on one side thereof with the shoulder **48** and on the other side thereof with the shoulder **54** when the head portion **40** is threaded into engagement with the tail portion **42**. The tail portion **42** also includes a conduit hole **58** extending therethrough and in alignment with a conduit hole **60** extending through the center of the strut **36**. The conduit holes **58**, **60** extend to the cavity **52** for receiving a cable **62** therein carrying appropriate wires which are connected to the transducer **32** and to appropriate recording elements.

As shown in FIGURE 3, one end of the transducer **32** is flush with one end of the aperture **44** so as to place the transducer in position for direct contact with the slice delivery stream **12**.

As more clearly illustrated in FIGURE 2, the head portion **40** and the tail portion **42** each have a circular lateral cross-section and a teardrop longitudinal cross-section for providing an aerodynamic configuration to the slice delivery stream **12**. The end of the transducer **32**, which is provided in the cavity **52**, the aperture **44**, and flush with the end of the aperture **44**, complements the teardrop configuration of the housing **34**. The strut **36** has a teardrop lateral cross-section and, as illustrated in FIGURE 3, the longitudinal axis of the strut **36** is displaced from the longitudinal axis of the housing by an acute angle to provide a more streamlined shaped to the slice delivery stream **12**. The rounded ends of the housing **34** and the strut **36** face into the delivery stream **12** to provide a minimum adverse affect thereon.

The transducer **32** of the present invention is of relatively small size and weight having an exposed surface at the one end of the housing **34** which has a diameter of .25 inch. The transducer **32** is of the flush diaphragm pressure type and occupies a volume less than 0.05 cubic inch and weighs approximately one-tenth of an ounce. This small size and relatively light transducer allows immediate insertion and withdrawal of the unit into and out of the slice delivery stream **12**. As can be readily appreciated from FIGURES 2 and 3, the housing **34** and strut **36** are relatively inflexible to forces exerted on the rounded end of the portion **40**. Therefore, when the slice delivery stream **12** is directed against the exposed face of the transducer **32**, substantially no vibrations will occur with respect to the housing **34** supporting the transducer **32**. Therefore, pressure measurements derived from the transducer **32** will not be affected by fluctuations and vibrations of the supporting structure.

It can be readily appreciated that the transducer **32** can provide an indication not only of pressure in the slice delivery stream **12**, but will provide an indication of the speed of the stream **12** and the basis weight of the stock therein.

Contained within the conductor **62** are conductors for applying a source of voltage to the transducer **32** and for providing a signal from the transducer **32** to a recording instrument. A circuit for providing such an indication is illustrated schematically in FIGURE 4 wherein a voltage is applied to a pair of terminals **64** and **66**. A balanced bridge circuit generally indicated with the reference numeral **68** is connected at input terminals thereof to the terminals **64**, **66** and contains in one leg thereof a resistive unbonded strain gage such as indicated by the reference numeral **70** and forming a part of the transducer **32**. A recorder **72** is connected across output terminals of the bridge circuit **68** and provides an indication of any unbalance of the resistance in the circuit. Therefore, since the value of resistance of the resistor **70** changes in proportion to the pressure exerted on the exposed face of the transducer **32**, an indication of such change will be recorded on the recording device **72**. A resistor **74** is provided for balancing the entire circuit and a limiting resistor **76** is connected from substantially mid-point on an adjustable arm of the resistor **74** to one of the output terminals of the bridge **68**.

The recording device **72** can provide an indication of either pressure, velocity, or basis weight of the stock in comparison to either horizontal movement or distance of the transducer **10** from one end of the headbox **14** or in comparison to a time basis. Therefore, the recording device **72** may be of the strip recording type as illustrated and either pressure, velocity, or basis weight may be recorded thereon in the Y direction while horizontal movement or distance of the sensor **10** from one end of the headbox **14** or time may be recorded along an X direction thereof. Terminals **78** and **80** are provided for driving the recording device **72** in accordance with horizontal movement or displacement of the sensor **10** or in accordance with lapse of time. In this manner, a comparison of readings at the various stations across the outlet **22** can

be derived from the recording device **72**. If desired, the recording device **72** can be replaced by a tape recorder or other similar recording device for providing a permanent record of the readings obtained from the sensor **10**.

I claim as my invention:

1. A device for measuring paper stock flow from a headbox onto a traveling paper web forming surface comprising,

a transducer having a pressure sensitive area and producing an electrical output signal as a function of flow velocity,

a relatively small housing supporting said transducer being of a size to generate substantially no disturbance in the flow characteristic of a stock stream emerging from a headbox slice,

a support for said housing for mounting the housing on a headbox in the stock stream between the slice opening and web forming surface,

and a movable positioning means between the support and the housing for moving said housing to predetermined locations in said stock stream.

2. A device for measuring paper stock flow from a headbox onto a traveling paper web forming surface in accordance with claim **1** wherein said housing comprises means forming a cavity in one end thereof with said transducer mounted in the cavity facing the oncoming stock stream.

3. A device for measuring paper stock flow from a headbox onto a traveling paper web forming surface in accordance with claim **2** wherein said transducer is mounted flush with said one end of said housing.

4. A device for measuring paper stock flow from a headbox onto a traveling paper web forming surface in accordance with claim **1** wherein said housing is aerodynamically shaped and oriented in the direction of the stock stream flow to offer minimum flow resistance.

5. A device for measuring paper stock flow from a headbox onto a traveling paper web forming surface in accordance with claim **1** wherein said support comprises a strut having an aerodynamic configuration.

6. A device for measuring paper stock flow from a headbox onto a traveling paper web forming surface in accordance with claim **1** wherein said positioning means further includes means for moving said housing simultaneously vertically and horizontally.

7. A device for measuring paper stock flow from a headbox onto a travelling paper web forming surface in accordance with claim **5** wherein said housing comprises a longitudinal axis and is constructed and arranged so as to have a circular lateral cross-section and a teardrop longitudinal cross-section and wherein said strut is constructed and arranged so as to have a teardrop lateral cross-section as well as a longitudinal axis displaced at an acute angle to the longitudinal axis of said housing so that a minimum amount of disturbance is created in said stream.

8. A device for measuring paper stock flow from a headbox onto a travelling paper web forming surface in accordance with claim **1** wherein said positioning means further comprises means for moving said housing vertically into and out of the stock stream.

9. A device for measuring paper stock flow from a headbox onto a travelling paper web forming surface in accordance with claim **1** wherein said positioning means further comprises means for moving said housing horizontally along a line parallel to the stock stream.

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S. LEON BASHORE, Primary Examiner

U.S. Cl. X.R.

73—53, 194; 162—198; 235—151.31, 151.34; 324—71