

June 16, 1936.

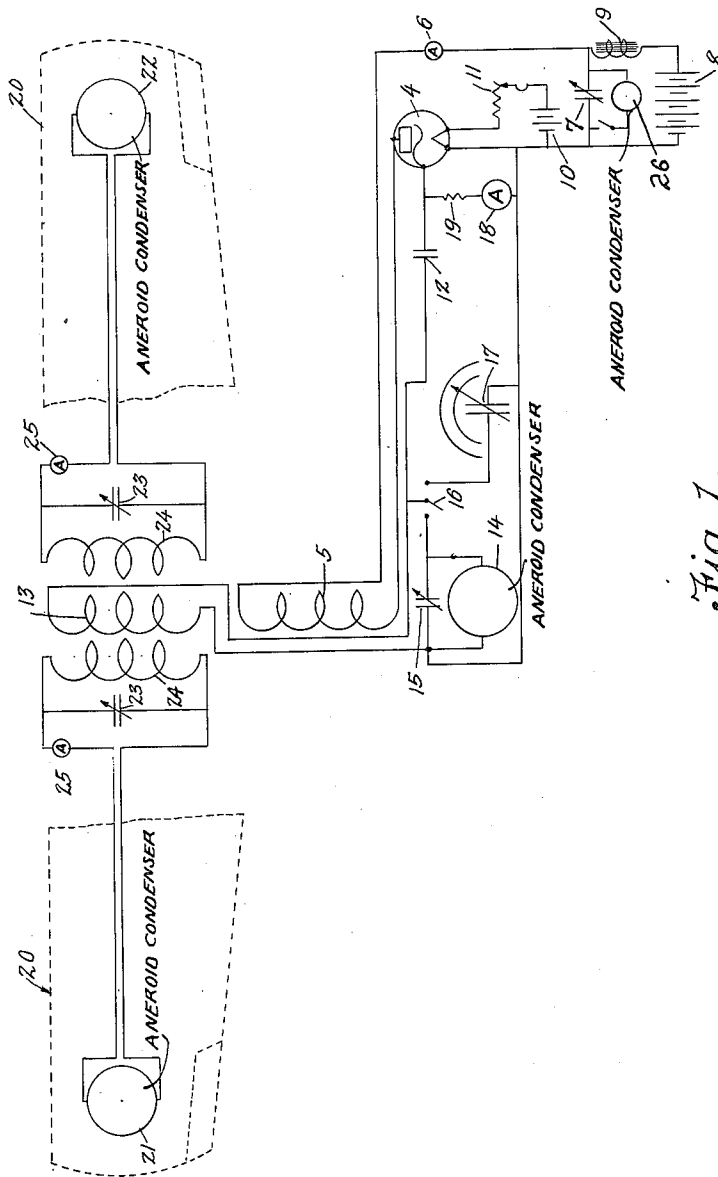
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2,044,009

AIR NAVIGATION APPARATUS

Filed Nov. 3, 1931

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

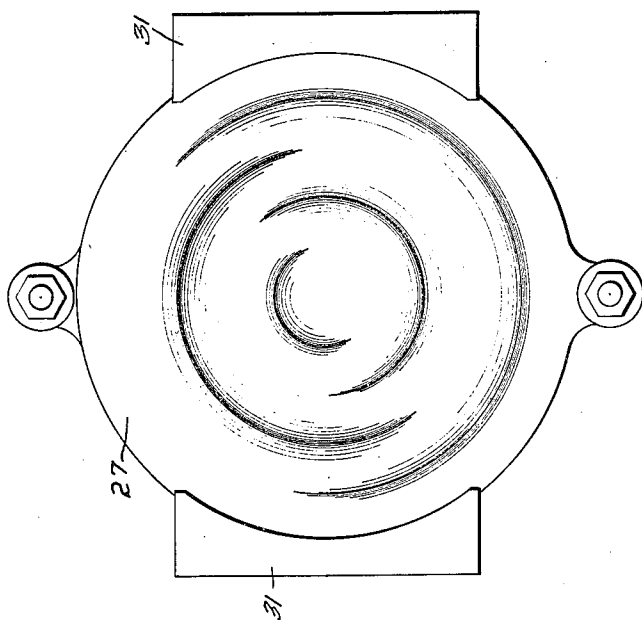


Fig. 3.

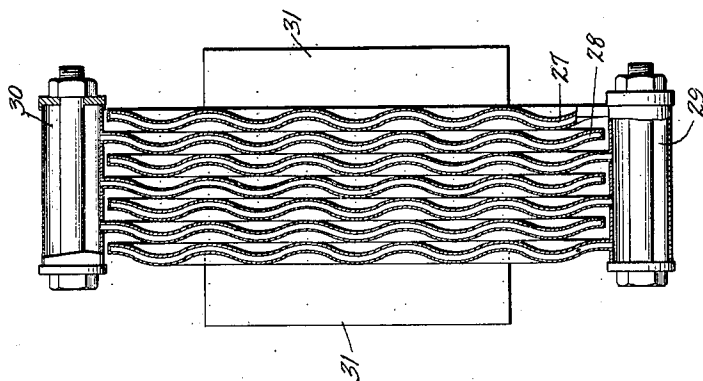


Fig. 2.

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AIR NAVIGATION APPARATUS

James Anthony McNally, United States Navy

Application November 3, 1931, Serial No. 572,817

11 Claims. (Cl. 177—351)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

My invention relates to a device to aid in the navigation of airplanes in "blind flying", and especially to one that indicates various changes in the relative position of the ship by alterations in the flow of electric current in coupled circuits that are controlled by aneroid condensers.

The objects of this invention are to provide a means whereby it is possible for the pilot to determine the attitude of his plane at all times, to determine his altitude, and to fly at a constant altitude.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of parts as will be described more fully hereinafter.

Reference is to be had to the accompanying drawings forming a part of this specification, in which like reference characters indicate corresponding parts throughout the several views, and in which:

Fig. 1 is a diagram of the circuits of the instrument;

Fig. 2 is a transverse section of the aneroid condenser;

Fig. 3 is a side elevation of the aneroid condenser.

Essentially, my invention consists of an oscillating circuit coupled to two absorption circuits, whereof one is in each wing of the airplane. Each of the three circuits includes an aneroid condenser of which the capacity is varied by changes in air pressure thereon.

Vacuum tube 4 comprises the usual plate, filament, and grid. The plate circuit includes inductance 5, milliammeter 6, and variable condenser 7. Battery 8 is connected to this circuit in parallel with condenser 7 through choke coil 9. Battery 10 is connected to the filament through variable resistance 11.

The grid circuit comprises condenser 12, inductance 13, aneroid condenser 14, and variable condenser 15, the inductance 13 being coupled to inductance 5 in a manner well known to produce regenerative action. Condensers 14 and 15 are in parallel with each other and with inductance 13, the condensers being connected to one side of the circuit by means of double throw switch 16 which may be used to cut out the two condensers and connect calibrated variable condenser 17 in parallel with inductance 13 in their stead. Milliammeter 18 and resistance 19 are connected in series across the grid circuit between vacuum tube 4 and condenser 12.

Well out in the wings 20 of the airplane are

placed the aneroid condensers 21 and 22, each of which is connected to a tuned circuit comprising a variable condenser 23 in parallel with an inductance 24, the inductances being coupled with inductance 13. A milliammeter 25 is connected in each of the absorbing circuits in the wings. If desired, an aneroid condenser 26 may be connected across variable condenser 7 to compensate for capacity effects to ground.

The aneroid condensers above mentioned consist of two sets of plates 27 and 28. The plates are double-walled chambers made of material like that used in aneroid barometers, the former being in communication with a chamber 29 and the latter with chamber 30, the space in the chambers and the plates being partially evacuated. Increase in air pressure will cause the walls of the plates to collapse toward each other, thus moving the plates farther from each other and decreasing their capacity, while diminution of the pressure will permit them to expand and come closer together with a resultant increase in capacity. Alterations of the capacities of the aneroid condensers will change the frequencies of the circuits, and thus differences of altitude will be indicated by variation in the currents flowing in the circuits, which will be shown by the readings of the milliammeters. The aneroid condensers will be mounted in suitable insulating material 31. Where desirable, any parts of the apparatus may be shielded as in standard construction of high frequency sets.

Preferably a very high frequency oscillation will be used, and the oscillating circuit will be tuned to a slightly higher frequency than the absorption circuits, so that relatively large changes in the readings of the ammeters will be obtained for small variations in the capacity of the aneroid condensers. The difference in frequency between the oscillatory circuit and the absorption circuits will be small so that there will be an appreciable amount of absorption, and the frequencies of the absorption circuits will be the same so that equal currents will flow in them when the plane is transversely level, inequality of these currents indicating that one wing is higher than the other.

After the several circuits have been tuned so that the frequency of the driver circuit is slightly higher than that of the absorption circuits, aneroid condensers 21 and 22 in the latter and aneroid condenser 14 in the former will keep substantially the same relations existing regardless of altitudinal changes so long as the plane is level, and this condition will be indicated by equal readings of

the meters. However, if one wing is raised and the other lowered, the differential pressures on condensers 21 and 22 will cause one of the circuits to depart from resonance, while the other circuit is caused to more nearly approach resonance and the pilot can determine from the readings how to bring his ship back to the level. The condition of resonance in the circuits is indicated by maximum readings on all the meters.

Altitude may be measured by throwing switch 16 to connect variable condenser 17 in the oscillating circuit in place of aneroid condenser 14 and variable condenser 15. Condenser 17 is calibrated to read in feet, so that when the absorption circuits are adjusted for a given frequency the setting of condenser 17 which puts the driver circuit in resonance with them indicates the altitude of the plane.

For flying at a constant altitude the condenser 17 is set to indicate the desired height. Any departures of the ship therefrom will be shown by the changes in the ammeter readings in the driver circuit.

Aneroid condenser 14 should be placed on the fore-and-aft center line of the plane so that it will not be affected by changes in the relative heights of the wings.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiment of my invention, and that various changes in construction, proportion and arrangement of parts may be made within the scope of the appended claims, without sacrificing any of the advantages of my invention.

The herein described invention may be manufactured and used by or for the Government of the United States for governmental purposes without the payment of any royalty thereon.

I claim:

1. In an instrument for navigating airplanes, a vacuum tube; an inductance, a milliammeter, and a variable capacitance all three in the plate circuit thereof; a second inductance coupled with the mentioned inductance, a variable condenser and an aneroid condenser in parallel with the said second inductance, a variable capacitance calibrated to indicate altitude, a switch optionally to connect said calibrated capacitance in place of the said variable and aneroid condensers to measure altitude, a fixed condenser between said second inductance and the grid of said tube, a milliammeter and a resistance in series connected in parallel with said second inductance between said fixed condenser and said grid, the last-mentioned seven elements forming the grid circuit of said tube, the said aneroid condenser being disposed on the longitudinal center line of the plane; and in each wing of the airplane an absorption circuit comprising an aneroid condenser substantially in the tip of the wing, an inductance and a variable condenser in parallel connected to said last mentioned aneroid condenser, and a milliammeter between said last mentioned variable condenser and the aneroid condenser in circuit therewith, the inductance of each absorption circuit being coupled to the said second inductance.

2. In an instrument for navigating airplanes, a vacuum tube; an inductance, a milliammeter, and a variable condenser connected in series to form the plate circuit thereof; a second inductance coupled to the said inductance, an aneroid condenser and a variable condenser in parallel with said second inductance, a fixed condenser between said two condensers and the grid of said

tube, a milliammeter and a resistance in series connected in parallel with the aforesaid condensers between said fixed condenser and said grid, the last mentioned six elements being comprised in the grid circuit of said tube; and a tunable absorption circuit in each wing of the airplane inductively coupled to said second inductance, each of said absorption circuits including a current measuring instrument and an aneroid condenser, the last mentioned aneroid condensers being substantially equidistant from the longitudinal center line of the airplane.

3. In an instrument for navigating airplanes, a vacuum tube; an inductance, a milliammeter, and a variable condenser connected in series to form the plate circuit thereof; a second inductance coupled to the said inductance, a calibrated variable condenser in parallel with said second inductance, a fixed condenser between said calibrated condenser and the grid of said tube, a milliammeter and a resistance in series connected in parallel with said calibrated condenser between said fixed condenser and the said grid, the last mentioned five elements being comprised in the grid circuit of said tube; and a tunable absorption circuit in each wing of the airplane inductively coupled to said second inductance, each of said absorption circuits including a current measuring instrument and an aneroid condenser, the last mentioned aneroid condensers being substantially equidistant from the longitudinal center line of the airplane.

4. In an instrument for navigating airplanes, an oscillating circuit comprising a vacuum tube with an inductance, a variable condenser, and a meter in the plate circuit thereof, and a second inductance coupled with the first inductance, an aneroid condenser and a variable condenser in parallel with the second inductance, and a resistance and a meter in parallel with the last mentioned two condensers, in the grid circuit thereof; and a pair of symmetrically disposed tunable absorption circuits in the wings of the plane coupled with the inductance in the grid circuit of the tube, each of said absorption circuits including a meter and an aneroid condenser.

5. In an instrument for navigating an airplane, an oscillating circuit including an aneroid condenser substantially on the longitudinal center line of the plane, and a pair of symmetrically disposed absorption circuits in the wings of the plane, each of said absorption circuits comprising an inductance coupled with the oscillating circuit, a variable condenser in parallel therewith, an aneroid condenser substantially in the tip of the wing connected to the said variable condenser and inductance, and a meter connected between said aneroid condenser and the other elements of the absorption circuit.

6. In an instrument for navigating an airplane, an oscillating circuit comprising a vacuum tube with an inductance, a variable condenser, and a meter in the plate circuit of said tube, and a second inductance coupled with the said inductance, a calibrated variable condenser in parallel with the second inductance, and a resistance and a meter in parallel with the last mentioned two condensers, in the grid circuit of said tube; and a pair of symmetrically disposed tunable absorption circuits in the wings of the plane coupled with the inductance in the grid circuit of the tube, each of said absorption circuits including a meter and an aneroid condenser.

7. In an instrument for navigating airplanes,

an oscillating circuit comprising a vacuum tube, a plate circuit therefor, a grid circuit therefor including an inductance, an aneroid condenser and a variable condenser connectible in parallel with the said inductance, a variable condenser calibrated to indicate altitude, means to connect said calibrated condenser in parallel with the said inductance to measure altitude, and means to connect either said aneroid condenser and said variable condenser or said calibrated variable condenser in parallel with said inductance; and a pair of absorption circuits, one in each wing of the plane, coupled to said inductance, each of said absorption circuits comprising an aneroid condenser adjacent the tip of the wing, a meter in series therewith, and an inductance and a variable condenser connected in parallel with each other and connected to said meter and said aneroid condenser.

8. In an instrument for ascertaining a difference of barometric pressure between two points, a source of oscillations, barometric means for causing said source to emit a frequency that varies with the barometric pressure on said means, a tuned absorption circuit coupled with said source of oscillations, barometric means for varying the resonant frequency of said absorption circuit in accordance with the barometric pressure on said means, and additional means in said absorption circuit for indicating when said barometric means are under the same pressure or under different pressures.

9. In an instrument for navigating an airplane, an oscillating circuit including an electric device sensitively responsive to changes in atmospheric pressure substantially on the longitudinal center line of the plane to vary a characteristic of the circuit in response to changes in altitude and a pair of symmetrically disposed absorption circuits in the wings of the plane, each of said absorption circuits comprising an

inductance coupled with the oscillating circuit, a variable condenser in parallel therewith, an element having an electrical characteristic sensibly variable by small changes in atmospheric pressure substantially in the tip of the wing connected to the said variable condenser and inductance, and a meter connected between said element and the other parts of the absorption circuit.

10. In an instrument for navigating an airplane, an oscillating circuit including a condenser sensibly responsive to small changes in atmospheric pressures, a pair of tunable absorption circuits symmetrically disposed with respect to said condenser and coupled to the oscillating circuit, each of said absorption circuits including an element having an electrical characteristic sensibly variable by small changes in atmospheric pressure, and indicating means in each of said circuits to show the magnitude of the current flowing in the respective circuits.

11. In an instrument for navigating an airplane, an oscillating circuit, two absorption circuits symmetrically disposed with respect to the oscillating circuit and coupled thereto, means in each of said circuits to indicate the current flowing therein, means in each of said absorption circuits responsive to air pressures to change the resonant frequency of the absorption circuits proportionately to variations in air pressure, and means in said oscillating circuit to vary the frequency of the oscillating circuit proportionately to changes in air pressure to keep the readings of all said indicating means constant when all said means responsive to air pressures are subjected to the same pressure conditions but to cause differences in the readings of the indicating means when the air pressure conditions are not the same on all.

JAMES ANTHONY McNALLY.