Jan. 19, 1932. P. KOLLSMAN 1,841,607

TURN INDICATOR

Filed July 3, 1929

Fig. 1

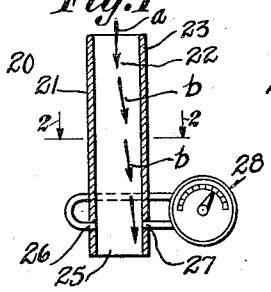


Fig. 3

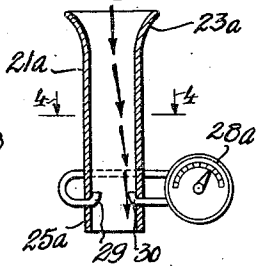


Fig. 5

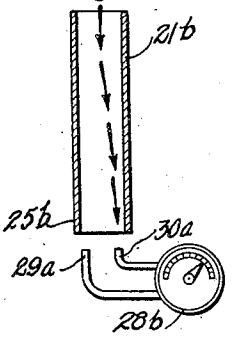


Fig. 6

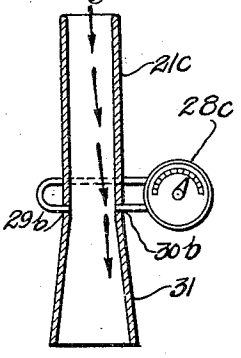


Fig. 2

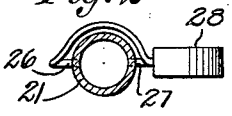


Fig. 4

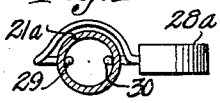


Fig. 10

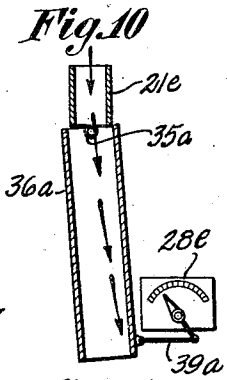


Fig. 12

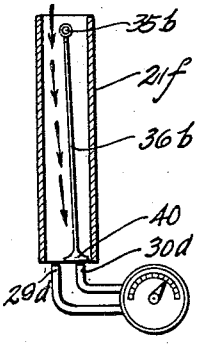


Fig. 7

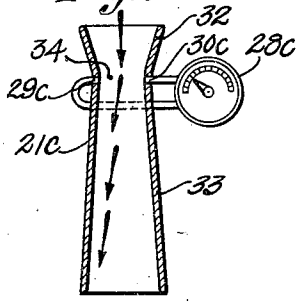


Fig. 8

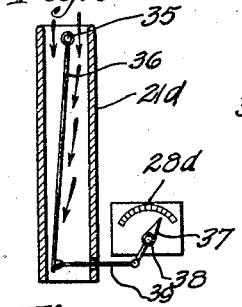


Fig. 9

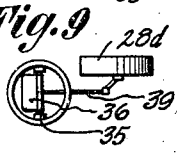


Fig. 11

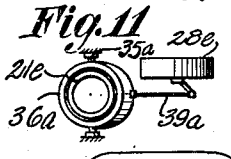


Fig. 13

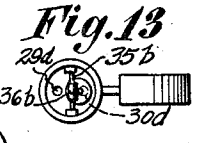


Fig. 14

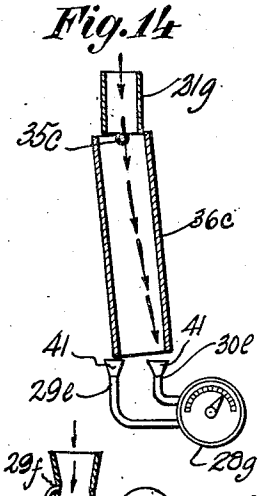


Fig. 15

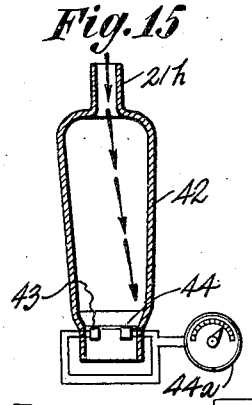


Fig. 16

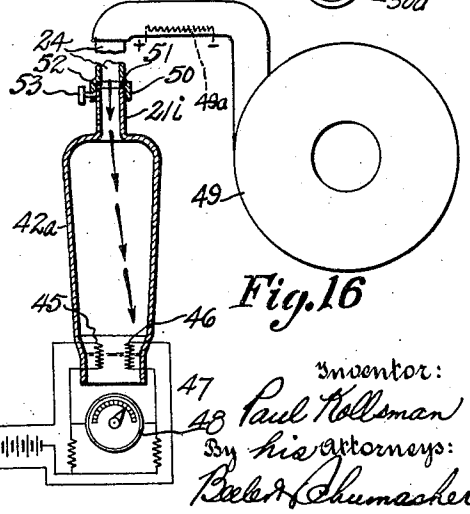
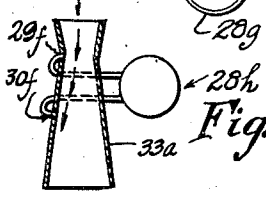


Fig. 17



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By his attorneys:
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UNITED STATES PATENT OFFICE

PAUL KOLLSMAN, OF WOODHAVEN, NEW YORK

TURN INDICATOR

Application filed July 3, 1929. Serial No. 375,612.

This invention relates to turn indicators, and has among its objects the provision of an improved device of the nature set forth in which the momentum of a fluid moving along a predetermined path is utilized for showing a directional change.

Another object of the invention is to provide a device of the character described having means to guide a fluid stream for movement in any given relation to the movement of the device, while permitting the stream to move in a different relation when the device makes a turn, and indicating means responsive to a change in the movement of the stream.

A further object of the invention is to furnish a simplified turn indicator.

A further object of the invention is the provision of improved means that are sensitive to their relation with the fluid stream.

Other objects and advantages of the invention will become apparent as the specification proceeds.

With the aforesaid objects in view, the invention consists in the novel combinations and arrangements of parts hereinafter described in their preferred embodiments, pointed out in the subjoined claims, and illustrated on the annexed drawings, wherein like parts are designated by the same reference characters throughout the several views.

The term "indicator" as used herein is intended to include anv device that responds to any change in the fluid stream, and which may even control or operate any other device, as may be desired, when a turn occurs.

In the drawings:

Figure 1 is a sectional view of a device embodying the invention.

Fig. 2 is a sectional view thereof taken on line 2—2 of Fig. 1.

Fig. 3 is a modification of the invention showing a Pitot tube arrangement.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is a form of the invention with a modified Pitot tube arrangement.

Fig. 6 is a modification of the invention having a Venturi tube.

Fig. 7 is another modification of the invention having entrance and outlet cones.

Fig. 8 is a view preferably in vertical section of the invention with a movable member along the fluid stream to operate an indicator.

Fig. 9 is a top plan view of the same.

Fig. 10 is a modification of the invention in which the movable member encloses a portion of the stream.

Fig. 11 is a top plan view thereof.

Fig. 12 is a further modification in which a deflector or valve element responsive to the fluid stream coacts with spaced indicator points.

Fig. 13 is a top plan view thereof.

Fig. 14 is a further modification in which the deflector encloses the fluid stream.

Fig. 15 is a sectional view of a further modification of the invention in which the indicating means is responsive to temperature or some other condition which is affected by the fluid stream.

Fig. 16 is a still further modification in which the source of a fluid stream is shown, and a secondary change, in the flow of current, produced by temperature variation due to the stream.

Fig. 17 is a view in section of a modification of the invention with the region of response confined to one side of the plane of the device.

The advantages of the invention as here outlined are best realized when all of its features and instrumentalities are combined in one and the same structure, but, useful devices may be produced embodying less than the whole.

It will be obvious to those skilled in the art to which this invention appertains, that the same may be incorporated in several different constructions. The accompanying drawings, therefore, is submitted as showing merely the preferred exemplification of the invention.

Generally described, the invention provides a turn indicator in which the momentum of a fluid stream is used to show a change in direction. The fluid used may be a gas or a liquid, and among the former air may be mentioned. By using a fluid in

motion, the kinetic energy thereof is available to produce a greater reading on an indicator. The device gives a predetermined direction to the fluid stream, and is intended to render the flow comparatively smooth and uniform. When a turn occurs, the fluid stream moves in a second path or direction relative to the device and affects any suitable means that is responsive thereto, or to the change mentioned. It is not desired to limit the invention as to the indicating means, and only a few of the many possible arrangements are shown herein, the same being illustrative merely. The indicating means may be influenced by the fluid stream in a direct mechanical manner, with or without the coaction of an auxiliary stream guide or deflector, or by affecting a condition of the indicator to render the same directly responsive, or to produce a secondary change which causes the indicator to show a turn. The speed of the turn is shown by the amount of the deflection on reading. If the fluid used is to be conserved, it may be recirculated in an obvious manner, and the flow may be caused either by suction or pressure, depending on which produces the smoothest flow.

The direction of the fluid stream directing means may be defined as being at any angle, but preferably 90°, to the axis of the turn that is to be indicated. Consequently the device may be variously mounted on the air craft, and function regardless whether the turn is horizontal or vertical.

Where the actuation of the indicator by the fluid stream is mechanical, pressure connections or Pitot tubes can be used, or a movable member of sufficiently large area to be highly sensitive to the stream. Where a change in any given condition of the indicator or associated element is relied upon to show the turn, such change may be electrical, thermal, or even chemical, and for the electrical changes may be mentioned those produced by a variation in temperature of a resistance (indirect) or a thermocouple (direct).

Referring in detail to the drawing, 20 denotes a device embodying the invention. The same includes a straight channel or tube 21 that is smooth interiorly, and is of a suitable length to give direction to the fluid stream 22. Preferably a suitable inlet connection from an end 23 of the tube is shown at 24 in Fig. 16 and includes a straight run of pipe to permit the flow to become as uniform as possible. The velocity of the fluid stream through the tube 21 may be regulated according to the sensitivity of the indicating means, and it may also depend in part upon the density of the fluid used. The velocity of the fluid stream will in turn be a factor in determining the length of the tube 21, as the tube ought to increase somewhat in length with an increase in velocity. The fluid may be discharged from the tube at the end 25 thereof, and if it is to be recirculated, a suitable connection may be made at this end.

In spaced relation to the end 23 of the tube, and preferably in proximity to the end 25 thereof, are pressure connections 26, 27, made with any suitable indicator 28. The latter may be a sensitive pressure gage calibrated to indicate a turn. The latter is not shown specifically, as the invention can be used with many different types of indicators. The connections 26, 27 are in any desired relation, preferably disposed on opposite sides of a vertical plane that extends fore and aft of the aircraft or other vehicle on which the device is used. The parts at the said connections may lie in the surface of the tube to receive pressure primarily.

The operation of the device may be best understood by tracing through the tube a portion of a fluid stream. Entrance into the tube 21 may be in an axial direction as shown by arrow *a*. Due to the turn of the aircraft, or the like, on which the device is mounted, and assuming that such turn occurs in a clockwise direction, the flow then occurs toward the wall on the right side of the tube as shown by arrows *b*. Consequently the pressure on port 27 will be greater than at 26, and the indicator will show accordingly. The velocity head will also make itself effective to some extent due to the angle of the fluid stream with respect to the port 27. If the indicator used is of a type that is responsive to differential pressure, the reading may be increased by the suction zone at 26, which will result from the change in path of the stream. If the turn is counter clockwise, the same operation will occur, but in opposite direction.

Within the scope of the invention the connections 26, 27 may also be made at 90° or any other angle with respect to each other, and need not be 180° apart, and in fact the connections can be spaced apart on the same side of the plane referred to, since the differential pressure between the points due to a change in path of the fluid stream, will operate the indicator. This applies also to other forms of the invention.

In Figs. 3 and 4 is shown a modification of the invention including a tube or direction channel 21*a* having an enlarged entrance 23*a* which may be in the nature of an orifice that is properly proportioned to efficiently conduct the fluid from a supply pipe of large diameter into the device. In a large pipe, the velocity is low, thus causing a very uniform flow to obtain. This feature of the invention is, of course, applicable in any of the forms of the invention shown. Coacting with the member 21*a* are a plurality of Pitot tubes 29, 30 extending through the wall of the tube and spaced along a diameter in proximity to the outlet end 25*a* of the device. An indicator 28*a* is connected to the Pitot tubes in any suitable manner. When the flow is at an angle to

the axis of the device, the fluid stream acts primarily on one of the Pitot tubes, and the indicator needle responds in direction to the superior force.

In Fig. 5 is shown a modification of the invention wherein a tubular stream guide 21*b* has co-operating therewith a plurality of spaced Pitot tubes 29*a*, and 30*a*, that connect with an indicator 28*b*. The Pitot tubes are at the outlet end 25*b* of the stream guide, and preferably slightly spaced outward therefrom, and slightly within the extended wall of the device.

In Fig. 6 is a modification of the invention in which the device includes a direction tube 21*c* that terminates in an outlet cone 31. In proximity to the point at which the tube and the cone join, are a plurality of connections 29*b* and 30*b* which co-operate with an indicator 28*c*. The said connections may be made also in the form of Pitot tubes if desired. The outlet cone assures a smooth and even stream line flow past the connections.

In Fig. 7 is shown a form of the invention in which a Venturi tube 21*d* acts as the direction guide for the fluid stream, this tube including the conventional inlet and outlet cones 32, 33. At the throat 34 are connections 29*c* and 30*c* disposed on opposite sides of a vertical plane that runs fore and aft of the airplane or the like on which the device is used. An indicator 28*c* of any suitable type communicates with the connections. According to this modification, a high velocity is readily obtained together with a stream line flow. The arrows for the fluid stream show that a right turn is being made.

In Figs. 8 and 9 is shown another modification of the invention including a guide passage 21*d* through which the fluid is adapted to flow, and which, like the other forms of the invention is stationary in relation to the aircraft on which the device is mounted. Pivotally mounted at 35 in the guide passage is a movable member or vane 36 of extended area, disposed in or parallel to the vertical longitudinal plane of the aircraft. When a turn is made, and the fluid assumes a path at an angle to the said plane, it acts over the entire area of the vane 36. Thus a considerable force is available for actuating an indicator 28*d*. In the latter, the pointer 37 is pivotally supported at 38 and connected with the free end of the movable vane 36 by a link 39. The vane may be flat as shown, or of any other desired shape to conform to the fluid stream, and to obtain the greatest sensitivity of the device.

In Figs. 10 and 11 is shown another modification of the invention in which a direction tube 21*c* is used, and the fluid stream therefrom actuates a movable member 36*a* that is spaced longitudinally with respect to the said tube. This arrangement is thus distinguished from the preceding modification in which the movable member and the direction tube are alongside of each other. Here the tube 21*c* corresponds to a nozzle, and the movable element consists of a channel, as for example, the cylinder shown, which is pivotally mounted at 35*a*. The element 36*a* is normally in alinement with the tube or nozzle 21*c*, and is of somewhat larger diameter to receive the fluid stream in any angular position of the former. The pivotal axis at 35*a* lies, of course, in the vertical longitudinal plane of the aircraft. The indicator 28*e* is connected with the element 36*a* by any suitable means such as the link 39*a*. When a turn occurs, the fluid stream acts angularly on an area that is equal to that at the diameter of the movable element, and the resulting force readily operates the device.

The preferred embodiment of the invention is that shown in Figs. 10 and 11. In this embodiment the tube 21*e* acts as a direction determining and flow equalizing means, reducing to a minimum variations of direction, feed and flow of the air. Since the flow passage 36*a* is itself responsive to a change in direction of the air stream, a relatively large deflection may be obtained, as the flow passage may move through any desired angle, and yet the cross sectional area of said flow passage may be made as small as may be desired.

In Figs. 12 and 13 is shown a further modification of the invention in which a relatively stationary guide tube 21*f* has an axis 35*b* in proximity to the upper end thereof, on which is pivotally mounted a vane 36*b*. On the lower end thereof is a deflector or valve 40 which in the usual position, lies between the Pitot tubes 29*d* and 30*d*. When a turn occurs, the said deflector is moved by the vane 36*b* to cover one of the said tubes, so that the other alone will be acted on by the fluid stream. The deflector 40 is intended to be so shaped as to conform as far as possible to the stream line flow, whereby the accuracy of the reading will be assured.

In Fig. 14 is shown a still further modification of the invention including a nozzle 21*g*, or the like, at the outlet whereof is pivotally mounted at 35*c* a tube 36*c*. At the outlet of the latter are a plurality of Pitot tubes 29*c* and 30*c* which are spaced on opposite sides of a vertical plane passing through the pivot 35*c*, and with reference to which plane the turning occurs. The said Pitot tubes have relatively large entrances 41, and connect with a suitable indicator 28*g*. When a turn occurs, the fluid stream deflects the tube 36*c* and is discharged against but one of the Pitot tubes, the indicator registering accordingly.

In Fig. 15 is shown a further modification of the invention in which a direction tube or nozzle 21*h* discharges a fluid into a chamber 42. This may be variously shaped depending on the flow conditions, and can also be in

the nature of a cone as shown at 33 in Fig. 7. Spaced from the inlet of the cone are a plurality of thermocouples 43, 44 which are on opposite sides of the reference plane of turning. The fluid stream is at a temperature other than that at the thermocouples. The latter operate a galvanometer 44*a* and when the fluid stream due to a turn acts on one of the thermocouples, the latter no longer balance, and the indicator registers a turn. Any suitable means may be used for causing the temperature variations specified.

In Fig. 16 is shown a further modification of the invention in which a flow directing element 21*i* discharges a fluid into a chamber 42*a*, at an outlet whereof are a plurality of spaced electrical resistances 45, 46. These are connected into a circuit 47 in which the currents are counteracting. Connected into the circuit is any suitable galvanometer 48. The element 21*i* supplies a fluid at a temperature other than that at the resistances to change the degree of resistance by producing a variation in temperature. Thus the resistance against which the fluid stream is directed may have the temperature thereof either increased or decreased as the case may be. The fluid stream is taken from any suitable source as, for example, a centrifugal blower 49 which discharges the fluid through a heater 49*a* and thence through a straight run of pipe 24 of suitable length to equalize the flow. The said pipe may have an annular flange 50 within which is formed a seat 51 receiving packing 52 that may be compressed by the element 21*i* which is locked in place by a set screw 53. Any of the devices above shown may be thus connected, but any other connecting means may be used, as that shown herein is merely for illustration.

The effect if any, of a change in elevation of the device on the density of the fluid medium can be counteracted by a suitable control, or by calibration of the indicator dial.

It will thus be seen that I have provided a device which fulfills the several objects of the invention and which is well adapted to meet the conditions of practical use.

In Fig. 17 is shown a further modification of the invention including a flow passage in the form of a Venturi tube 33*a* with which coacts any suitable indicator 28*h*. In this device it is clearly illustrated that the connections 29*f* and 30*f* may be on one side of the central plane of the device. With the path of the fluid deflected as shown by the arrows, a differential pressure exists between the points 29*f* and 30*f* which may actuate indicating means of various types. This differential pressure exists since at the point 29*f* there exists a reduced pressure while at 30*f* the pressure is greater, according to the well known theory of venturi. If the turn is in the opposite direction, the differential pressure will be different, or it may be less, and even create a region of reduced pressure at 30*f*, whereupon the indicator may by proper calibration show a turn, or operate a mechanism that is to be affected on occurrence of the turn.

It is more advantageous to construct the connections 29*f* and 30*f* on opposite sides of the axis, or as shown in Fig. 7. The reason is that a much stronger pressure or suction, (as the case may be, depending on different factors or the direction of the turn) is obtained; and the invention must be responsive to a change in direction of a given relatively small mass of air.

I claim:

1. A turn indicator comprising an element for giving direction to a fluid stream, and indicating means turning with the element and being responsive to a change in the path of the fluid stream with respect to said means.

2. A turn indicator for aircraft comprising means for causing a fluid to flow along a predetermined path, an indicator, and other means affected by a relative change in the path of the fluid to cause the indicator to show a turn.

3. A turn indicator for aircraft comprising a single fluid stream directing means, other means disposed in predetermined relation with respect to said directing means so as to be affected by the said fluid stream when the aircraft makes a turn, the second mentioned means including an indicating device to show the occurrence of the turn.

4. A turn indicator for aircraft comprising a member to guide a fluid to flow along a given path, means arranged with respect to any axis about which a turn is to be made to be responsive to a change in the fluid stream with relation to said axis, caused by a turn of the aircraft, and an indicator operated by said means on response of the latter as aforesaid.

5. A turn indicator for aircraft, or the like, comprising a channel to cause a fluid to flow in a predetermined path, means disposed substantially symmetrically with respect to said path on opposite sides thereof and acted upon by said fluid, and other means coacting with the second mentioned means to indicate a turn.

6. A turn indicator for aircraft, or the like, comprising means to cause a flow of fluid, other means to cause the fluid to flow in a given path, said fluid changing its path due to its momentum with respect to the second mentioned means, on the occurrence of a turn of the aircraft, and means responsive to the momentum of the fluid to be affected by a change in the path thereof.

7. A turn indicator for aircraft, or the like, comprising means to cause a flow of fluid, other means stationary with respect to the aircraft to cause the fluid to flow in a predetermined path, the fluid automatically

changing its direction slightly relative to the second mentioned means when the aircraft turns, and vane means acted on by the fluid according to the change in direction thereof.

8. A turn indicator for aircraft, comprising a source of a fluid stream, means to cause the same to flow in a predetermined path with respect thereto, an indicator, and spaced tubular connections from the indicator to the fluid stream on opposite sides of the path thereof to respond to a change of the latter relative to said first mentioned means on occurrence of a turn.

9. A turn indicator for aircraft, comprising a source of a fluid stream, means to cause the same to flow in a predetermined straight path, and means extending along the said path and acted on by the fluid stream when the latter changes its path relative to the first mentioned means due to the momentum of the fluid on occurrence of a turn of the aircraft, and an indicator actuated by the second mentioned means.

10. A turn indicator for aircraft, comprising means to cause a fluid stream to flow in a predetermined path, an indicator, thermosensitive means disposed in proximity to said path, said fluid varying the temperature of the thermosensitive means on a change in direction of the path of the fluid relative to the thermosensitive means due to the momentum of the former, when a turn is made.

11. A turn indicator for aircraft, comprising means to cause a fluid stream to flow uniformly and in a predetermined path, elongated tubular means of relatively considerable area extending along the said path and receiving the fluid stream to be acted on over substantially its entire area by the fluid stream due to the momentum of the latter when the same changes its path relative to the first mentioned means on occurrence of a turn of the aircraft and an indicator actuated by the second mentioned means.

12. A turn indicator for aircraft, comprising a source of a fluid stream, means to cause the same to flow in a predetermined relative path, an indicating means, and spaced elements in promixity to said path and coacting with the indicating means, each of said elements being substantially sensitive to the energy of the fluid stream if the path of the latter changes with respect to said means due to the momentum of the fluid stream, to indicate the direction of turning.

13. A turn indicator comprising a source of a fluid stream, means to render the flow of the stream substantially uniform, and to cause the stream to flow in a predetermined straight path relative to said means, said fluid stream changing with respect to said means during a turn, and other means responsive to the energy of the fluid stream to indicate the change in path.

14. A turn indicator comprising a source of a fluid stream, means to render the flow of the stream substantially uniform, and to cause the stream to flow in a predetermined path relative to said means, said means including a conical tube, receiving said fluid stream, said fluid stream changing its path with respect to said means during a turn, and other means coacting with said conical tube and responsive to the energy of the fluid stream to indicate the change in path.

In testimony whereof I affix my signature.

PAUL KOLLSMAN.