

Feb. 2, 1960

G. C. MABRY, JR., ET AL

2,923,152

5-PRONG AERODYNAMIC PICKUP

Filed Sept. 12, 1955

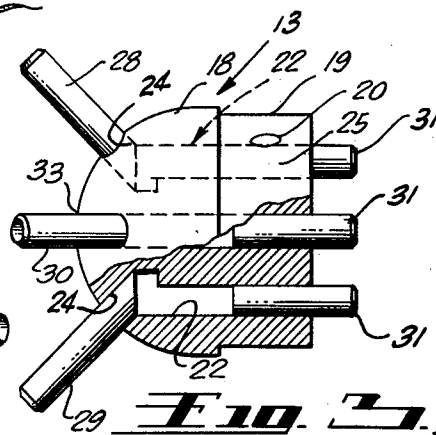
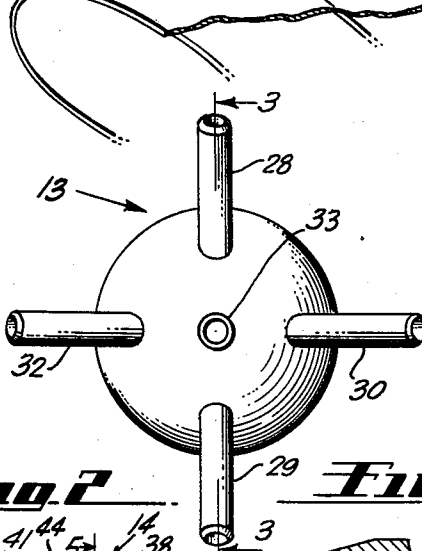
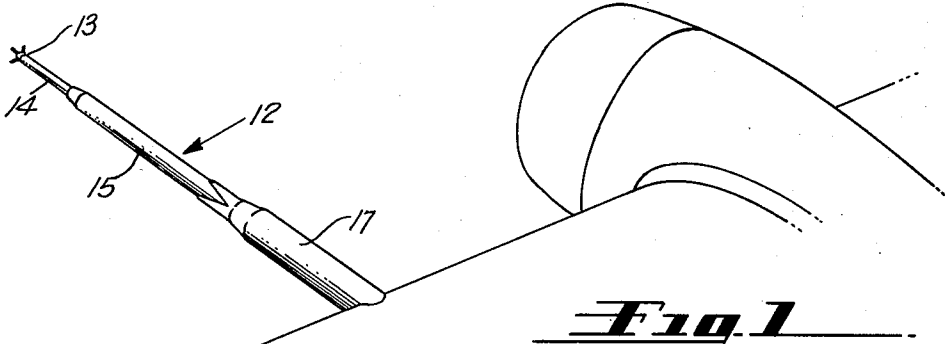


Fig. 2

Fig. 4

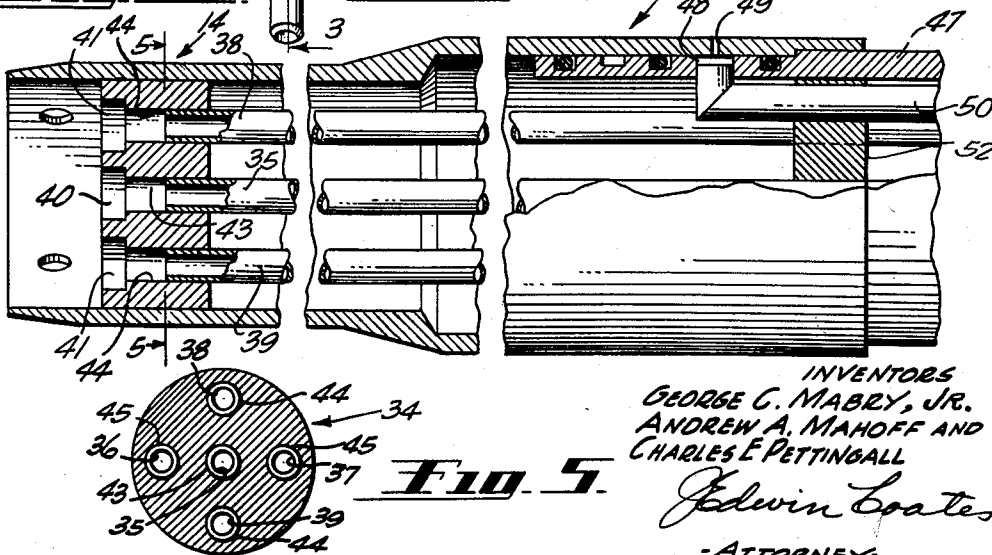


Fig. 5

INVENTORS
GEORGE C. MABRY, JR.
ANDREW A. MAHOFF AND
CHARLES E. PETTINGALL

Edwin Coates
-ATTORNEY-

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George C. Mabry, Jr., Los Angeles, Andrew A. Mahoff, Tarzana, and Charles E. Pettingall, Los Angeles, Calif., assignors to Douglas Aircraft Company, Inc., Santa Monica, Calif.

Application September 12, 1955, Serial No. 533,538

4 Claims. (Cl. 73—182)

This invention relates to main airstream airflow sensing apparatus for airplanes. Conventional such apparatus usually is capable of sensing but one, or at most, two airflow variables and otherwise is limited in its scope of utility.

This invention, broadly considered, consists of an arrangement adapted to sense, or pick up, in the one unitary device, a plurality of aerodynamic variables, up to at least three in number. For the present purposes, these variables are: angles of attack, angles of sideslip and indicated airspeeds. However, it will hereinafter become apparent that the principles of the invention can be utilized to so modify the device as to enable it to sense other airflow variables than these three, so that the invention is by no means limited to sensing the aforementioned variables.

The inventive concepts will be further particularized in connection with a typical embodiment thereof which is illustrated in the accompanying drawings and described hereinafter in conjunction therewith, but merely in order to clarify these concepts and render them concrete.

In these drawings,

Figure 1 is a rear three-quarters perspective view of the new pickup and boom article operatively mounted to an airplane wing;

Figure 2 is a front-end view of the foremost portion, or pickup head, of the article;

Figure 3 is a side view, partially in longitudinal section, of the pickup head, including rearwardly extending connector conduits for associating it with the remainder of the article;

Figure 4 is a fragmentary longitudinal section of the rear end portion of the article, and

Figure 5 is a section on line 5—5 of Figure 4.

As shown in Figure 1, the present construction includes a substantially hollow, generally tubular, chordwise extending article, 12, which constitutes a boom or sensing arm, having its rear end secured in the wing and its forward end lying some distance ahead of the leading edge of the wing. The article is terminated forwardly by an air-pressure pickup unit, or sensing head, 13 which is disposed in the undisturbed air ahead of the leading edge by means of boom components, constituting supporting means, comprising a hollow reducer-member 14, a spacer tube 15, a mounting tube 17 and wing-attachment fittings and structure, not shown, but lying inside the wing and of any desired conventional type employed for booms.

The pickup unit 13 is coaxially carried in the forward end of the reducer fitting, 14, which latter is coaxially joined to the spacer tube, 15 the latter being coaxially mounted in the mounting tube 17.

The unit 13 is shown as a casting having a hemispherical head 18 and a cylindrical neck 19. The head and neck are provided with five generally longitudinally extending passageways, as shown, one passageway, as depicted in Figure 2, extending on the longitudinal cen-

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terline of the unit 13, the other four passageways being circularly grouped around this central passageway. Four threaded radial bores 20 are disposed in mutually equidistant circular arrangement around the periphery of the neck to enable detachable attachment of the head to the reducer fitting 14, the attachment being effected by such fastening means as set screws, studs, etc., not shown.

The two passageways 22 that lie in the vertical centerplane of the unit 13 near the periphery of the head each include an oblique entering portion 24 and an axial portion 25. Mounted coaxially in each portion 24 is a hollow, tubular probe or pickup prong, a probe 28 being mounted in the portion 24 of the upper air passageway 24, 25 and a probe 29 being mounted in the portion 24 of the lower passageway. The included angle between probes 28 and 29 is 90° and this disposition and mutual arrangement of probes 28 and 29 enable them to sense and pickup and transmit rearwardly the varying airstream pressures due to varying angles of attack of the craft. This vertical pairing of the probes 28 and 29 enables them to take care of sensing all normal variances of angle of attack, and usually amounting to about 40° total variance above and below the horizontal.

Although the invention also contemplates the feasibility of employing but one such probe for sensing angles of attack, preferably two such probes, mounted as described, should be utilized, thereby to multiply the sensitivity of the device. Probes 28 and 29 accurately pick up therein a certain predetermined percentage of the total-airstream pressure, depending upon the particular angle of attack, for angles varying as much as 20° on each vertical side of the zero or horizontal position. This airstream pressure is, in the usual manner, referred by suitable converting means, not shown, in reference means of a known nature, not shown, to the impact pressure picked up by the central probe (as later described). The airstream pressure picked up by the central probe of course has first been passed to suitable known converting means for converting airstream pressure to electric signals, the signals then having been passed to the first-mentioned reference means. The resultant signal of this referring procedure is then transmitted to an indicating instrument on the cockpit panel, this instrument reading angles of attack. The converting, reference and indicating apparatus, being known and conventional and forming no claimed portion of present invention, need no showing or description herein and will be obvious to and readily provided by any man skilled in this art.

A pair of co-acting angle of sideslip sensing probes 30 and 32 is disposed in the horizontal centerplane of the unit 13 for the purpose of sensing sideslip angles. The probes 30 and 32 define an included angle of 90° with each other. Depending upon the angle at which the craft is sideslipping, the horizontally disposed probes 30 and 32 pickup 0% to 200% of the total-airstream pressure. Through suitable, known converting apparatus, not shown, the picked up pressure is referred, in suitable known reference apparatus, to the impact pressure. The latter has been picked up and passed, as later described, through suitable converting apparatus. The electric signal resultant from this reference is transmitted through suitable known converting means, not shown, to an indicating instrument on the pilot's panel. The converting apparatus, reference apparatus and the instrument being known and conventional and forming no claimed part of the present invention, need no showing or description herein.

The central probe 33 is disposed directly on the longitudinal centerline of the head so as to pick up, or sense and transmit rearwardly, total-airstream pressure, from

which impact pressure is derived as later explained, and for use in reference to the angle of attack pickup and the angle of sideslip pickup, this impact pressure is put thru suitable known converting apparatus, not shown, and constituting no part of this invention, which converts the air pressure into an electric signal for reference, as aforementioned, to the converted angle of attack pressure and the converted angle of sideslip pressure. None of these converting, transducing or reference means nor their combination constitutes a claimed portion of subject invention and all these means are known and conventional, as is their aforesaid mode of use. Detailing thereof herein is therefore needless.

In order to transmit these air pressures and the static air pressure from the head to the boom-part of the article, connector tubings 31 are shown in Figure 3, as mounted in the rear ends of the bores in the hemispherical pickup head. The rear ends of tubes 31 seat coaxially in bores in a forward wall or plug 34 mounted coaxially in the forward end of the reducer fitting 14 for positioning the rear ends of tubing 31. The forward ends of five conduits 35, 36, 37, 38 and 39 for conducting these pressure-fluids out the rear end of the boom and leading to the aforesaid translating instrumentalities are mounted in the rearward portions of the aforesaid bores in member 34 that also receive connectors 31. To flow-connect the tubes 31 with the five aforesaid grouped conduits, plug 34 includes, in its front face, a central bore 40, for the central one of tubes 31, two bores 41 in the vertical plane for the angle of attack connectors 31, and two bores, not shown, but lying to each side of bore 40 for the angle-of-sideslip connectors. Penetrating the rear face of plug 34 is a central bore 43 for conduit 35, transmitting total airstream pressure; a pair of vertically spaced bores 44 for tubes 38 and 39 for transmitting angle of attack pressures and a pair of bores 45 for tubes 36 and 37 for transmitting angle of sideslip pressures.

The total-airstream tube 35 leads this pressure, to a suitable, known reference device, not shown, to which the static air pressure is also led by means later described, in order to obtain the impact pressure. The latter is the difference between the total-airstream pressure and the static pressure, and this impact pressure is converted, by known means forming no part of this invention, into electric signals which represent indicated airspeed. These signals are transmitted to an instrument on the pilot's panel.

Tube 15, near its rear end, internally bears a sleeve 47, mounted coaxially therein by its front end, the rear end of the sleeve being suitably attached to the front end of boom-mounting tube 17, as shown. Sleeve 47 is provided with a radially extending port 48 arranged to register with a corresponding radially extending port 39 in tube 15. A lead-back tube 50 has its front end angled to seat in port 48 to take the static pressure picked up in port 49 to the reference means aforesaid.

Sleeve 47 is traversed at an intermediate point 52 by a plug through which the rear ends of all the aforesaid transmitting tubes are passed for support on their way to the respective aforesaid transducers, converters and reference means.

Although for the purposes of rendering the invention clearer by reference to a typical concrete embodiment thereof certain components thereof have been described with specific details as to their shapes, composition, etc., such specificity in no manner constitutes the invention or limits its scope, which is delineated by the following claims.

We claim:

1. In a substantially hollow sensing-boom for chord-wise positioning on an airfoil: a removable aerodynamic-variables pickup unit that includes a head-portion and a neck-portion; said neck-portion having a plurality of first conduits extending longitudinally rearwardly there-

from for directing the pressure-components of the aerodynamic variables picked up from the airstream by said head-portion rearwardly of said boom; a plurality of second conduits extending longitudinally of said boom and forwardly terminating short of the rearward termini of said first conduits and adapted to transmit the pressure-components of said aerodynamic variables rearwardly in said boom; and mounting means disposed coaxially of the forward portion of said boom and lying substantially intermediate the rearward end-portions of the first conduits and the forward end-portions of the second conduits; said mounting means being constructed and shaped so as to normally fixedly mount the forward ends of the second conduits and to removably receive the rear ends of the first conduits, thereby to enable ready removal and replacement of said pickup means from the boom and to readily establish and disestablish accurate communication of said first conduits with the corresponding ones of said second conduits.

2. In a substantially hollow sensing-boom for chord-wise positioning on an airfoil: a removable aerodynamic-variables pickup unit that includes a head-portion and a neck-portion; said neck-portion having a plurality of first conduits extending longitudinally rearwardly therefrom for directing the pressure-components of the aerodynamic variables picked up from the airstream by said head-portion rearwardly of said boom; a plurality of second conduits extending longitudinally of said boom and forwardly terminating short of the rearward termini of said first conduits and adapted to transmit the pressure-components of said aerodynamic variables rearwardly on said boom; and mounting means disposed coaxially of the forward portion of said boom and lying substantially intermediate the rearward end-portions of the first conduits and the forward end-portions of the second conduits; said mounting means being constructed and shaped so as to normally fixedly mount the forward ends of the second conduits and to removably receive the rear ends of the second conduits, thereby to enable ready removal and replacement of said pick up means from the boom and to readily establish and disestablish accurate communication of said first conduits with the corresponding ones of said second conduits; said mounting means essentially consisting of a disk-like, perforate solid, the forward face of the disk including a plurality of seats shaped and arranged for releasably engaging the rear end-portions of the conduits protruding rearwardly from said neck-portion; the rear face of the disk including a plurality of seats correspondingly positioned relatively to the first-said seats for normally fixedly engaging the front ends of said second conduits, and means establishing communication, through the body of said disk, of the first-said seats with the second-said seats; whereby the pick-up unit and the rearward ends of the first conduit may be readily inserted into the forward end of said boom and yet accurately establish communication with the second conduits so as to effect transmission rearwardly in said boom of the pressure-components of the aerodynamic-variables picked up by said pick-up unit.

3. A sensing boom for sensing aerodynamic variables in an airplane, comprising: coaxial, outer and inner hollow elongate boom members arranged with their adjacent end-portions overlapping disengageably; a plurality of conduits extending longitudinally and substantially centrally of both boom members for transmitting the pressure components of the aerodynamic variables rearwardly in the boom, said conduits terminating short of the front-portion of the boom; means in the forward portion of said outer boom-member for removably mounting the last-said conduits in the outer member; and an aerodynamic-variables pick-up head removably mounted in the forward end of said outer member; said head including means for removably establishing communication of the pressure components of the picked-up

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variables with said transmitting conduits; whereby said head may be readily assembled to and disassembled from the boom and the latter may also be sectionally assembled and disassembled.

4. A sensing boom for sensing aerodynamic variables in an airplane, comprising: coaxial, outer and inner hollow elongate boom-members arranged with their respective adjacent end-portions overlapping disengageably; a radial aperture in the overlapping region of said members, said aperture communicating with static ambient air pressure; a static pressure pick-up conduit extending longitudinally in said inner member and having its forward extremity communicating removably with said aperture; a plurality of conduits extending longitudinally centrally of both members for transmitting the pressure components of the aerodynamic variables rearwardly in the boom, said conduits terminating short of the front portion of the boom; means in the forward portion of said outer member for removably mounting the forward ends of the last said conduits in the outer member; and

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aerodynamic pick-up head removably mounted coaxially in the forward end of said outer member, said head including means for removably establishing communication of the pressure components of the respective aerodynamic variables picked up thereby with corresponding ones of said transmitting conduits; whereby said head may readily be removed from, and replaced in, said boom and whereby said boom-members may readily be disassembled.

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