May 31, 1938. E. A. LINK, JR 2,119,083

AVIATION TRAINER

Filed July 26, 1934 2 Sheets-Sheet 1

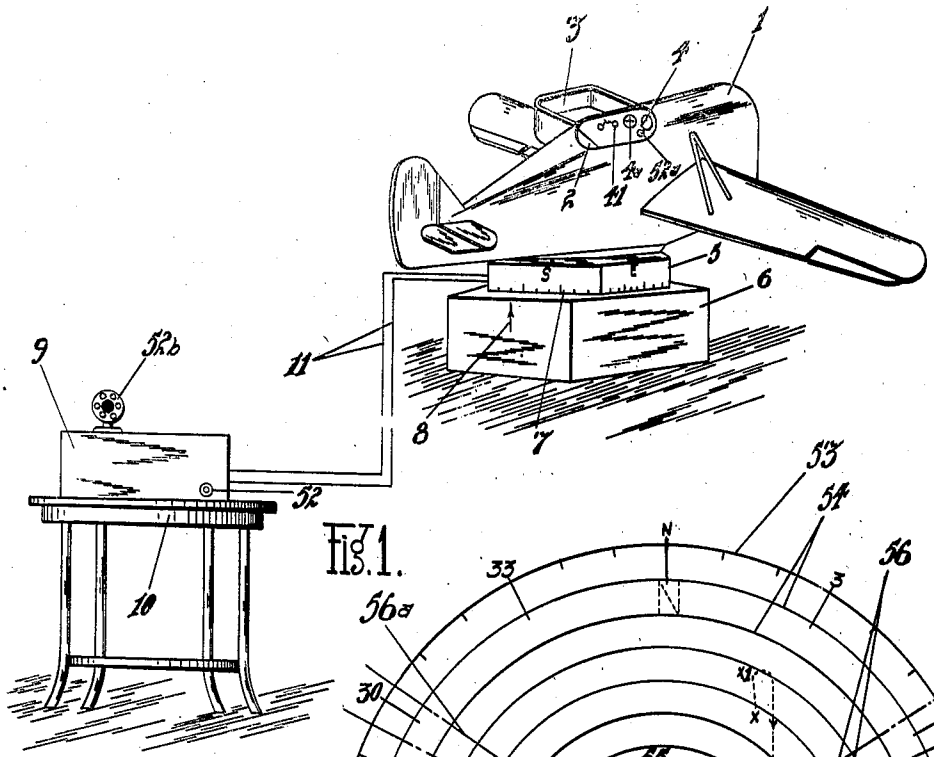

Fig. 1.

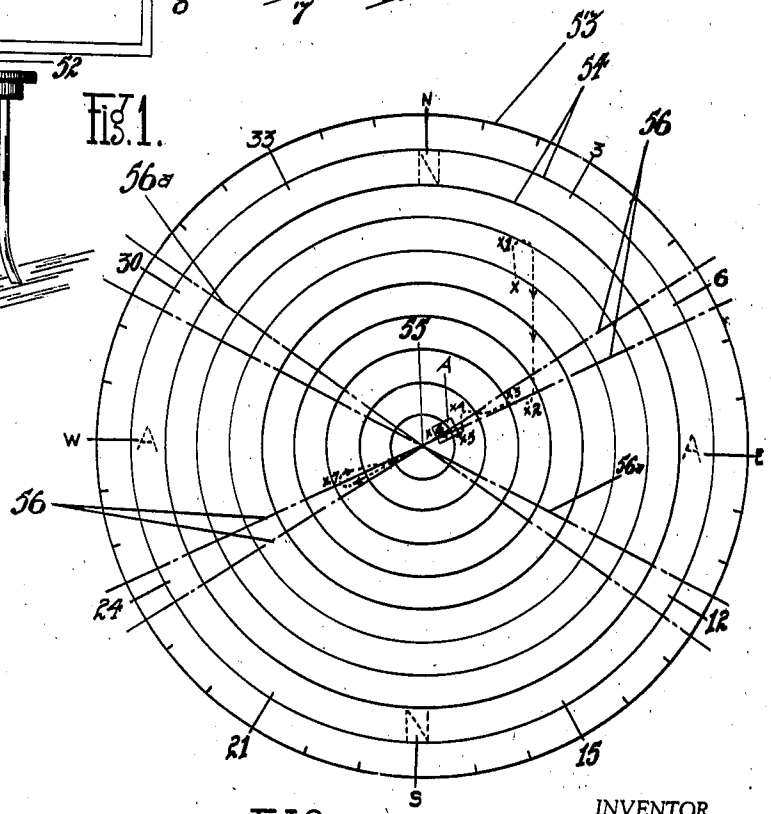

Fig. 2.

INVENTOR.
EDWIN A. LINK, JR.

BY Philip S. Hopkins

ATTORNEY.

May 31, 1938: E. A. LINK, JR. 2,119,083

AVIATION TRAINER

Filed July 26, 1934 2 Sheets-Sheet 2

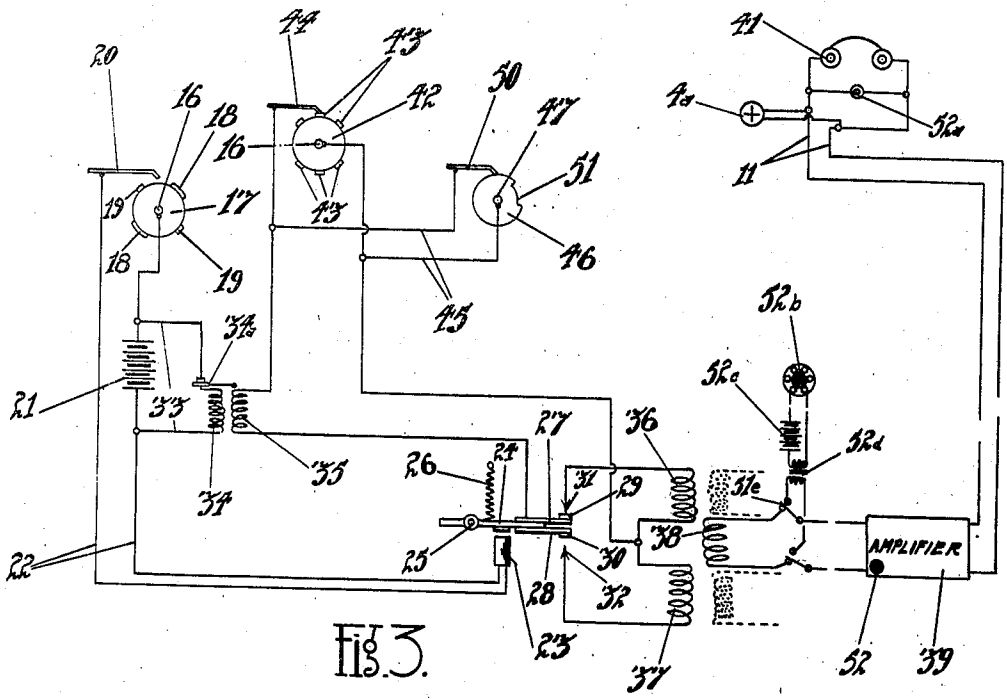

Fig. 3.

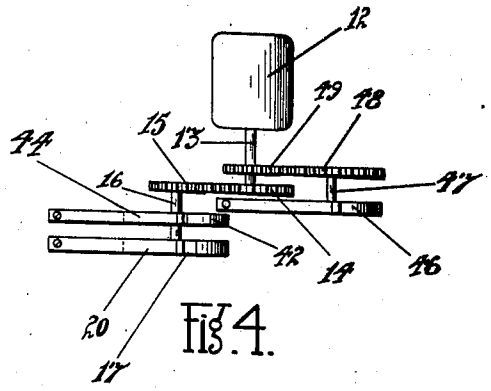

Fig. 4.

INVENTOR.
EDWIN A. LINK, JR.
BY Philip S. Hopkins
ATTORNEY.

Patented May 31, 1938 2,119,083

UNITED STATES PATENT OFFICE

2,119,083

AVIATION TRAINER

Edwin A. Link, Jr., Cortland, N. Y.

Application July 26, 1934, Serial No. 737,081

4 Claims. (Cl. 35—12)

My invention relates to an aviation trainer and particularly to a means of training pilots in the art of "blind" or radio flying and air navigation.

With the development of aviation and the establishment of scheduled operations on definite courses between fixed points, there has been included the directional radio beam comprising radio broadcasting stations located at the airports which comprise the terminals of various "runs". These radio broadcasting stations send out, directionally, signals receivable by the radio receiving sets in the aeroplanes and rendered audible and/or visible to the pilot through suitable translation means such as earphones, pointer indicators, and the like. In some instances such signals are translated into both audible and visual indications for the pilot.

The nature of these signals broadcast from the various stations is such as to inform the pilot as to his position with respect to a direct line course to the particular station from which the signals are sent. The audible signals are such that if the pilot is to the right of a certain course to a given airport and station, a code signal representing the letter N and constituting a dash-dot signal will be heard. If the student is to the left of the course he will hear the code signal representing the letter A, namely, dot-dash. If the student is directly on-course, his signal will constitute a continuous hum without distinction between dots and dashes.

The volume of these signals will increase as the pilot approaches the airport and sending station and will decrease if his flight is away from such station.

The signals sent out by the stations also include periodically the code signal of the station and airport from which the signals are being broadcast. For instance, three dots might be the station signal of a given airport.

If the receiving set in the aeroplane is equipped with a visual indicator of known type, the pointer or other indicating member will respond in like manner to show whether the plane is to the right or left or on a given course.

These broadcasting stations are so designed and shielded that when a pilot is directly over a station no signals will be heard. Consequently a pilot flying into a station and receiving the signals continuously as above described, knows immediately when he is passing directly over the sending station, because of the complete interruption of the receiving of the signals.

In actual practice the broadcasting station for an airport is located a specified distance from the landing field, say two miles, and so arranged that the landing field is directly on one of the "on-course" line of signals from the station.

By this system of radio signaling from the various airports, pilots are able to fly directly to their destination solely by instruments and without the necessity of sight of the ground.

It will be obvious that in order for a pilot to become skilled in the art of this blind or radio flying, it requires considerable training and practice. It is also equally obvious that for a pilot to receive the necessary training and practice by actual flight and instruction in an aeroplane, the cost thereof is necessarily high.

It is the principal object of my invention, therefore, to provide a means of training and instructing pilots in this art of blind or radio flying and to make it possible for them to practice and become thoroughly familiar with this type of flying in a trainer on the ground, eliminating the expense of actual flight training practice and in addition eliminating the hazard of student blind flying.

One of the important features and objects of my invention lies in the provision of a trainer capable of directional control and preferably simulating as nearly as possible the actual feel and control of an aeroplane and within which the student pilot may be enclosed so that his vision is limited entirely to the instruments in the trainer corresponding exactly to the instruments in an aeroplane, and included particularly among many which might be provided, a compass. The pilot is also provided with a loud speaker or a set of earphones by which audible signals corresponding to those above described in actual practice, can be heard, and, if desired, with a visual indicator responsive to the signals for visually translating the signals.

A signal transmitting apparatus is provided under the control of an instructor by means of which the signals are communicated to the student in the trainer. The instructor by constantly checking the position of the trainer on its support, under the control of the student therein, is able with the signal transmitting service, to communicate to the student within the trainer the signals corresponding exactly to the actual broadcast signals above described, and to observe and to record on a suitable chart the "progress" of the student in response to such signals.

By this method of instruction a pilot may be taught to fly by radio and may acquire a very definite degree of efficiency therein before going

to either the expense or the hazard of actual flight.

One feature and object of my invention lies in the provision of a novel signaling device by means of which signals simulating exactly the actual radio signals of a broadcasting station, are made available to the student in the trainer.

A further object lies in the provision of a means of recording the test "flights" of the student in the trainer.

Another object lies in the provision of means whereby the instructor can talk to the student in the trainer through his receiving set.

Other objects and advantages will be apparent as the description proceeds, reference now being had to the figures of the accompanying drawings forming a part of this application and wherein like reference numerals indicate like parts. It is to be understood that the form of apparatus herein shown and described is but illustrative only as it will be apparent that the apparatus used may vary greatly in detail without departing from the invention.

In the drawings:

Figure 1 is a diagrammatic illustration of the complete apparatus used, in assembled relation.

Figure 2 is a detail view of a form of chart by means of which the test "flights" of the student may be recorded.

Figure 3 is a diagrammatic view, illustrating the electrical signal providing means.

Figure 4 is a detail view illustrating a portion of the automatic signal providing mechanism.

The reference character 1 refers generally to a trainer of a type suitable for use with this invention and resembling generally that shown and described in applicant's prior Patent No. 1,825,462 issued September 29, 1931. The details of this trainer have not been shown nor will they be described herein as they form no part of this invention except in the combination as hereinafter claimed. Suffice it to say that the trainer constitutes essentially a frame simulating the construction of an aeroplane and provided with a cockpit seat 2 in which the student pilot is positioned. A hood 3 is provided to completely enclose a student within the cockpit so as to limit his vision to the instruments therein, such as the compass 4 and, if desired, a visual radio indicator 4a.

The trainer is suitably supported upon a rotatable member 5 which may be provided with any desired or suitable means for rotation with the trainer upon a base or support 6. It will be understood, of course, that the rotation of the trainer is under the direct control of the student in the trainer and that it is suitably adapted for complete 360 degree rotation upon the support 6. In other words, the student within the trainer is able by any desired or suitable means (not shown) to rotate the trainer to any position of the compass desired. The rotatable support 5 is suitably marked or graduated as at 7, such graduations corresponding to the graduations of a compass. A fixed point or mark 8 is provided on the stationary base 6 in full view of the instructor or operator in order that he may observe with accuracy the exact directional position of the trainer at all times. This is for a purpose to be described.

It should be understood clearly that the particular type of trainer is relatively unimportant. Many forms of apparatus may be used. It is applicant's intention that the word "trainer" as hereinafter used shall include any desired construction of non-flying type, that is, incapable of actual flight but controllable as to directional position.

The signal sending apparatus is indicated generally at 9 and may be suitably supported upon a table 10 or the like, the electric signal impulses being transmitted to the trainer by suitable wires 11. The arrangement of the signaling device and the trainer is such that the instructor or operator has at all times a clear view of the trainer while operating the signaling device.

It will be understood that in order to provide proper instruction and training to the student pilot, signals must be provided for him which simulate in closest detail the actual broadcast signals of a radio station to aeroplanes in flight. My signaling means for this purpose will now be described.

With reference to Figure 4 it will be observed that I have provided a motor 12, the shaft 13 of which is provided with a gear 14 meshing with a gear 15 on a shaft 16. Mounted upon this shaft 16 for rotation therewith is a contact wheel 17 provided at spaced points on its periphery with fixed contacts 18 and 19, the former being relatively longer than the latter so as to provide, in a manner hereinafter described, distinguishable "dash and dot" signal impulses. It will be noted from Figure 3 that these contacts 18 and 19 are spaced apart and it should also be understood at this point that the number of such contacts and the size of the wheel 17, as well as the speed thereof, are all subject to variation without departing from the invention. A brush contact member 20 is provided for cooperation periodically and successfully with the contacts 18 and 19 as the wheel 17 rotates. The periodic engagement of the contact 20 and the contacts 18 and 19 serves to close an electric circuit, the source of energy of which is provided by a battery 21 and which circuit is indicated by the wires 22. Included in this circuit is an electromagnet 23 which obviously is periodically energized by the engagement of the contacts 18 and 19 with the contact 20, the periods of energization corresponding with the size of the contacts 18 and 19 and the time they are engaged with the contact 20. Obviously the magnet 23 will thus be energized for successive relatively long and short periods corresponding to "dashes" and "dots" respectively.

The armature for the electromagnet 23 comprises a pivoted arm 24 pivoted at 25 and normally held out of engagement with the magnet 23 by a coil spring 26. Carried at one end of the arm 24 is a pair of spaced spring contact arms 27 and 28 carrying the contacts 29 and 30 respectively. Fixed in cooperative relation with these contacts 29 and 30 are the stationary contacts 31 and 32 respectively. In the normal position, that is, with the magnet 23 not energized and the spring 26 holding the armature arm 24 upwardly, the contact 29 is in engagement with the contact 31. When the magnet 23 is energized, the contact 30 moves into engagement with the contact 32. The spring material of the contact arms 27 and 28 is such that during the movement of the armature 24 downwardly, the contact 29 remains in engagement with the contact 31 until after the contact 30 has engaged the contact 32. When the armature 24 is in its lowermost position in engagement with the magnet 23, the contact 29 disengages the contact 31, and remains disengaged until the circuit to the magnet 23 is broken and the armature 24 again moves upwardly un-

der the influence of spring 26. During such return movement, the contact 30 remains in engagement with the contact 32 until the contact 29 engages the contact 31. In the uppermost position, the contact 30 leaves the contact 32. This arrangement is for a purpose which will appear from the description to follow.

Referring to Figure 3 it will be noted that there is provided a "hummer" circuit consisting of the wires 33 and including a primary coil 34 and a common microphone hummer 34a, well known in the art. This hummer device may be of the order of a thousand cycles and receives its energy from the same battery source 21. The hummer circuit serves to modulate the battery circuit with corresponding impulses delivered through the primary coil 34. A secondary coil 35, cooperating with the primary 34 includes in its circuit the contacts 29 and 30 and, through the contacts 31 and 32, a pair of primary coils 36 and 37. Obviously therefore, the signals from the primary 34 of the hummer circuit, induced into the secondary 35, are transmitted to either the primary 36 or the primary 37, depending upon whether the contact 29 engages the contact 31 or whether the contact 30 engages the contact 32. It will also be apparent that due to the arrangement of the contacts 18 and 19 on the wheel 17, and the energization of the magnet 23 by the actuation of such contacts with the brush 20, the induced hummer signals or impulses in the primary 36 will be in the nature of dash-dot signals and those in the primary 37 will be in the nature of dot-dash signals. This is obvious from the fact that when the magnet 23 is energized in a dash-dot sequence, such sequence being carried out by the corresponding engagement of the contact 30 and contact 32, the opposite sequence will prevail as between the contact 29 and contact 31.

The primaries 36 and 37 are the same size and length and are spaced apart a distance of substantially the length of one of them. A secondary coil 38 is provided for cooperation with both of the primaries 36 and 37 and is suitably arranged for adjustment with respect to the primaries 36 and 37 whereby it may be moved to a position adjacent the coil 37 and in such position will induce the signals therefrom. If adjusted to a position adjacent the primary 36 it will induce the signals from such primary. If it is adjusted to a position intermediate the two primaries 36 and 37 it will induce enough of the signals from both primaries to result in a continuous hum signal, the dot-dash of one primary and the dash-dot of the other primary succeeding each other in a manner to provide a continuous unbroken hum signal in the secondary 38. By the same token the intermediate positions of adjustment of the secondary 38 toward either of the primaries 36 or 37 will result in an induced signal of the primary nearest which the secondary is located, predominating.

The induced current from the secondary 38 is amplified by a suitable amplifier 39 of any desired construction or arrangement and the output of such amplifier is carried by the wires 11 to the earphones 41 and/or the visual indicator 4a through such other translating devices or receivers necessary to render the signals audible and/or visible to the student in the trainer.

In order that the signals may be periodically interrupted and a station signal given in simulation of actual conditions as previously explained, the shaft 16 is provided with a second wheel 42 having on its periphery a series of spaced contact members 43 corresponding to the desired station signal to be given, for instance, three "dots". Obviously, any particular combination of "dots" and "dashes" can be provided but the three "dots" illustrate the feature here described. Cooperating with the contacts 43 is a brush contact member 44 in position to periodically engage the contacts 43 as the wheel 42 is rotated. The contacts 43 and 44 are included in the circuit of the secondary 35 of the hummer device and as the wheel 42 rotates continuously, the normal operation would be for such contacts to continuously modulate the hummer circuit so that the signals provided by the cooperation of these contacts would be heard continuously in the earphones. A short circuit is provided for the circuit of these contacts 43 and 44, however, comprising the wires 45 and a contact wheel 46 mounted upon a shaft 47 upon which is also a gear 48 meshing with a gear 49 on the motor shaft 13 whereby the contact disk 46 is continuously rotated from the motor. A brush contact member 50 is provided for engaging the periphery of the contact disk 46 and when such contact engagement is established, as is normally the case, the circuit of the contacts 43 and 44 is "shorted", thereby offsetting and eliminating the influence of the signals produced by the contacts 43 and 44 upon the circuit of the secondary 35. The disk 46 is provided on its periphery, however, with a notch 51 which periodically reaches the brush contact 50, thus breaking the short circuit and permitting the signals produced by the contacts 43 and 44 to modulate the induced current in the secondary 35 and consequently respond in the primaries 36 and 37 and in the secondary 38 to the earphones 41.

The operation of the contact disk 46 with its brush contact 50 is so arranged and timed that during the period when the contact 50 is in the slot 51 and out of contact with the disk 46, the three dot signals will be repeated twice. The causing of these three "dot" signals is also arranged and timed with respect to the contact disk or wheel 17 that one set of three "dot" signals will be induced through the primary 36 and the next sent through the primary 37. This is also in simulation of the actual broadcasting of corresponding signals to planes in actual flight wherein the station call or signal is periodically given twice, once on each side of the true course.

A suitable volume control 52 is provided on the amplifier 39 whereby the volume of the signals transmitted to the earphones 41 can be varied. A volume control 52a is also provided in the trainer by means of which the student can adjust the volume of signals received.

I have also provided means whereby the instructor can talk to the student pilot in the trainer during his test "flight". This means comprises a microphone 52b, the circuit of which may receive its energy from a battery 52c, or if desired, from the battery 21. The microphone circuit includes a transformer 52d and is located for "cutting into" the input of the amplifier circuit by means of a double pole, double throw switch 52e. By this means the instructor may at any time interrupt the test "flight" and talk to the student pilot in the trainer, to advise or instruct him. It has been found useful as a matter of training, for the instructor to periodically interrupt the signals and give the student "weather" reports by this means, corresponding to actual broadcast re-

ports, thus acquainting the student with this additional condition of actual flight.

The complete operation of the invention will now be described. The student pilot having been instructed as to the meaning of the various signals above explained, is placed in the trainer and the hood 3 drawn over him so that he must control the direction of his test "flight" solely by the compass 4 and the signals, visual or audible, which he receives from the signal sending device. The instructor may, of course, assume any desired position for the trainer, representing a plane in flight, with respect to a radio station and airport and will then proceed to give the signals to the student in the trainer which correspond to the initial assumed position of the trainer, and through its various turns corresponding to the same signals which an actual plane in flight in a corresponding initial position and corresponding turns and paths, would receive from an actual radio station. The instructor also assumes the pilot and trainer to be a given distance from the airport and station and assumes a constant speed of "flight". With these factors, and by checking the time element of the test "flight" and by watching the graduations 7 on the trainer with respect to the fixed pointer, the instructor is able to observe and to chart the course of the student pilot responsive to the signals given him by the instructor.

In Figure 2 is illustrated a typical chart which may be used for this purpose although it will be understood that the particular details thereof may be varied considerably without departing from the invention. This chart comprises a disk 53 provided with concentric circle lines 54 drawn around a centrally located broadcasting station 55. On this chart are also drawn the so-called "on course" radio "beams" represented by the lines 56 and 56*a*.

This chart corresponds to a typical radio beam map for a given station and airport which sends out beams in four directions, in the instance shown, 60° east of north, 30° south of east, 60° west of south, and 30° north of west. Such maps are available to the public and the student pilot in the trainer is preferably, though not necessarily, provided with one to assist him in his instruction and training. In the illustration here given it will be assumed that the student pilot in the trainer is supplied with a map showing the corresponding beams and station as is shown on the chart 53, or at least is familiar with it and knows that this test "flight" is to be to the station and airport thereof. These maps also show which "beam" and which direction from the station, the landing field is located.

On the chart, the landing field or airport A is located on the beam or course extending 60° east of north from the station.

It will be noted that the "beams" as shown on the chart divide the area around the station and airport into four quadrants, which for convenience will be called the north, south, east and west quadrants, corresponding to the direction they lie from the station.

In beginning the test "flight" the instructor arbitrarily fixes the position of the "plane" or trainer at the point X on the chart. Bear in mind at this point that the student pilot enclosed within the trainer must now by the use of the radio signals reaching him, locate his position with respect to the airport A and still with the use of signals received, theoretically bring the "ship" into such airport on the radio beam. The student, of course, does not know at the start of his test flight what position the instructor has placed him with respect to the station or the beam.

For convenience, I will assume the trainer to be equipped, on this theoretical "flight" with the earphones 41 only and that the signals sent by the instructor and received by the student pilot are audible only. It will be understood, however, that the visual indications may also be used, alone or in combination with the audible signals.

The instructor, having arbitrarily fixed the position of the trainer at X on the chart, now adjusts the secondary 38 into inductive relation with the primary 37. This results in an N or dash-dot signal reaching the pilot through earphones which tells him immediately that he is in either the north quadrant or the south quadrant, but does not tell him whether he is headed in a direction with respect to a "beam" which will permit him to intersect it or whether he is flying away from it. In order to find out he decides to continue flying straight north which he does for a period of say five minutes, to the position X—1 as plotted by the instructor on the chart 53, the distance between the concentric lines 54 representing a certain elapsed time at a certain speed. In taking this course the student pilot first adjusts his volume control 52*a* to reduce the volume to the lowest audible point possible. This enables him to detect more quickly any decrease or increase in volume than if it were turned up loud. Observing this direction of flight by the student, the instructor, seeing that the pilot is flying away from the course, decreases gradually the volume of the N signal being sent to the pilot who, noticing this decrease in volume, immediately realizes that he is flying away from the course and also that he is in the north quadrant. He thereupon turns the trainer about and begins to fly straight south, the instructor noting the change in course on the chart. As the pilot continues to fly south by his compass, he begins to approach the on-course "beam" and during his approach to the "beam", the instructor gradually and in accordance with the time and speed element previously determined, shifts the secondary 38 in a direction towards the space between the primaries 36 and 37 and when the proper time has elapsed for the trainer to have reached the on-course "beam", the instructor has moved the secondary 38 to a position directly between the primaries 36 and 37 in which position the pilot receives the on-course signal or the continuous hum. In other words, in this position the secondary 38 induces the combined dash-dot and dot-dash signals from the primaries 36 and 37 and he hears a continuous hum and immediately knows that he has now reached an on-course "beam". He does not know as yet, however, whether he has reached the "60° east of north" beam, or the "30° north of west" beam. During his approach to the "beam" the instructor has slightly increased the volume of the signals, and by this the student pilot realizes that in flying due south to the beam he has also flown nearer to the station and airport.

Before making a turn after reaching the "on-course" signal, however, he continues to fly south to a point just beyond the on-course "beam" 56, indicated at X—2 on the chart. The instructor observes this by checking the time element and at the proper moment adjusts the secondary 38 towards the primary 36 to give a distinguishable and predominating A signal or dot-dash to the

student pilot, thus advising him that he has flown across and slightly beyond the on-course "beam".

At this point, the student, being familiar with the direction of the two beams above mentioned, knows that by turning due west he can find out whether he has intersected the "60° east of north" beam or the "30 north of west" beam, for if it is the former he will, by flying due west, quickly regain the beam and if it is the latter, he will get farther away from it.

The student thereupon turns due west and shortly he again hears the continuous on-course signal, the instructor observing the turn and controlling the signals. The student now knows which beam he is on, whereupon he turns slightly south at the point X—3 and starts to fly on the beam. The instructor observes from the position of the trainer, however, that the student soon starts "flying" slightly to the north of the course, and, in accordance with his time check, again gradually moves the secondary 38 towards the primary 37 to give the N signal. It should be noted here that all this time during the "flight" from the point X—2 on the chart, the instructor increases gradually the volume of the signals which tells the pilot that he is flying nearer to the field.

When the pilot realizes from the N signal he is receiving that he is again flying to the north of the course, he turns south again at the point X—4 and again crosses the on-course "beam" and flies on past it a short distance to the point X—5, the instructor observing this carefully and adjusting the secondary 38 to provide the proper signals to the pilot to show him his position. As soon as the pilot hears the A signal again predominating, he turns north, he having by this time quite accurately determined the compass direction on the on-course "beam", even without previous knowledge thereof, and as soon as he again reaches the on-course signal at X—6, he turns directly on the "beam" and continues directly on this on-course or constant hum signal, which the operator continues to increase in volume, until the student pilot is theoretically directly over the station 55. At this point the operator operates the amplifier control to entirely cut off momentarily, all signals to the earphones. At this the student pilot knows that he has reached a point directly over the station. It is obvious to the student that he may immediately turn back either to the right or left and come in again on the same on-course "beam" for his theoretical landing, knowing that the airport is on this beam and back about two miles from the station. In the illustration here shown, however, the instructor observes that the pilot continues on for a considerable distance, remaining on the on-course signal. The instructor gradually decreases the volume of the signal, thus telling the pilot that he is now flying away from the field. At the point X—7, the student turns the trainer to the right to fly back to the field. As he does so he enters the A signal zone (the west quadrant) on the opposite side of the field from which he originally came in, which is a further check to his position, the instructor moving the secondary 38 towards the primary 36 in order to provide this A signal. The student now turns back on to the on-course beam and retraces his path over the station 55, receiving the "silent" signal as he does so. He now knows that the airport A lies about two miles directly ahead of him and that he can safely "lose altitude" with confidence as to his position.

This is but one illustration of any number of maneuvers and test "flights" which a student pilot undergoes in his training and instruction to fly by radio. During this or any of such test "flights" the student, of course, periodically hears the station call in the manner previously described, this being taken care of automatically without the necessity of the operator controlling it. Thus the student is taught not only how to fly directly on a radio beam to a given station and airport but is taught how to locate his position with respect to such station and beam, if lost, and to get on to such beam with a minimum loss of time.

After but a very few hours instructions and practice in a practical application of this invention, a pilot is able to take a real aeroplane into the air under actual flying conditions and by the use of his receiving set and the actual broadcast of the radio signals from the station and airport, to easily and readily fly by radio.

Once again the importance and value of training of this kind is emphasized because of the saving of expense of actual flight, which, if blind flying conditions are followed by hooding the pilot in the plane, requires an additional pilot in the open for safety, and eliminates the hazard of actual blind flying practice.

It will be apparent that many changes may be made by way of detail without departing from the spirit and scope of my invention. I do not limit myself, therefore, to the exact form herein shown and described, other than by the appended claims.

I claim:

1. An apparatus for instruction and training in flying by radio comprising a grounded trainer controllable as to direction, means observable from a position away from said trainer for indicating the compass position of said trainer, means in said trainer for receiving signals simulating radio signals broadcast to aeroplanes in actual flight, means for creating and transmitting such signals to said receiving means in accordance with the observed compass position of said trainer, and means on said creating and transmitting means for varying the intensity of such signals.

2. An apparatus for instruction and training in flying by radio comprising a grounded trainer controllable as to direction, means observable from a position away from said trainer for indicating the compass position of said trainer, means in said trainer for receiving signals simulating radio signals broadcast to aeroplanes in actual flight, means for creating and transmitting such signals to said receiving means in accordance with the observed compass position of said trainer, means on said creating and transmitting means for varying the intensity of such signals and means in said trainer for varying the intensity of the received signals.

3. An apparatus for instruction and training in flying by radio comprising a grounded trainer controllable as to direction, means observable from a position away from said trainer for indicating the compass position of said trainer, means in said trainer for receiving signals simulating radio signals broadcast to aeroplanes in actual flight, means for electrically creating and transmitting such signals to said receiving means in accordance with the observed compass position of said trainer, and means on said creating and transmitting means for varying the intensity of such signals.

4. An apparatus for instruction and training

in flying by radio comprising a grounded trainer controllable as to direction, means observable from a position away from said trainer for indicating the compass position of said trainer, means in said trainer for receiving signals simulating signals broadcast to aeroplanes in actual flight, means for electrically creating and transmitting such signals to said receiving means in accordance with the observed compass position of said trainer, means on said creating and transmitting means for varying the intensity of such signals, and means for selectively interrupting the transmission of said signals and establishing a telephone circuit to said trainer.

EDWIN A. LINK, JR.