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AURAL FLYING

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Fig. 1.

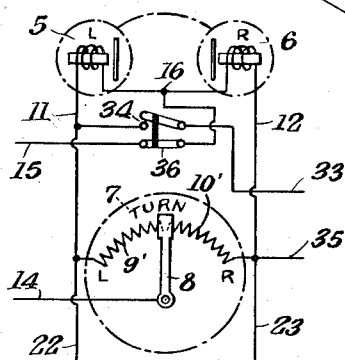
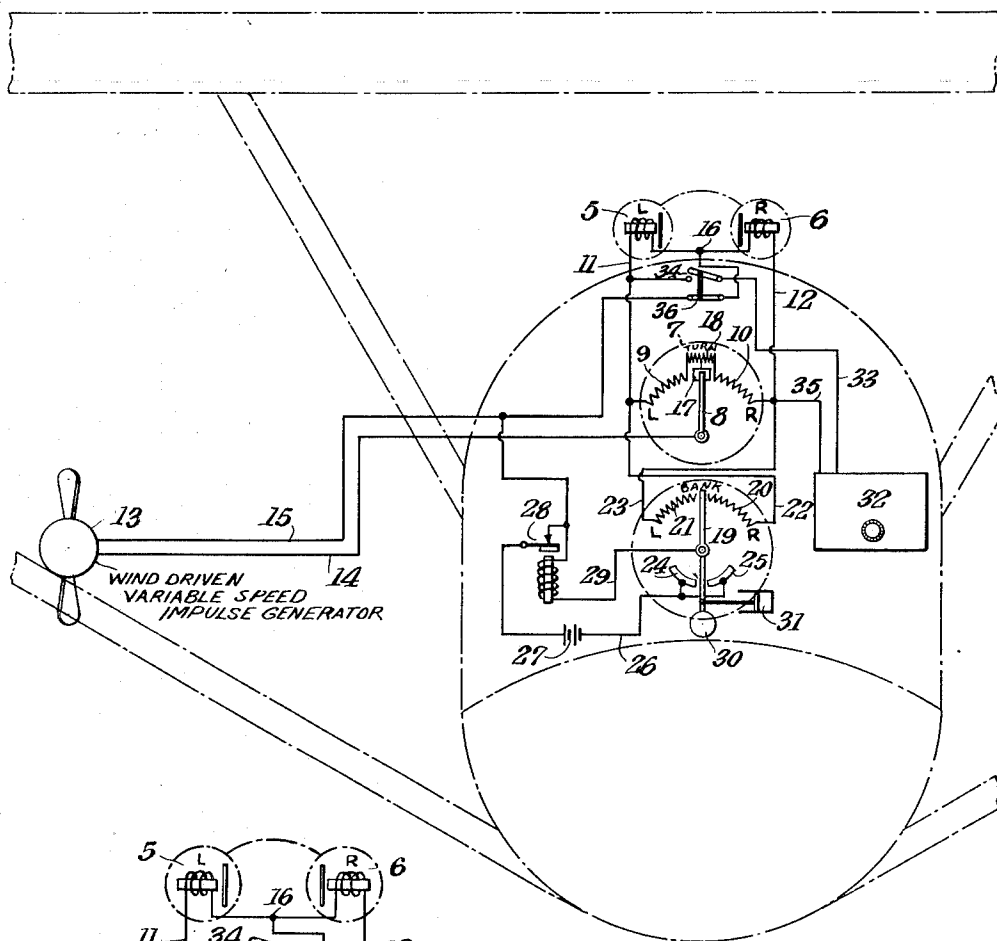


Fig. 2.

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AURAL FLYING

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36 Claims. (Cl. 177-311)

This invention relates to what has come to be known as "blind flying" or "instrument flying".

Flying by instruments as heretofore practiced has required the practically constant attention of the pilot to certain instruments and then the application of corrective measures in a definite order in accordance with the readings of such instruments. In the so-called "1-2-3" method the turn indicator is watched and deflections from straight flight corrected with the rudder, next in order the bank indicator is observed and corrections made with the ailerons and then from the climb indicator corrections for pitch made with the elevators. This absorbs practically the entire visual attention of the pilot and requires that he properly translate the meaning of the instrument readings and then arbitrarily operate the ship controls in a definite memorized order. This flying by arbitrary rule naturally requires extended training. It is not suited to all types of individuals and at best is fatiguing, opening up possibilities of error in judgment or action at critical moments.

The objects of this invention are to depart from such arbitrary and unnatural methods and to make the matter of flying a more natural and instinctive process.

These and other desired objects are attained through a realization of the fact that the sense of hearing is instinctively associated with the matter of direction and that the act of steering can be naturally governed through aural indications. In a practical application of this principle, the pilot is advised binaurally of turn, bank and pitch conditions and in such manner that he will react naturally to apply necessary corrective measures.

In the accompanying drawing, illustrative embodiments of the invention as shown, but it will be appreciated as the invention is more fully understood that various modifications, variations and changes may be made all within the true spirit and broad scope of the invention.

Fig. 1 is a diagrammatic view illustrating a form of the invention for airplane use and in which a quiet or substantially silent neutral zone gives indication to the pilot of normal or proper flying conditions.

Fig. 2 is a generally similar view, illustrating a second form of the invention, in which sound is a definite accompaniment of the so-called neutral zone.

In the forms of the invention herein shown, the pilot is equipped with a headset having left and right ear phones 5 and 6. These may be the

same as usually provided for radio reception and in fact, may be used alternately or simultaneously for the two purposes, as will be later described.

A gyroscopic turn indicator is indicated at 7. This is connected to give the straight ahead, left and right turn indications in the head phones.

In the first illustration, the straight ahead indication is a neutral zone in which no sound is heard in either phone or only a low sound is heard in both phones. On departure from a straight course, the sound or signal indication is switched either to the left or to the right ear, according to the direction of turn. In the second form of the invention illustrated, the neutral zone of forward travel is accompanied by sound heard equally in both ears and on departure from a straight line, the sound is cut off from one ear or the other, according to the direction of turn.

In Fig. 1, the arm 8 of the turn indicator, as it swings left or right from the center straight ahead position engages one or the other of the variable resistance elements 9, 10, in each instance, gradually cutting out resistance as it swings away from the center position.

The outer ends of these turn resistances 9, 10, are connected by wiring 11, 12, with the left and right head phones 5, 6, respectively.

The sound or signal source consists in the present disclosure of a small wind driven magneto generator 13, suitably mounted on the plane out of the propeller stream. Other sound sources may be provided, but the one illustrated has special advantages, particularly in that it may be utilized also to give a pitch or climb indication, as will later appear.

The connections for the sound generator are shown simply as a lead 14, to the swinging arm 8, of the turn indicator and a lead 15, to an intermediate point 16, between the two head phones.

The frequency or range of frequencies of the sound source 13, whether it be a magneto electric generator such as indicated, an electromagnetic generator or other type, such as a radio tube oscillator or the like, is preferably such as will give the desired warning indications in the phones without annoying or tiring the pilot.

In the first example shown, upon the start of a turn, the arm 8 will establish connection with the inner end of one or the other of the turn resistances 9, 10, cutting the sound source in on one or the other of the ear phones through the resistance and if the turn becomes sharper, will reduce resistance accordingly, thus increasing the signal more or less in proportion to the amount of deviation.

In the Fig. 2 form of the invention, where the turn indicator or switch arm 8 is in engagement with both resistances or contacts 9', 10', in the center neutral position, the sound indication will be heard equally in both ears until a deviation occurs and then all sound will be switched to the ear on the side of the direction of turn.

Since with the wind driven form of generator the frequency and hence the note in the telephones varies with the air speed, this sound may be used as a measure of climb or pitch. In a diving position, the note will rise and conversely in a climbing position the note will lower. Hence with a familiarity of the note of normal cruising travel, the pilot can judge aurally as to the position of the ship about its transverse horizontal axis. This matter of pitch indication may be checked with climb indicator, altimeter and tachometer and be used more as a primary rather than as a final indication of longitudinal attitude. If in a turn the pitch indication will be received only in the one ear but in straight travel, this indication will be received in both ears in the second form having the sound neutral zone.

In the first or quiet neutral form of the invention, provision may be made for pitch indication in the neutral position of the turn indicator as shown in Fig. 1, by having an intermediate contact 17, engageable by the switch arm 8 and having a center point connection with a relatively high resistance 18, bridged across the inner ends of the two resistances 9, 10. The resistance 18 is such that in the neutral position, sufficient current can flow in parallel in opposite directions through both phones to give a low or quiet signal, the tone frequency of which will increase and decrease with changes in pitch or longitudinal attitude and which will at the same time indicate the neutral straight ahead condition. This resistance is however, sufficiently high in its total length to sufficiently reduce telephone current back over through one resistance 9 or 10, when the switch arm 8 is engaged with the other of such resistances.

Bank indications are given in the present disclosure by superimposing distinguishable sounds or variations on the turn or turn and pitch indications. Thus in Fig. 1, a series of clicks, varying in intensity with the degree of bank are introduced into the telephone circuit by a bank indicator arm 19, pivoted to swing into engagement with one or the other of the variable resistances 20, 21, connected by wiring 22-11 and 23-12, with the left and right ear phones, said switch arm also in the case of an abnormal bank, contacting one or the other of two contact segments 24, 25, connected in on the common telephone line 15, by wiring 26 and including a battery or other current source 27, in parallel with a current interrupter 28. This current interrupter may be of the buzzer type as indicated connected with the switch arm 19 by wiring 29.

The bank signal initiator is indicated as of the pendulum type, properly weighted at 30, and suitably damped as at 31, to hold a central neutral position so long as the banking is properly executed, but to engage resistances 20, 21 and contacts 24, 25, when the banks are too slight or too great.

If one wing or the other is too low, the bank pendulum will close a local circuit at 24, 25, through the interrupter 28 and this will introduce alternate pulsations of the battery current 27, into the telephone line 15, the intensity of which will vary in accordance with the amount

of resistance 20 or 21, in circuit, as determined by the extent of improper bank. This variation introduced in the telephone connections to one or both ears, dependent upon the turn conditions, gives the pilot necessary information as to banking attitude and possible need for correcting same.

The invention may be combined and used with more or less standard gyroscopic turn and bank indicators or special turn and bank instruments for initiating the corresponding signals may be provided. Thus it is shown in Fig. 1, that the additional necessary apparatus may be combined with the more or less standardized instrument panel of a plane.

Furthermore, the invention may be utilized in combination or in connection with the usual radio receiving equipment. For example in Fig. 1, the same head phones serve for both radio and control signal reception. This is accomplished by connecting the radio receiver 32, through a line 33, including switch 34, with one side 11 of the head phone circuit, the other side 12 having a return 35 to the radio set. The radio receiving switch 34 is shown in this instance as connected to actuate a control cut-out switch 36, in the line 15, so that when one is in use, the other will be cut out of service. Under some circumstances, both radio and control signals may be received simultaneously and if desired, the radio may be kept entirely separate from the control signal system.

With the invention in use, the pilot is apprised of turning movements by the switching of the signal sound to one or the other ear and the general rate of such turning movements by the intensity of such sounds. In the silent or quiet neutral zone system first illustrated, the absence of sound or the presence of the dim or background sound in both ears, gives indication that the ship is on a straight course. In the second form of the invention, the presence of equal signal sound in both ears denotes the direct course and variations therefrom are made known by the switching of all sound in one ear, with increasing intensity as the turn becomes sharper.

The natural reaction in both instances, is to turn away from the warning sounds, causing the pilot to instinctively use his rudder to steer back to the straight course. If the sound is of increasing tone frequency, the pilot knows that the ship is diving and if of decreasing tone frequency, that the ship is climbing. This matter of degree or intensity of sound can thus be recognized as a pitch or climb indication. Becoming familiar with the tone or pitch of the sound for normal cruising of the ship, the pilot may know the fore and aft attitude of the plane and correct for same without reference to climb indicators and the like, or may use this to check against the instruments usual for this purpose. As herein illustrated, wherein some sound is present in both phones in the neutral zone, the pitch indication will be perceptible when the plane is travelling straight as well as when in a turn. In the case of an absolutely silent neutral zone, the test for pitch may be made by swinging the plane one way or the other, to cut in the sound for a turn indication, the tone of such indication then serving as an index of pitch.

If the flight is level transversely or banking is effected at a proper angle, the banking indicator or signal initiator maintains its neutral

position and no banking signals are given, but if one wing or the other lowers, or banking is at an abnormal angle where slip or skid may occur, the bank switch 19, cuts in the signal
5 varying indication in the ear on the low side and with intensity more or less proportionate to the danger of the angle, causing the pilot again in this instance to react instinctively to restore the plane to level flight or correct bank-
10 ing angle.

The invention is particularly suited to planes of modern design which, as well-known, are inherently stable and can be flown practically with rudder alone. The natural and instinctive trans-
15 lation of turn indication to rudder operation with this invention, makes it possible to fly ships of such character with but very little previous training or experience.

While all three indications of turn, bank and
20 pitch have been provided in the present disclosure, it will be apparent that turn and pitch, turn and bank or bank and pitch indications only might be used to advantage, the same being within the contemplation of the invention.

25 The necessary apparatus is all relatively simple and reliable and works in well with present equipment. While head phones appear at present to be the most satisfactory form of binaural receivers, it is considered that other types of
30 such receivers may be employed. Because of this and the possibility of other changes within the scope of the invention, it should be understood that the terms employed herein have been used in a descriptive rather than in a limiting
35 sense, except possibly for limitations as might be required by the state of the prior art.

The wind driven generator provides a practical signal source, but it is contemplated that the signal note may be produced in other ways
40 and that actually the sound generating means may be on the ground, as in the form of a beam or broadcast and picked up in the plane by radio for turn, bank, or turn and bank indication purposes. In such case, the turn indicator would
45 be used as before to cut out reception in one ear or the other, as the ship turns from the predetermined direction, and the bank indicator would operate in a manner as previously described for banking indications.

50 The invention may be applied to other dirigible craft than airplanes. More than one signal note may be used. Thus the banking indication might be a different signal note instead of merely pulsations or interruptions imposed
55 on the turn indication signal note. Also, the indications might be reversed, that is, the signal note in one ear or the other for banking indication and the clicking or interruptions imposed for turn indicating movements.

60 In all instances, the natural function of the ears in maintaining equilibrium is utilized, so as to make the matter of steering the craft instinctive and a natural reaction to the aural warnings received by the pilot. These aural notifications
65 leave the pilot entirely free to watch altitude, engine and other indicator. Thus a pilot may devote attention to other necessary details in full security, knowing that if the occasion arises, he will hear an informative warning. The signals
70 thus received are sufficient for blind flying purposes and without the eye strain and fatigue of the usual instrument flying. While it is preferred that the signals vary in amount as well as in kind, so that the pilot may judge the extent of turn
75 or bank, for instance, it is possible that in some

instances it will be sufficient merely to give notice that the ship is in a turn or improperly banked, with the direction of such movement. The signalling in one ear or the other gives the pilot a
5 sense of direction similar to that experienced in listening to ordinary external sounds. These signals are entirely independent of the controls by which the craft is navigated, so that the controls may be used as required, to correct the ship's
10 attitude without occasioning any false or unnecessary signal indications. The switching from binaural to monaural reception provides natural and realistic directional indications, which the
15 pilot can follow instinctively. The gyroscopic turn indicator and the combination gravity and centrifugal bank indicator are representative in character, for as will be appreciated, other means
responsive to variations in flight attitude may be provided.

What is claimed is:

20 1. Apparatus for aural flying, comprising in combination, binaural signal receivers, means for generating a signal for said receivers, means responsive to changes from a normal flight attitude
25 for selectively switching said signal individually to said binaural receivers in accordance with direction of change from said normal flight attitude and including means for varying the in-
tensity of the signal in said receivers in accordance with extent of change from said normal
30 flight attitude.

2. In combination, binaural signal receivers, means for generating a turn signal for said re-
35 ceivers and means including a turn sensitive device and mechanism controlled thereby for selectively impressing the signal from said signal generating means on the individual binaural re-
ceivers in accordance with direction of turn and for varying said signal in accordance with the
40 degree of turn.

3. In combination, binaural signal receivers, means for generating a bank signal for said re-
45 ceivers and means including a bank sensitive device and mechanism controlled thereby for selectively impressing the signal from said signal generating means on the individual binaural re-
ceivers in accordance with direction of bank and for varying said signal in accordance with the
degree of bank.

4. In combination, binaural signal receivers, means for generating individually distinct turn
50 and bank signals for said receivers, turn and bank sensitive devices and connecting means operated by said turn and bank sensitive devices for select-
ing individual signal receivers in accordance with
55 direction of turn and bank and for transmitting said turn and bank signals accordingly to said selected signal receivers.

5. Aural flight apparatus, comprising binaural signal receivers, a wind driven signal generator
60 therefor, turn and bank sensitive means for selectively transmitting signal energy generated by said wind driven generator to the individual
signal receivers in accordance with direction of turn and bank, including means for providing
65 selectively distinct aural turn and bank indications in said receivers and said wind driven signal generator being of variable tone frequency in accordance with air speed to provide by changing
70 frequency, a recognizable pitch indication in the signal receivers.

6. In combination, binaural signal receivers, means for generating a signal for said receivers,
75 means responsive to changes in flight attitude for selectively transmitting signal from said signal

source to the individual receivers in accordance with direction of change from flight attitude, a radio receiving set and means for connecting both of said binaural receivers to said radio receiving set for radio reception and for connecting said receivers individually in receptive relation to said signal generating means for flight signal reception.

7. In combination, binaural signal receivers, means for generating a signal for said receivers, a turn sensitive device and means operable thereby to select and effect transmission of the signal from said generating means to one or the other of said binaural signal receivers in accordance with direction of turn, a bank sensitive device and means operable thereby to vary the signal as selectively transmitted to the respective signal receivers in accordance with the direction of bank.

8. In combination, binaural signal receivers, means for generating a signal therefor, turn and bank sensitive devices, connecting means operable by one of said devices to switch generated signal from one receiver to the other in accordance with direction of change sensed by said device and connections from the other device including means for varying the signal switched to the selected signal receiver in accordance with direction of change sensed by the latter device.

9. In combination, means for generating individually distinct turn and bank signals, binaural signal receivers, connecting means from said turn and bank signal generating means to said binaural receivers, including turn and bank switch arms and turn sensitive means for operating said turn switch in accordance with direction of turn and bank sensitive means for operating said bank switch arm in accordance with direction of bank.

10. In combination, binaural signal receivers, means for generating a signal therefor, a turn sensitive device and means operable thereby to switch signal from said source to one or the other receiver in accordance with direction of turn, said turn sensitive device having an intermediate neutral position, said means being operable in said intermediate neutral position for switching said signal substantially equally to both receivers.

11. In combination, binaural signal receivers, means for generating a signal therefor, means responsive to change in attitude along one axis for selectively transmitting and varying the intensity of transmission of signal from said generating means to said signal receivers individually in accordance with the extent of such change in attitude and additional means responsive to change in attitude along a different axis for superimposing another signal on the signal selectively impressed on said receivers by said first responsive means.

12. Aural flying apparatus, comprising in combination, a telephone headset with individual ear phones, turn and bank sensitive mechanism and means operable by said turn and bank sensitive mechanism for impressing turn and bank signals on said individual ear phones in accordance with direction of turn and bank and oppositely varying in intensity in the respective phones in accordance with the degree of departures from straight line and properly banked conditions of flight.

13. In aural flying apparatus, the combination of binaural receivers, a wind driven variable speed impulse generator of varying frequency in accordance with air speed, a turn sensitive instrument and means operable thereby for switching

the output from said generator from one to the other of the binaural receivers in accordance with change in turn from one direction to another and for varying the signal so switched in accordance with the degree of turn.

14. In aural flying, the combination of a telephone head set having individual ear phones, a signal source, an instrument having a normal neutral flight position and sensitive to change in attitude from the normal flight position and means including switching mechanism operable thereby in accordance with changes from normal flight position for cutting such signal source in on one or the other ear phone and for maintaining a quiet background signal in both ear phones in the normal neutral flight position of said instrument.

15. In aural flying, the combination of binaural signal receivers, a signal source, an instrument sensitive to change of attitude from a normal flight position and switch means operable thereby including a variable resistance for each signal receiver and an operating element movable by said instrument on changes from the normal flight attitude to increase resistance in one signal receiver while decreasing it in the other signal receiver and a common resistance between the two resistances for maintaining a background signal in both receivers in the normal flight position of the instrument.

16. In aural flying, the combination of turn and bank sensitive devices, binaural signal receivers, a signal source, switch mechanism operable by one of said devices for selecting and transmitting the signal from said source to one or the other of said receivers in accordance with deviation direction and switch mechanism operable by the other of said devices for superimposing additional signal impulses on said transmitted signals.

17. In aural flying, the combination of turn and bank sensitive devices, binaural signal receivers, a signal source, switch mechanism operable by one of said devices for selecting and transmitting the signal from said source to one or the other of said receivers in accordance with deviation direction and switch mechanism operable by the other of said devices for superimposing additional signal impulses on said transmitted signals, said switch means including variable resistances by which said signals are varied in intensity in accordance with the degree of departure from straight ahead and proper banking attitudes.

18. The method of providing pitch and turn indications for aircraft flight, comprising generating a signal varying in frequency with aircraft speed and converting the same to binaural signals and varying said binaural signals relatively to each other in accordance with changes in direction of turn.

19. The method of providing pitch and turn indications for aircraft flight, comprising generating a signal varying in frequency with aircraft speed and converting the same to binaural signals and varying said binaural signals oppositely in audibility with changes in turn.

20. The method of providing pitch and turn indications for aircraft flight, comprising generating a signal varying in frequency with aircraft speed and converting the same to binaural signals and relatively varying the same proportionately with angles of turn.

21. The method of providing flight indications for piloting of aircraft, comprising creating bin-

aural signals on said aircraft and relatively varying the same in accordance with turn of the craft.

22. The method of providing flight indications for piloting of aircraft, comprising generating a signal and converting the same to binaural signals on said craft and relatively varying the same according to direction of turn of the craft.

23. The method of providing flight indications for piloting of aircraft, comprising creating binaural signals on said aircraft and relatively varying the same proportionately with angles of turn of said aircraft.

24. The method of providing flight indications for piloting aircraft, comprising creating binaural signals and oppositely varying the same in accordance with and in proportion to changes in direction of flight of said aircraft.

25. In combination with aircraft, a source of signal energy on said aircraft, binaural receivers on said aircraft and means on said aircraft for automatically impressing signal energy from said source on said binaural receivers increasingly to one while decreasingly to the other in proportion to extent of change of direction of said aircraft.

26. In combination with aircraft, a source of signal energy on said aircraft, binaural receivers on said aircraft and means for automatically dividing said signal energy between said binaural receivers during straight flight and for relatively increasing signal strength in one of said receivers while decreasing signal strength in the other of said receivers upon change in direction of flight of said aircraft.

27. Aural flight apparatus, comprising turn and bank sensitive devices having intermediate neutral positions and shiftable to positions at opposite sides of said neutral positions in accordance with direction of turn and direction of bank, binaural signal receivers, means for generating individually distinct turn and bank signals for said receivers and connecting means from said turn and bank sensitive devices for selectively transmitting either or both said individually distinct turn and bank signals to the individual signal receivers in said positions of the turn and bank sensitive devices at opposite sides of said intermediate neutral positions.

28. In combination with aircraft, binaural signal receivers on said aircraft, means for generating a continuous signal for said receivers and means for transmitting said continuous signal from said generating means selectively to one or the other of said binaural receivers in accordance with the direction of turn and for varying said transmitted signal in accordance with the degree of turn.

29. The method of providing flight indications for piloting of aircraft, comprising generating a continuous signal and converting the same to

separate continuous binaural signals and relatively varying the same according to direction of turn of the craft.

30. In combination with aircraft, a turn sensitive instrument thereon, binaural receivers on said aircraft and means controlled by said turn sensitive instrument for automatically producing a turn indicating aural signal in one receiver with turn of the craft in one direction and a reverse turn indicating aural signal in the other receiver with turn of the craft in the opposite direction.

31. In combination with aircraft, binaural receivers on said aircraft, a signal source for said receivers varying in frequency with air speed of the craft and means for variably impressing signal from said source on the individual binaural receivers in accordance with direction of turn of said aircraft.

32. The method of providing flight indications for piloting of aircraft, comprising generating a continuous signal and converting the same to separate continuous binaural signals and relatively varying the same according to direction and amount of turn of the craft.

33. In combination with aircraft, binaural receivers on said aircraft, a turn sensitive instrument on said aircraft and means controlled by said turn sensitive instrument for creating equal aural signals in both binaural receivers during straight flight of said craft and for creating a greater signal in one receiver with turn of the craft in one direction and greater signal in the opposite receiver with turn of the craft in the opposite direction.

34. The method of providing flight indications for piloting of aircraft, which comprises creating binaural signals substantially equal in effect with straight ahead flight of the craft and varying the aural effect of one signal or the other with turn of the craft in one direction or the other.

35. Aural flight apparatus, comprising in combination, binaural signal receivers, a signal source for said receivers, means responsive to deviations from a predetermined flight attitude and means controlled by said flight attitude responsive means for selectively impressing signal from said source on one or the other of said binaural receivers in accordance with deviations from said predetermined flight attitude and for establishing a neutral signal indication at both receivers during said predetermined flight attitude conditions.

36. In combination with aircraft, binaural signal receivers on said aircraft and means for creating and for automatically modifying signal in the individual receivers in accordance with deviation from a predetermined flight attitude including air speed sensitive means for modulating said signals in accordance with air speed of the craft.

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