

March 28, 1944.

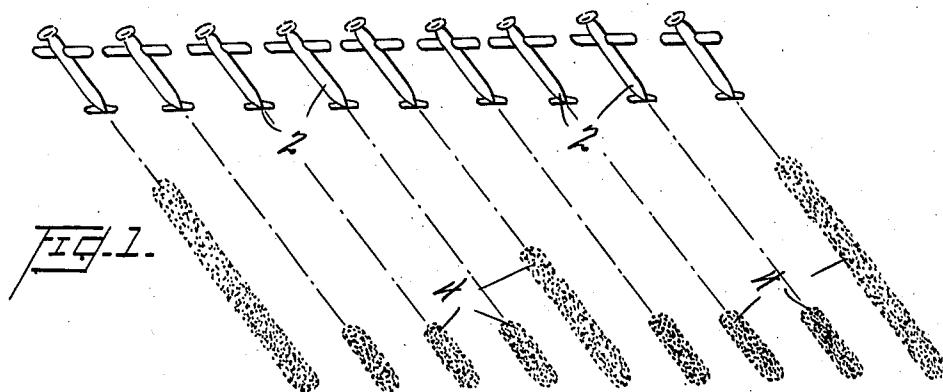
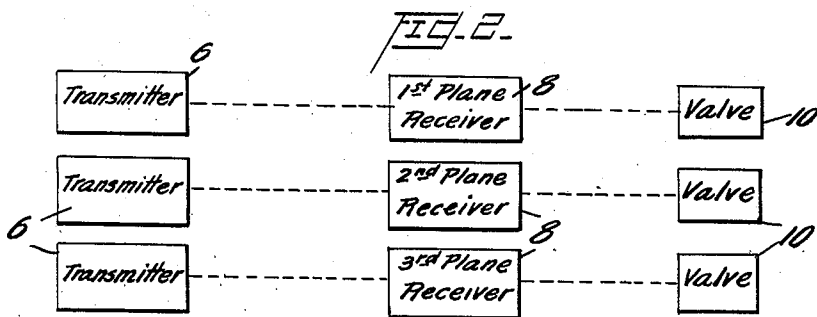
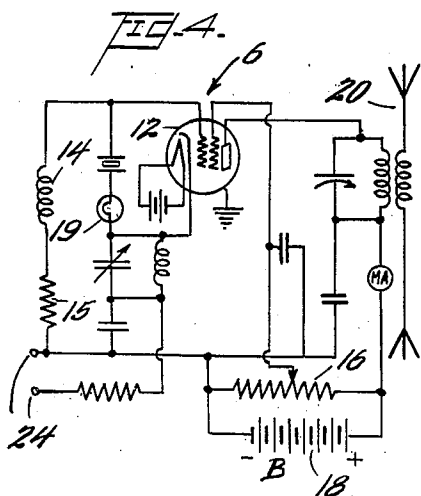
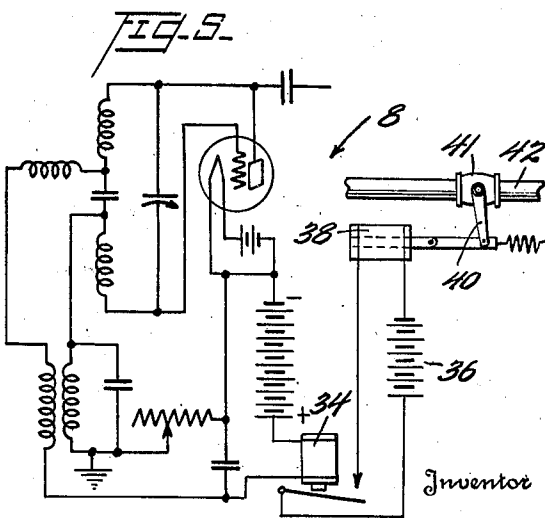
J. T. REMEY

2,345,152

SKY WRITING WITH A PLURALITY OF AIRPLANES

Filed Nov. 7, 1940

3 Sheets-Sheet 1



John T. Remy

334 Martin T. Fisher,

Attorney.

March 28, 1944.

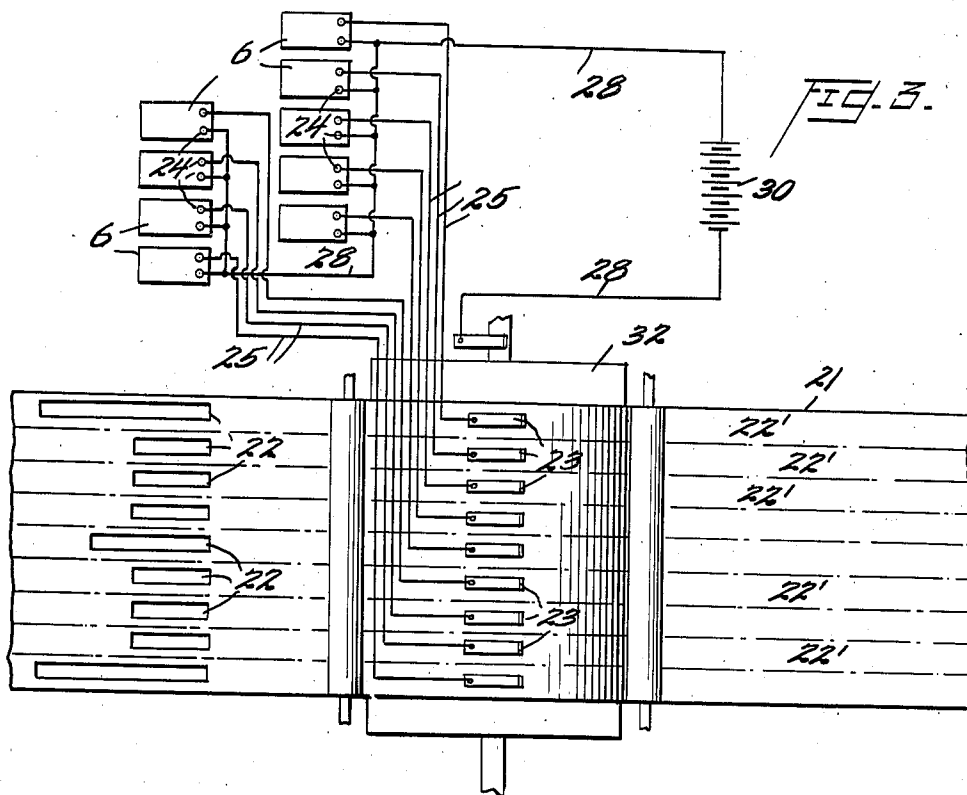
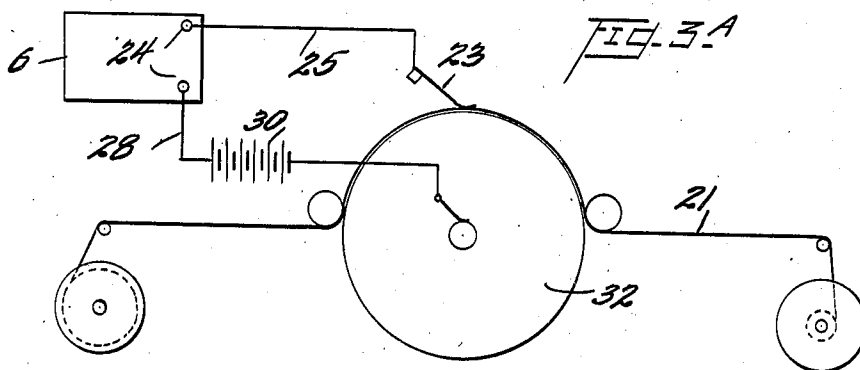
J. T. REMEY

2,345,152

SKY WRITING WITH A PLURALITY OF AIRPLANES

Filed Nov. 7, 1940

3 Sheets-Sheet 2



Inventor

John T. Remy

334

Martin T. Fisher,

Attorney

March 28, 1944.

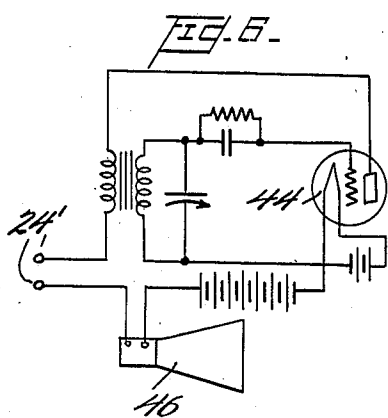
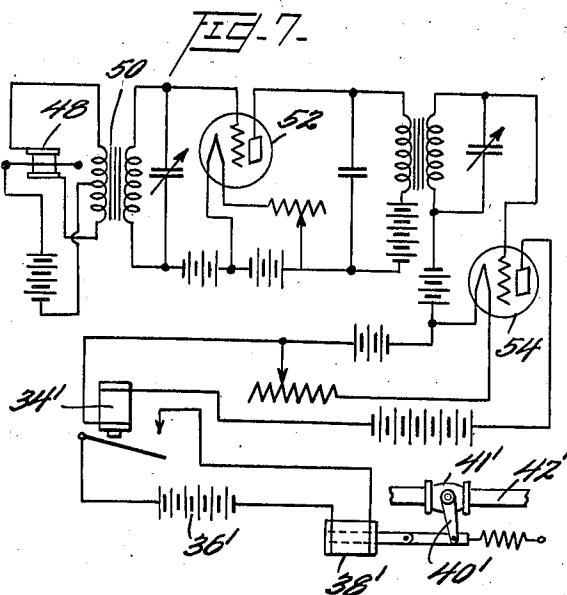
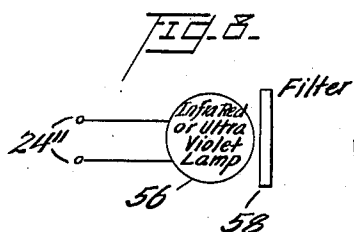
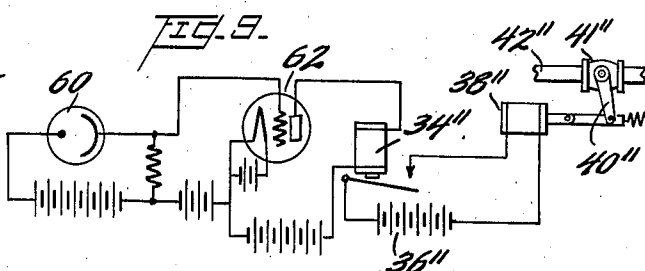
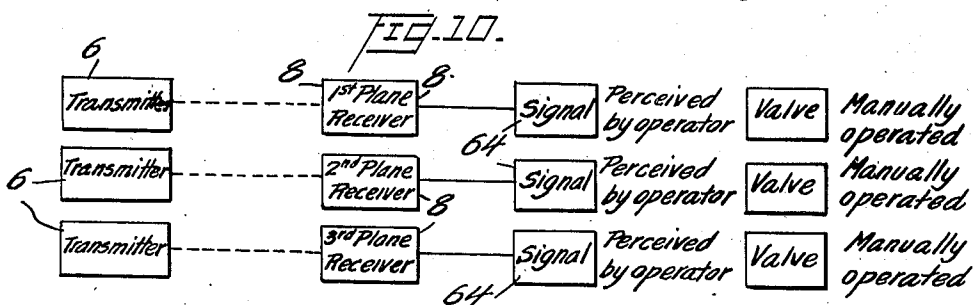
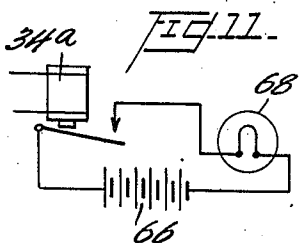
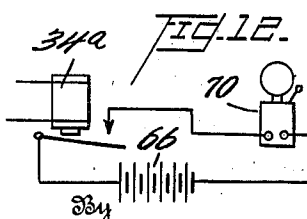
J. T. REMEY

2,345,152

SKY WRITING WITH A PLURALITY OF AIRPLANES

Filed Nov. 7, 1940

3 Sheets-Sheet 3



Inventor

John T. Remy

Martin T. Fisher,

Attorney.

UNITED STATES PATENT OFFICE

2,345,152

SKYWRITING WITH A PLURALITY OF AIRPLANES

John T. Remey, New York, N. Y.

Application November 7, 1940, Serial No. 364,747

18 Claims. (Cl. 40—127.1)

This invention is a method of and apparatus for forming letters or symbols in the air by means of contiguous and substantially parallel smoke trails.

In my prior Patent No. 1,716,794, dated June 11, 1929, there is disclosed a method of and apparatus for forming letters or symbols in the air by means of contiguous and substantially parallel smoke trails, and the present invention is an improvement over the method and apparatus set forth in that patent.

In my prior patent there is disclosed a column carrying smoke forming material, which column is carried through the air, in nearly vertical position, by being suspended from a moving aircraft. This column is provided with a number of smoke-emitting valves, the opening and closing of which are controlled, so that the length and placement of the several smoke trails is such as to build up a letter or symbol.

In the present invention, a similar principle is utilized, in that a plurality of smoke emitting valves is provided, but in this case each valve together with corresponding smoke forming mechanism, is carried by an individual airplane and these airplanes fly in contiguous and parallel paths, the valve in each plane being operated so as to control the placement and length of smoke trail formed by that plane.

The several planes, say ten or fifteen, in number for example, fly in formation. This may be "company front" formation, in horizontal or vertical planes, or in echelon formation, in horizontal, vertical or diagonal front formation.

The several planes are not mechanically connected. Each plane, however, is provided with controllable means for forming at least one heavy smoke trail, and with means for starting and stopping the smoke trail as desired.

It will be evident, in order that the several smoke trails emitted by the several planes shall cooperate to form a finished letter, that the starting and stopping mechanism in the several planes be very closely and accurately coordinated and controlled.

The term "smoke" is used herein to cover not only products of combustion, but also to cover smoke-like material formed in other ways. The "smoke" may be formed by injecting oil into the exhaust of the plane, or by a spray of titanium tetrachloride, which hydrolyzes on coming into contact with the moisture in the air and makes a white cloud, or by mixing sprays of ammonia and hydrochloric acid, or in any other suitable way.

The principal object, therefore, of this invention is to provide a plurality of airplanes, each of which is provided with smoke trail forming mechanism, with coordinated control so that this mechanism in the several planes will be operated, either automatically or manually, to control the length and placement of the smoke trails so as to build up finished letters.

To accomplish these objects, individual or selective signals are sent to each airplane and these signals are selectively received, that is, are received only by the plane for which they are intended, and are amplified. The amplified signal in each case may directly control a smoke valve for starting and stopping the smoke trail. The smoke trail will therefore be placed in the air and will be of a length depending on the time and duration of the signal sent to each plane. This control is automatic.

As a corollary to the automatic operation, manual operation may be used as follows:

The signal for an individual plane is received and amplified by that plane as before; however, the amplified signal, instead of directly operating a smoke valve, operates a signal such as a light or a buzzer, or a tactile device, and as soon as the operator perceives such a signal he turns on the smoke valve and as soon as the signal stops he turns it off. Slight delays might be involved in such manual operation due to different reaction times of the operators in the several ships, but such variations in reaction times would only be a matter of a fraction of a second and so much differences are not serious.

In accordance with the present invention, signal waves sent from the ground or from another airplane are selectively received by the several airplanes and the received wave is amplified to work the smoke valve directly or to give a signal to the operator who, in turn, works the smoke valve. Also, the received wave may be perceived directly by the operator, who works the smoke valve. In my companion application Serial No. 364,748, filed of even date herewith, waves sent from the ground or from another airplane, are received and amplified and caused to operate a patterned record, which patterned record, in turn, serves to operate the smoke valve directly or to operate a signal, such as a light or buzzer, to tell the operator when to operate the smoke valve. In my companion application Serial No. 364,749, filed of even date herewith, there is also provided a patterned record which is started either manually or by clockwork, such record either controlling the smoke valve di-

rectly, or operating a signal to tell the operator when to operate the smoke valve.

The invention will now be described in more detail by reference to the accompanying drawings, which are largely diagrammatic, in which:

Figure 1 is a perspective view of a plurality of airplanes flying in "company front" formation and emitting smoke trails to form a letter;

Figure 2 is a diagrammatic view illustrating the relationship of the several devices of the invention, for automatic operation.

Figure 3 is a diagrammatic view of actuating means for the transmitters;

Figure 3A is a diagrammatic side-view to illustrate certain features of Figure 3;

Figure 4 is a diagrammatic view of a radio transmitter;

Figure 5 is a diagrammatic view of a radio receiver and cooperating mechanism for operating a smoke valve;

Figure 6 is a diagrammatic view of a sound transmitter;

Figure 7 is a diagrammatic view of a sound receiver and cooperating mechanism for operating a smoke valve;

Figure 8 is a view of a light transmitter;

Figure 9 is a view of a light receiver and cooperating mechanism for operating a smoke valve;

Figure 10 is a view, analogous to Figure 2, illustrating the relationship of the several devices of the invention, for manual operation;

Figure 11 is a view of a light signal, for preception by the operator;

Figure 12 is a view of a sound signal, for perception by the operator.

Referring now to these drawings, in which similar reference characters refer to similar parts, a plurality of planes 2, are shown in Figure 1, flying in company front formation. They are here shown as flying in a horizontal plane, but they could fly in a vertical plane, or along a diagonal, if preferred. The several planes fly in contiguous and substantially parallel paths, and emit smoke trails 4, the length and placement of which are controlled so that the trails cooperate to build up a finished letter or symbol.

The length and placement of the smoke trails is, in one embodiment of the invention, controlled automatically, by radio waves or by sound waves or by light waves. Each of these types of waves has individual characteristics, as to means for generating them, wave length, frequency, speed of travel and means for receiving them, and therefore are not to be regarded as equivalents.

Referring to Figure 2, a plurality of transmitters 6, is provided, one for each of the planes 2. In place of plural transmitters, a single transmitter sending out separate frequencies, to be picked up by correspondingly tuned receivers, could be used. The transmitters may be on the ground, or in a control plane which may be flying along with the others and which might be one of the smoke emitting, trail forming planes, or these transmitters might be in a plane flying at some distance from the others. Each of these several transmitters sends out a signal wave which is intended for reception only by a particular plane. The signals are therefore "selective." Each plane is provided with a receiver 8 which receives the signal intended for it, and this receiver in turn is connected to operate a valve 10, which when open, releases a smoke trail, the length and placement of which depends on

the duration and timing of the received signal wave.

Where a radio signal wave is used, the transmitter 6 may be a transmitter such as is shown in Figure 4. This transmitter circuit is known and is shown here for the purpose of illustration only, as other known types of radio transmitters may be used.

This transmitter 6 uses what is known as a "Tri-tet" circuit, and comprises a vacuum or amplifying tube 12, of the "6L6" type. The radio frequency choke 14 is about 2.5 mh. A grid leak is shown at 15. A screen voltage divider is shown at 16, the "B" battery at 18. 19 is a small dial light. The output of the plate circuit is impressed on the usual antenna 20. Such a circuit may have an output of about 10 watts.

A signal wave of a particular frequency sent out by a particular transmitter 6 is received by the receiver tuned to that frequency.

Assuming there are nine airplanes for a particular sky writing job and that there is an individual transmitter 6 for sending out a radio wave of a particular frequency, it is necessary to control the timing and duration of each radio wave in order to control the placement and length of the smoke trail.

This may conveniently be done by the use of a record 21, Fig. 3, analogous to the record used in a player piano, in that such a record may be of paper and is provided with indicia in the form of slots 22, the positioning and length of which on the record determines the placement and duration of the several smoke trails. If nine planes are used, the record is provided with nine longitudinally extending channels or zones, 22', one for each plane. There will also be provided an electrical contact making, resiliently mounted brush 23 for each of said channels and each brush 23 will be connected to one of the two operating contacts 24 on the nine transmitters 6, by means of wires 25.

The other contact 24 of each transmitter will be connected by wires 28 to a source of power 30, the other terminal of which is connected to a common contact plate or cylinder 32 on the under side of the paper record just below the brushes 23.

The record 21 will be driven by some constant speed drive, such as clock work or a spring motor, as in a phonograph, or by a geared-down synchronous motor.

Instead of a slotted record, the record could be a belt carrying other indicia serving as contact-closing devices, as is well understood in the art of electric signs, such, for example, as metallic letters, which when they contact the brushes 23, close corresponding circuits.

From the mechanism as above described, it is evident that as the record moves along under the brushes 23 the brushes will drop through the slots in the record into contact with cylinder 32 and close circuits to the several transmitting sets, at a time, and for a length of time, depending upon the position and length of the slots.

Each plane is provided with a receiver 8, illustrated diagrammatically in Fig. 5. This is a known type of receiver and is merely shown here as an illustration of one convenient circuit for this purpose. Each receiver is, of course, tuned to a particular wave length corresponding to the wave length of its corresponding transmitter 6. The incoming wave is impressed on and amplified by a receiving circuit, the amplified signal operating the relay 34. The relay circuit in-

cludes the source of power 36 and solenoid 38 which is operatively connected to the operating arm 40 of the smoke valve 41. When the valve 41 is opened smoke is released from the plane through a pipe 42, the plane being provided with any of the known types of smoke forming mechanism.

From the parts as thus described, it will be evident that as the record 21 is fed along under the brushes 23, radio waves will be sent at predetermined times and for predetermined lengths of time as determined by the location and length of the slots 22 in the record, and smoke trails will be formed in the air in exactly the same relationship as to timing and length as exists between the several slots 22 in the paper record.

Instead of radio waves, sound waves may be used. Due to the relatively slow speed of travel of sound, the planes furthest from the source would receive their sound signals a little late, but this can be readily compensated for by a corresponding change in position of the slots 22 in the control record 21.

Where a sound wave is used, the record 21 and cooperating brushes are used as before, the brushes and source of power being connected respectively to the terminals 24' of a corresponding series of sound transmitters, of the type shown in Fig. 6. This sound transmitter is of a known type and comprises a vacuum tube oscillator 44, the output side of which is connected to a loud speaker or similar sound waves producing device 46 to produce a sound wave of particular frequency.

Each plane is provided with a sound receiving and amplifying circuit, one type of which is shown in Fig. 7, tuned to respond only to a sound wave of a particular frequency. The incoming sound wave is picked up by the microphone 48, and a corresponding current is impressed on the transformer 50 and thence on the first stage of a two stage amplifier, including a vacuum tube 52 and cooperating parts, the output of which is impressed on the second stage of the amplifier, including a vacuum tube 54 and cooperating parts. The output of the second stage serves to operate a relay 34' analogous to the relay 34 of Figure 5. The relay circuit includes a source of power 36' and a solenoid 38' connected to the handle 40' of a smoke valve 41', in a smoke pipe 42'.

When a sound wave of a particular frequency is received by the receiver, the smoke valve 41' will be opened to produce a smoke trail the length and placement of which is determined by the timing and duration of the received sound wave, which in turn is controlled by the placement and length of the appropriate slots 22 in the record 21.

The smoke trail formation can also be controlled by invisible light waves, such as infrared or ultra-violet waves. Referring to Fig. 8 a plurality of sources 56 of invisible light rays is provided, each connected to terminals 24' already described, so that the formation of a plurality of bands of invisible light rays of various wave lengths are sent out from 55, through suitable filters 58 as may be desirable. The use of different kinds of invisible light sources and the use of filters will give the necessary different types of light rays to be received individually by the several planes.

Each plane is provided with a light ray receiving apparatus diagrammatically shown in

Fig. 9, comprising a photo-electric cell 60 responsive only to a particular band of invisible light. The output from this cell is impressed on the vacuum tube 62 and amplified to actuate a relay 34'', which is connected to operate a relay circuit comprising a source of power 36'', to operate a solenoid 38'' which in turn operates the handle 40'' of a smoke valve 41'' in a smoke pipe 42''.

With the three types of waves thus far described, the formation of smoke trails is entirely automatic, that is to say is entirely independent of the pilot or operator in each plane. However, practically the same mechanism can be used in connection with manual operation of the smoke valves. Referring to Fig. 10, a plurality of transmitters 6 would be provided which would send out radio, sound or light waves as before. These waves would be received and amplified by the respective receivers 8 in the different planes and these amplified waves would each operate a signal 64 which is perceived by the operator who then operates the handle 40 of control valve 41 to release a smoke trail in accordance with the length and duration of the received signal.

In Fig. 11, the relay 34a, analogous to the relay 34 of Fig. 5, closes a circuit through a battery 66 and light 68. As soon as the operator sees the light 68, he turns on the smoke, and when light 68 is extinguished, he turns it off.

Referring to Fig. 12, the relay 34a closes a circuit through a source of power 66 and a buzzer 70. When the buzzer starts, the operator operates valve 41 to turn on the smoke, and when the buzzer stops he turns off the smoke. A tactile signal could evidently be used in place of light 68 or buzzer 70, if desired.

There is thus provided control means for building up a letter or symbol by means of contiguous and substantially parallel smoke trails, and where, by either automatic or manual means, the placement and length of the several smoke trails is controlled by the timing and duration of selectively received waves which may be either radio, sound, or light, which waves may be sent from the ground or from an airplane.

While the present preferred embodiments of the invention have been illustrated in some detail, it should be understood that the disclosure is illustrative of the invention, and not restrictive thereof, and that it can be carried out in other ways.

I claim as my invention:

1. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, releasing substantially parallel smoke trails from said airplanes, and controlling the timing, length and placement of the smoke trails by signals to the several airplanes, said smoke trails cooperating to form individual and successive letters or symbols.

2. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, releasing substantially parallel smoke trails from said airplanes, and controlling the timing, length and placement of the smoke trails by signals to the several airplanes, which signals are perceived by the pilot of the airplane and guide him in operating smoke trail

releasing mechanism, said smoke trails cooperating to form individual and successive letters or symbols.

3. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, plying said airplanes in contiguous and substantially parallel paths, releasing substantially parallel smoke trails from said airplanes, and controlling the timing, length and placement of the smoke trails by signals to the several airplanes, which signals are amplified and rendered perceptible to the pilot and serve to guide him in operating smoke trail releasing mechanism, said smoke trails cooperating to form individual and successive letters or symbols.

4. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, releasing substantially parallel smoke trails from said airplanes, and controlling the timing, length and placement of the smoke trails by signals to the several airplanes, amplifying such signals and causing such amplified signals to control directly mechanism for releasing smoke trails of controlled length at controlled intervals, said smoke trails cooperating to form individual and successive letters or symbols.

5. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, releasing substantially parallel smoke trails from said airplanes, and controlling the timing, length and placement of the smoke trails by sending signals to the several airplanes, such signals involving the use of one of the following: sound waves, invisible light waves; the timing and duration of such waves determining the placement and length of the smoke trails, said smoke trails cooperating to form individual and successive letters or symbols.

6. Apparatus for forming letters or symbols in the air by means of smoke trails, comprising a plurality of airplanes arranged to fly in substantially parallel paths, each provided with mechanism for forming smoke trails, valve mechanism in each airplane for controlling the release of such smoke trails, and wave receiving and amplifying means for use in controlling said valve mechanism, for determining the placement and length of the smoke trails in accordance with the timing and duration of the received wave, said smoke trails being substantially parallel and cooperating to form individual and successive letters or symbols.

7. Apparatus for forming letters or symbols in the air by means of smoke trails, comprising a plurality of airplanes arranged to fly in substantially parallel paths, each provided with mechanism for forming smoke trails, valve mechanism in each airplane for controlling the release of such smoke trails, and wave receiving and amplifying means for directly controlling said valve mechanism, for determining the placement and length of the smoke trails in accordance with the timing and duration of the received wave, said smoke trails being substantially parallel and cooperating to form individual and successive letters or symbols.

8. Apparatus for forming letters or symbols in the air by means of parallel smoke trails, comprising smoke trail releasing mechanism, means for receiving a signal of a predetermined wave length, and means for amplifying such received signal and operating the smoke trail releasing mechanism for controlling the formation of the smoke trail in accordance with the timing and duration of the received signal.

9. Apparatus for use in forming letters or symbols in the air by means of smoke trails, wherein a plurality of signal waves of different wave lengths are selectively received by a corresponding plurality of airplanes flying in parallel paths, comprising means for generating a plurality of signals of different wave lengths, means for controlling the timing and duration of such signals, comprising a travelling record, plural pick-up members, each allocated to cooperate with a particular longitudinal zone on the record and actuated by indicia carried by the record, the several pick-up members respectively controlling the formation of different parts of the same letter, said pick-up members being individually and operatively connected to said signal generating means, and signal wave receiving means in each of said airplanes, each of which is responsive to only one particular wave length as generated by said signal generating means.

10. Apparatus for use in forming letters or symbols in the air by means of smoke trails, wherein a plurality of signal waves of different wave lengths are selectively received by a corresponding plurality of airplanes flying in parallel paths, comprising means for generating a plurality of signals of different wave lengths, and means for controlling the timing and duration of such signals, comprising a travelling record, said record being provided with indicia in the form of longitudinal slots, a plurality of contact closing brushes allocated to cooperate with particular slots in the record, each of said brushes, and its corresponding slot, respectively controlling the formation of different parts of the same letter, said contact closing brushes being respectively connected to the signal generating means, whereby signals of different wave lengths are sent out, the timing and duration of which correspond to the position and length of the corresponding slot in the record, and signal wave receiving means in each of said airplanes, each of which is responsive to only one particular wave length as generated by said signal generating means.

11. Apparatus for use in forming letters or symbols in the air by means of smoke trails, comprising a plurality of airplanes arranged to fly in substantially parallel paths, smoke trail releasing mechanism carried by each airplane, for forming predetermined parts of a letter or symbol and selective signal receiving means carried in each airplane, for use in controlling the timing and duration of the operation of the smoke trail releasing mechanism in such airplane, said smoke-trails being substantially parallel and cooperating to form individual and successive letters or symbols, and signal generating means for generating signals for individual reception by said signal receiving means in the several airplanes, said smoke-trails being substantially parallel and cooperating to form individual and successive letters or symbols.

12. Apparatus for use in forming letters or symbols in the air by means of smoke trails, comprising a plurality of airplanes arranged to fly in substantially parallel paths, smoke trail re-

leasing mechanism carried by each airplane, for forming predetermined parts of a letter or symbol selective signal receiving means carried in each airplane, and means in each airplane for amplifying such received signal and directly operating the corresponding smoke trail releasing mechanism, for controlling the timing and duration of the smoke trail made by that airplane, said smoketrails being substantially parallel and cooperating to form individual and successive letters or symbols, and signal generating means for generating signals for individual reception by said signal receiving means in the several airplanes, said smoketrails being substantially parallel and cooperating to form individual and successive letters or symbols.

13. Apparatus for use in forming letters or symbols in the air by means of smoke trails, comprising a plurality of airplanes arranged to fly in substantially parallel paths, smoke trail releasing mechanism carried by each airplane, for forming predetermined parts of a letter or symbol selective signal receiving means carried in each airplane, for use in controlling the timing and duration of the operation of the smoke trail releasing mechanism in such airplane and means for sending signals of different wave lengths at controlled intervals to the several airplanes, for selective reception thereby, said smoketrails being substantially parallel and cooperating to form individual and successive letters or symbols, and signal generating means for generating signals for individual reception by said signal receiving means in the several airplanes, said smoketrails being substantially parallel and cooperating to form individual and successive letters or symbols.

14. Apparatus for use in forming letters or symbols in the air by means of smoke trails, comprising a plurality of airplanes arranged to fly in substantially parallel paths, smoke trail releasing mechanism carried by each airplane, for forming predetermined parts of a letter or symbol, selective signal receiving means carried in each airplane, means in each airplane for amplifying such received signal and directly operating the corresponding smoke trail releasing mechanism, for controlling the timing and duration of the smoke trail made by that airplane and means for sending signals of different wave lengths at controlled intervals to the several airplanes, for selective reception thereby, said smoketrails being substantially parallel and cooperating to form individual and successive letters or symbols, and signal generating means for generating signals for individual reception by said signal receiving

means in the several airplanes, said smoketrails being substantially parallel and cooperating to form individual and successive letters or symbols.

15. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, intermittently releasing substantially parallel smoke trails from said airplanes, the length, timing and placement of the smoke trails being determined by plural signals selectively received by the individual airplanes, said smoke trails cooperating to form individual and successive letters or symbols.

16. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, intermittently releasing substantially parallel smoke trails from said airplanes, the length, timing and placement of the smoke trails being determined by plural signals of different wave lengths selectively received by the several airplanes, said signals being amplified and serving to operate smoke trail releasing mechanism, said smoke trails cooperating to form individual and successive letters or symbols.

17. The method for forming letters or symbols in the air by means of smoke trails, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in contiguous and substantially parallel paths, intermittently releasing substantially parallel smoke trails from said airplanes, the length, timing and placement of the smoke trails being determined by plural signals of different wave lengths selectively received by the several airplanes, said signals being amplified and rendered perceptible to the operator and serving to guide him in controlling smoke trail releasing mechanism, said smoke trails cooperating to form individual and successive letters or symbols.

18. The method of forming letters or symbols in the air, comprising the steps of assigning to each of a plurality of airplanes a certain part of each letter or symbol, flying said airplanes in substantially parallel paths, and releasing parallel smoke trails of controlled length at controlled intervals, from the several airplanes, for building up individual and successive letters or symbols by use of such parallel trails.

JOHN T. REMEY.