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RADIO DIRECTION FINDING SYSTEMS
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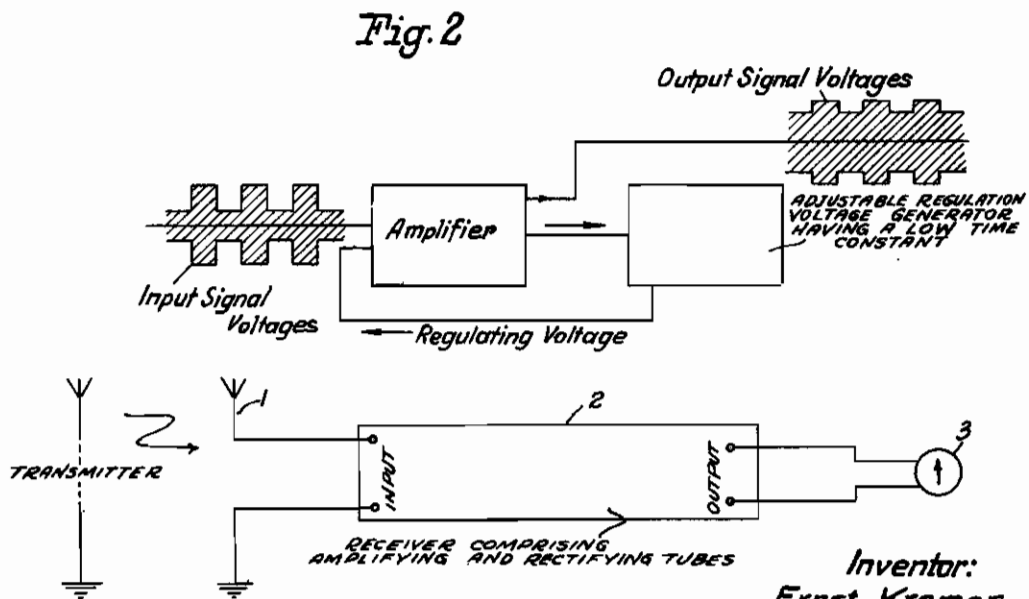
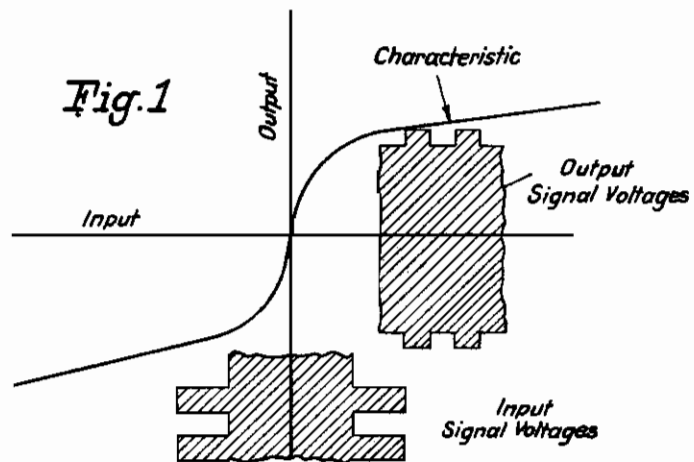


Fig. 1a

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RADIO DIRECTION FINDING SYSTEMS

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This invention relates to radio direction finding systems, and more particularly to new and useful means applicable in the receiving positions of such systems to improve reception of sharply bundled guide beams of radiation emanated from a radio beacon transmitter.

It is taught by experience that the effectively desired action of radio beacon transmitters, which are adapted to produce either alternately keyed or differently modulated and mutually intersecting radiation diagrams for the purpose of allowing amplitude comparison between the resulting signal voltages to be carried out in a direction finding receiver becomes harmfully influenced by buildings, iron framework and the like obstacles which in the vicinity of such transmitter act as unintended and undesired reflector and reflectors of the electromagnetic energy emitted by a radio beacon transmitter. The electromagnetic waves subject to reflection at such obstacles coact with the non-reflected direct radiation from the transmitter to build up standing waves, which so distort the radiation diagrams of the radio beacon that they are rendered more or less ripple dependent upon size and position of such reflectors. The numerous cusps resulting from this rippleness are extremely critical particularly in the region of the course line radiation beam, because of the fact that the undulated directional radiation patterns under certain circumstances are caused to intersect each other at a larger number of points instead of at only two points which are desired for defining the line of equal field intensity, so that in addition to the radiation guide beam defining the course line, a plurality of harmful divergent secondary beams is produced.

Attempts have been made in the past to overcome this difficulty by "concentrating" in a radio receiving equipment an incident divergent guide beam of radiation by so selecting the operating characteristic of the indicating means, e. g. by employing rectifying and amplifying tubes having a rectangular characteristic that amplitude differences set up in the input circuit of the receiver occur as enlarged differences in the output circuit thereof.

The deleterious effect described in the penultimate paragraph may in fact be avoided in a radio beacon transmitter by the provision of suitable directional antenna arrays or systems capable of more sharply bundling the directional radiation patterns subject to comparison in order to obtain more acute angles of intersection therebetween. This expedient has been found satis-

factory despite the rippled shape of the directional radiation patterns which are effectively caused to intersect one another only in two points desirable for obtaining the requisite course line beam of radiation. However, the extraordinarily pronounced sharpness of a guide beam of radiation resulting from such sharply bundled radiation patterns intersecting each other at very acute angles has not been well adaptable in the past for guiding aircraft, since the acoustically and/or optically indicating instruments forming part of a direction finding receiver mounted on such vehicle are caused to so sensitively respond thereto, that even the slightest deviation from the course line would involve exaggerative indications in or on such instruments. The aeroplane would thus too easily be subjected to a pendulum movement to and fro the actual course line on account of the pilot's continuous attempts to correct for such deviation from the proper direction of flight.

It is the object of this invention to overcome the difficulties referred to in the foregoing by imparting specific measures to direction finding receivers which are adapted to cooperate with a radio beacon transmitter emitting a sharply defined guide beam of radiation.

This problem is solved in accordance with one specific aspect of my invention by so influencing the characteristic of operation of a radio receiver in which field intensity differences of electromagnetic waves occurring in the input circuit thereof are converted into sound volume differences, that the proper sensitiveness of the indication instruments cannot exceed the permissible value adequate for wireless navigation even in response to sharply defined beams of radiation as mentioned above. This is achieved according to the main feature of my invention by so imparting the voltage differences of incoming signals to a change, that the corresponding voltage difference across the output circuit of the receiver is subjected to a considerable decrease. This amplitude difference decrease is preferably made adjustable in order to enable the pilot to individually regulate the sensitiveness of indication to a proper value, and particularly to accommodate such regulation to the atmospheric conditions prevailing. It is thus obvious that the measures for decreasing amplitude differences in a radio receiver as proposed in the present invention are quite contradictory to the amplitude difference increase endeavoured according to prior art as stated in the foregoing.

My invention will be more readily understood

from the following description taken in conjunction with the accompanying drawing, in which

Fig. 1 is a graph explanatory of one possibility for putting this invention into effect, while Fig. 2 schematically shows the possibility involving a further solution of the problem concerned.

The problem of securing an amplitude difference decrease which according to the main feature of this invention is to be carried out in a radio receiver in order to provide possibilities for securing reliable navigation even in response to an extremely defined beam of radiation allows different solutions.

One of the possible solutions which is based upon the facility to adjust the operating point of a radio receiving equipment to a range of its characteristic which presents a slightly ascending branch. This is shown in the graphic representation of Fig. 1. The signal voltages emitted from a radio beacon transmitter, picked up by the antenna and applied to the input circuit of a receiver, are diagrammatically shown in the lower part of this graph, while the voltage differences across the receiver output circuit in response to the adjustment of the operating point to a slightly ascending branch of the characteristic are considerably minimized as shown at the right hand of this figure. The last mentioned signals are then conveyed to a position indicating instrument which may be a pointer indicator or a telephone receiver.

A further solution of the problem subject to my invention is embodied in Fig. 2. Signal voltages diagrammatically shown at the left hand of Fig. 2 incoming to the amplifier of a radio receiving equipment are caused to so control a regulation voltage generator, in turn controlling the amplifier, that the signal voltages, that is voltage variations in the output circuit of the amplifier are reduced with respect to the corresponding amplitude variations existing across

the input circuit of the amplifier. Such voltage difference decrease is effected in a regulating circuit having a low time constant. In detail, the signal voltages incoming to the amplifier influence a regulation voltage generator, and the resultant regulating voltage from this generator is conducted back to the amplifier to so regulate the gain thereof that the voltage differences are smaller in the output circuit than in the input circuit. The signals thus occurring in the output circuit are shown to the right of Fig. 2. These signals are applied to a telephone receiver.

The above described solutions of the problem to so influence voltage differences between signals incoming to a radio receiver that minimized amplitude differences occur across the output circuit thereof are of great importance, specifically when acoustic position indication is concerned, because of the fact that it has heretofore been almost impossible to correctly determine or ascertain the magnitude of the amplitude differences in a telephone receiver since in response to a sharply defined guide beam of radiation referred to in the foregoing, even the faintest signal tone difference corresponding to the slightest almost inevitable deviation from the actual course line and perceived in a telephone receiver as a tone predominant over the continuous dash tone will cause the pilot to continually endeavour correction for such deviation with the result that the aeroplane will be subject to a pendulum or zigzag movement to and fro the actual course line.

The expedient according to my invention to provide means capable of effecting amplitude difference decrease and of correctly regulating the sensitiveness of indication in a radio receiver involves considerable features of novelty particularly when such receiver is adapted to respond to sharply defined guide beams of radiation.

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