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W. S. RABB.
CONTROL FOR AEROPLANES.
APPLICATION FILED JULY 29, 1920.

1,387,513.

Patented Aug. 16, 1921.

Fig. 2

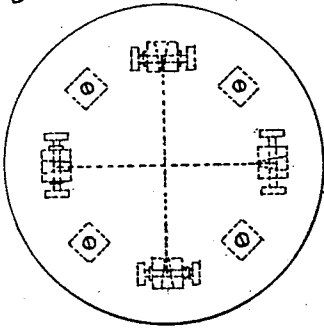


Fig. 12

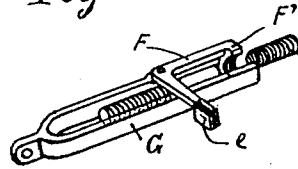


Fig. 10

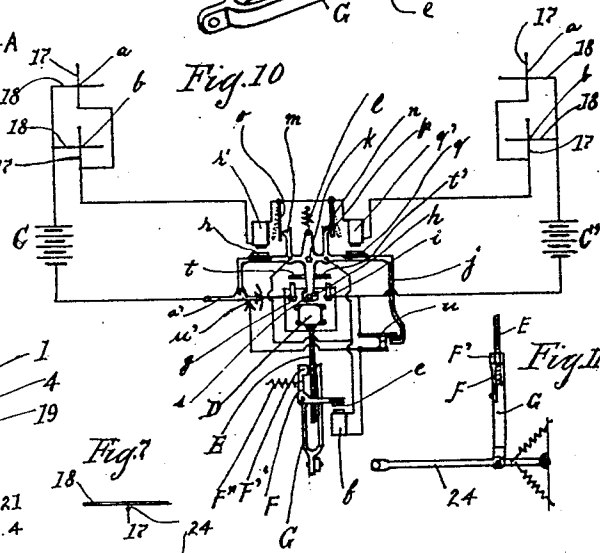


Fig. 1

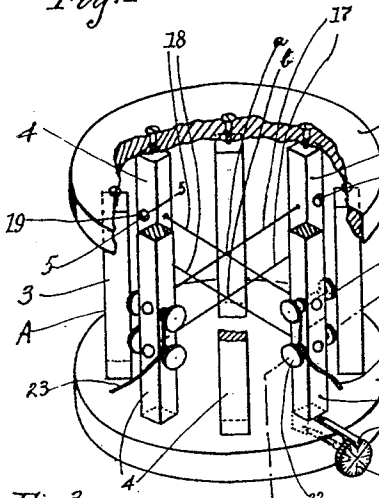


Fig. 7

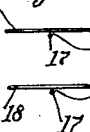


Fig. 9



Fig. 3

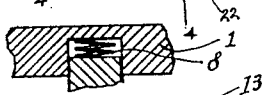


Fig. 6



Fig. 4

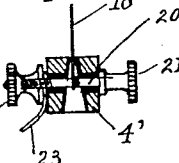


Fig. 5

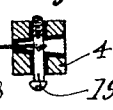


Fig. 8

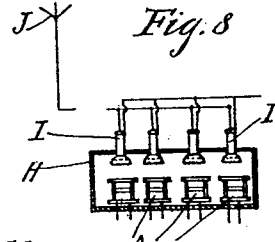
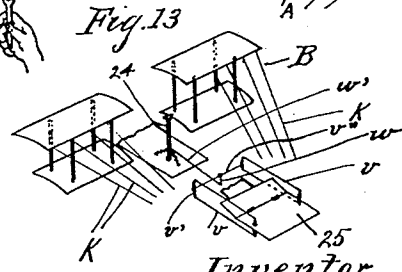


Fig. 13



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UNITED STATES PATENT OFFICE.

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CONTROL FOR AEROPLANES.

1,387,513.

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To all whom it may concern:

Be it known that I, WILLIAM S. RABB, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Control for Aeroplanes, of which the following is a specification.

This invention relates to radio controlling devices and more particularly to that class employed for controlling the steering devices of dirigible balloons or aeroplanes.

It may, however, also be used for controlling the operation of mechanism distant from the operator, other than the steering devices of machines used in aeronautics, as, for instance light houses at sea, etc.

An object of the invention is to provide improved means for controlling an aeroplane for military use, without an operator on board, said means being rendered effective to set in motion and control mechanism carried by the aeroplane (the latter being removed long distances from the position of the operator) by electric waves, such, for instance, as are commonly produced for transmitting sounds in the art of radiotelephony.

A further object of the invention is to provide a device of the class described, so constructed as to be easily used in connection with the diaphragms of the transmitter and receiver of two widely separated stations having radiotelephonic equipment.

As is well known, radiotelephony is achieved by simply removing the usual inter-connecting wires and substituting therefor a train of electromagnetic waves passing through space, the selected wave length being constant.

It is not thought necessary to here show or describe the means ordinarily used for producing comparatively undamped electromagnetic waves to be emitted from the aerial, and the means for effecting the necessary variations in the air pressure taking place in speaking a message against the transmitting diaphragm, or the means at the receiving end to cause the waves of variable amplitude to actuate mechanism which causes them to set in vibration a receiving diaphragm so that the displacements correspond with the variations in the amplitude of the electromagnetic waves.

In order to secure a more positive action, I use musical sounds of different notes or

even octaves, so that the difference between the wave amplitudes of the several sounds used, will be clearly and distinctly defined.

For example, I may use a unit tuned to the musical note E for controlling the ailerons of an aeroplane, one tuned to the musical note A, for the down movement of the elevator flaps, one to the note D for the up movement thereof, one to the note G for the rudder to the left, and one for the rudder to the right and so on. By using an approximately pure musical sound, a wave diagram will show a curve approximately a sine curve, or, in other words waves of uniform amplitude. Thus, the medium I employ to be sympathetically vibrated by the vibrating diaphragm of the receiving equipment on the aeroplane, may be sharply tuned, there being no complicated range of variable wave amplitudes to be accurately responded to. In the drawings:

Figure 1 is a perspective view of the invention, partly broken away.

Fig. 2 is a top view of same.

Fig. 3 is a fragmentary sectional view of the movable upright shown in Fig. 1.

Fig. 4 is a section on line 4—4 of Fig. 1.

Fig. 5 is a section on line 5—5 of Fig. 1.

Fig. 6 is an end view of the adjustment screw shown in Fig. 3.

Fig. 7 is a side view of a part of the vibratory wires forming part of the invention.

Fig. 8 is a front view of a plurality of units such as is represented by Fig. 1, in connection with a plurality of receivers of a receiving equipment.

Fig. 9 represents the transmitter and the aerial of a sending equipment showing the application of a tuning fork to the transmitter.

Fig. 10 is a diagrammatic plan view of the wiring on board an aeroplane, showing two units in operative connection with the usual lever or stick used ordinarily for raising and lowering the elevator flaps.

Fig. 11 is a side view of the stick showing part of the connecting mechanism.

Fig. 12 is a perspective view of a part of the motor shaft and the clutch to engage it, and

Fig. 13 is a perspective diagrammatic view of an aeroplane showing the stick and its connection with the elevator flaps.

The invention consists in a circuit closing or contact making device or unit capable

of being adjusted in syntony with the diaphragm of a receiver which vibrates responsive to the electro-magnetic waves of preferably approximately uniform amplitude such as would result from a continued pure musical sound. The unit may be used in connection with any radiotelephonic system such as the Ruhmer or Poulsen systems. With sharply tuned units, a number of same may be used simultaneously and selectively, so that several steering parts of an aeroplane may be simultaneously actuated.

In Fig. 1, A represents the circuit closing device having a top plate 1, and a bottom plate 2 being permanently joined together by four uprights 3, spaced between the uprights 3 and the uprights 4 and 4', three of the latter being permanently secured to the top and bottom plates. The upright 4' is bodily movable vertically between the plates 1 and 2, said plates being formed with rectangular openings 5 and 6 respectively, wherein the upright slidably fits. At its lower extremity it is formed with an inclined face 7 and with its upper extremity it engages the spring 8, which latter tends constantly to press it in a downwardly direction. Threaded radially in the edge of the bottom plate 2 so as to extend into the opening 6 thereof is the adjustment screw 9, the inner end 10 thereof being tapered to fit the slant of the face 7 of the upright 4'. Obviously, when the screw is fed inwardly the upright 4' will be raised and correspondingly lowered when the screw is withdrawn.

The screw is formed with a flat milled head 11, having on its outer face radial index lines 12. Slidably radially, as by means of the dove-tailed groove 13 in the upper face of the top plate 2, is the indicator arm 14 formed at its outer extremity with a notch 15 fitting snugly over the edge of the head 11 and formed with a pointer 16 extending over the face of the head. By means of the pointer 16 operating in connection with the lines 12 on the indicator, the operator may discern the amount of movement imparted to the screw 9 in the process of setting the upright 4' in vertical position. Extending from one to the other of the oppositely disposed uprights 4 are the spaced wires 17, and similarly from the oppositely disposed uprights 4 and 4' are the wires 18. Each wire is suitably secured at one of its ends to a screw 19 extending through the upright and being suitably insulated therefrom, as indicated in Fig. 5, of the drawings, the wire 17 or 18, as the case may be, extending through the side of the upright and being also insulated from the latter. At its opposite end the wire is suitably secured to a key 20 being formed with a head 21 said key extending frictionally laterally through one of the uprights 4 and the upright 4' re-

spectively, and being threaded to receive the finger nut 22 on the opposite side of the upright, whereby the electrical conductor 23 may be electrically connected with the key by means of said nut, as indicated in Fig. 4 of the drawings. The key and wire are suitably insulated from the upright. When the finger nut is caused to be turned the wires 17 and 18, as the case may be, may be drawn taut as the strings of a piano. Thus, each pair of wires may be tuned as desired to produce when vibrated a sound of any chosen note the note being preferably of a pure musical tone.

The two sets of wires 17 and 18 are spaced exactly the same distance apart and arranged so that a wire of one set will overlies and cross one of the wires of the other set, so that when the wires 18 are raised or lowered by means of the set screw 9 the gap will be increased or diminished as the case may be.

By having a long tapered end on the screw 9 and a very fine thread thereon, the upright 4' may be moved so that the wires 18 will all but touch the wire 17, so that the slightest vibration of the wires will cause them to contact and thereby cause an electric circuit in which they are connected to close.

As shown in Fig. 1, the upper wires 17 and 18 are connected in series by means of the conductor 23. Fig. 10 is a diagrammatic view of two units A, connected in separate circuits whereby to control the stick for operating elevator flaps of the aeroplane B, shown in Fig. 13. In the unit A an upper and lower set of wires are employed so as to insure contact, the upper set of wires being indicated by the letter *a* and the lower set by the letter *b*.

As indicated in Fig. 12 *a* and *b* are connected in series in a circuit, each unit having a battery designated respectively by C and C'. D designates a motor, E the threaded shaft thereof, F a bell crank having a threaded head F' adapted to fit side-wise over the threads of the shaft E so as to be screwed back and forth thereon when the shaft is moved and G a support for the bell crank F extending to the lever 24 and pivotally connected therewith so that the latter may be reciprocated when said bell crank is actuated by the shaft E.

On the other arm of the bell crank is the armature *e* associated with the magnet *f*; *g*, *h* and *i* designate the contacts for the motor, which latter is of the reversible type and designed to run in one direction when *h* and *g* are connected, and in opposite direction when *h* and *i* are connected. *j* is an oscillating yoke rocking on the pivot *k*, said yoke being held in neutral position by the spring *e*. When thus held the contacts *m* and *n* contact with the spring contacts *o*

and *p*. On the yoke *j* are the armatures *g* and *r* suitably insulated therefrom, said armatures being associated with the magnets *q'* and *r'* respectively. From the pivot *h* the yoke extends downwardly and is formed at its lower extremity with the pallet *s*, normally contacting with *h*. A pair of contact arms *t* and *t'* are adapted to contact so as to connect with *g* and *i* respectively when the yoke *j* is rocked in opposite directions. When the arm *j* is rocked counterwise of a clock it will lift the contact *u* to break the circuit, and when it is rocked in the opposite direction it will raise the contact arm *u'* to break the circuit. The operation of the circuits of both units may be described as follows. The circuit for one of the units operates as follows:

Battery to wires *a* and *b* to magnet *r'*, spring contact *o*, contact *m*, magnet *f*, contact arm *a'* to battery. Thus, energizing magnets *r'* and *f*, the former rocking the yoke *j* by attracting armature *r*, and the latter actuating bell crank *F* to operatively connect the head *F'* with the motor shaft *E*. The current now flows from battery to magnet *r'* to spring arm *p*, contact *n*, magnet *f*, contact *u*, to *i* through *i* to *h* to *g* to battery. Thus maintaining magnet *r'* and *f* energized and actuating the motor in one direction whereby the support *G* will be moved to actuate the lever 24.

Referring to Fig. 13, the lever 24 is operatively connected with the elevator flaps by means of the rods *v*, the lever arms *v'*, the rock shaft *v''*, and the lever arm *w* pivotally connected with the rod *w'*. Thus, the lever 24 will be actuated to operate the elevator flaps in one direction to cause the machine to rise or fall as the case may be.

The current for the other unit may be described as follows:

From battery *C'* through *b* and *a* to magnet *q'*, spring arm *p* to contact *n*, magnet *f*, contact *u* to battery, thereby energizing *q'* and *f* to rock the yoke *j* counter clockwise and thereby break the circuit at *u*. The current now flows from battery *C'*, magnet *q'*, spring contact *o*, contact *m*, magnet *f*, contact *u'*, contact *t*, to *h* to *i* to battery. The motor now runs in the opposite direction and obviously moves the lever 24 in the opposite direction. When contact between the wires *a* and *b* is broken the magnet *f* is deenergized and the bell crank *f* disengages from the shaft *e* by the influence of its spring *f''*.

The above sets forth one way of actuating steering devices of an aeroplane. In Fig. 8 of the drawings is shown a plurality of units *A* arranged in a row in a casing *H*, which is shown in cross section, but which is preferably closed to the atmosphere to avoid outward disturbances.

Above each of the units *A* with its dia-

phragm *M* directly over the unit, are a plurality of receivers *I*, said receivers being operatively connected with a radio telephonic receiving circuit, the aerial *J* thereof only being shown. The device shown in Fig. 8 is carried on the aeroplane in any suitable manner, one form of aerial therefor being indicated in Fig. 13 by the lines *K*. In Fig. 9 of the drawings is shown the transmitter *H* forming part of a radio telephonic sending circuit, the aerial thereof only being shown.

In operation, each of the units shown in Fig. 8, is tuned, as hereinbefore stated, to a pure musical sound, no two units being alike in tone. For each unit, there is provided at the sending station a suitable tuning fork *H*, of the tune corresponding to the tune of its respective unit.

When it is desired to close a particular steering device thereon, the proper tuning fork is repeatedly vibrated in front of the diaphragm *Z* of the transmitter, thereby actuating its corresponding unit on the aeroplane to close said particular circuit, the vibration of the tuning fork being continued until the aeroplane is observed to have sufficiently responded in its flight. When two or more of the steering devices are to be actuated simultaneously their respective tuning forks are vibrated simultaneously in front of the transmitter, as, each unit will respond only to waves of an amplitude produced by the sound to which it has been tuned.

While I have shown but two circuits for setting the motor in motion any number of circuits may be applied to the same motor, or if desired separate motors may be provided.

I claim:

1. In an electric circuit closing device, the combination with the vibratory diaphragm of a telephone receiver wherein vibration of a certain character may be selectively set up, or vibratory members adjacent said diaphragm so as to be sympathetically vibrated thereby and disposed immediately adjacent each other so as to contact with each other to thereby close an electric circuit when vibrated, all of said members being constructed so as to vibrate in unison sympathetically only in response to said certain selectively set up vibrations for the purpose set forth.

2. In an electric circuit closing device, the combination with the vibratory diaphragm of the transmitter and that of the receiver of a radiotelephone system, of crossed wires supported in spaced relation in a position relative to the diaphragm of the receiver so as to be influenced by certain air displacements of the latter when vibrated to set said wires in vibration, a tuning device for producing a musical sound against the transmitter diaphragm to produce said certain air

displacements, and adjusting means for varying the distance between said wires for the purpose set forth.

3. A device for controlling steering apparatus of a flying aeroplane, by a wireless telephony system such as the Poulson and the like, the latter having a diaphragm transmitter at the land station and a diaphragm receiver on the aeroplane, a motor
10 on the aeroplane operatively connected with steering mechanism of the latter to change

the course thereof when the motor is actuated, a normally open electric circuit connected with said motor to actuate it when said circuit is closed, and a vibratory circuit
15 closing device connected in said circuit and capable of adjustment in syntony with both of said diaphragms to vibrate sympathetically to close said circuit when said diaphragms are active.

20 In testimony whereof I affix my signature.
WILLIAM S. RABB.