June 5, 1951 R. P. BENNETT 2,555,867

AIR LAUNCHED RADIO STATION

Filed Aug. 28, 1945 3 Sheets-Sheet 1

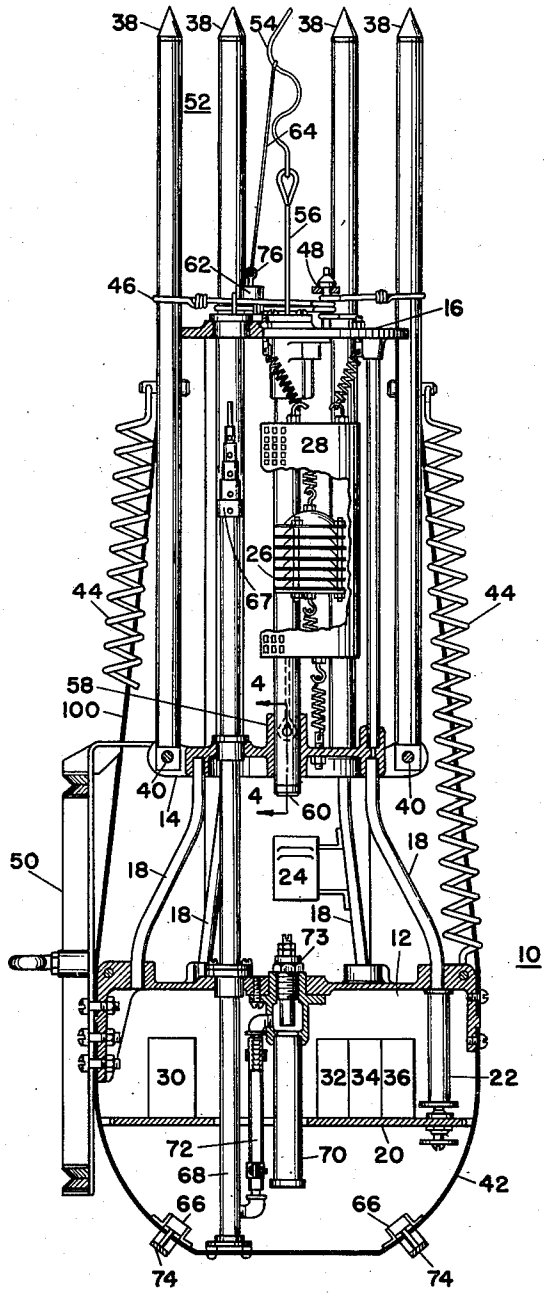

FIG. 1

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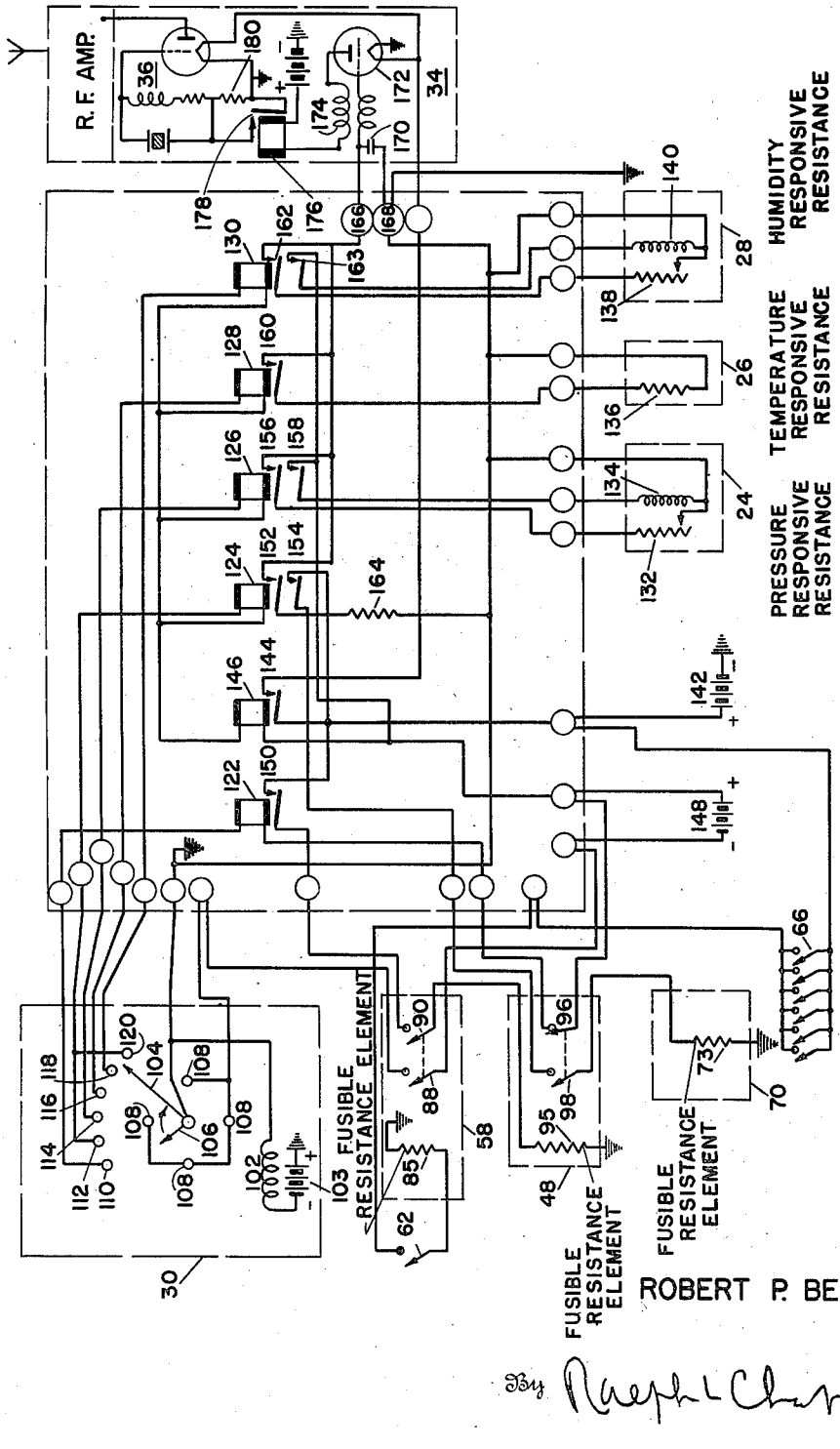

FIG. 2

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Filed Aug. 28, 1945 3 Sheets-Sheet 3

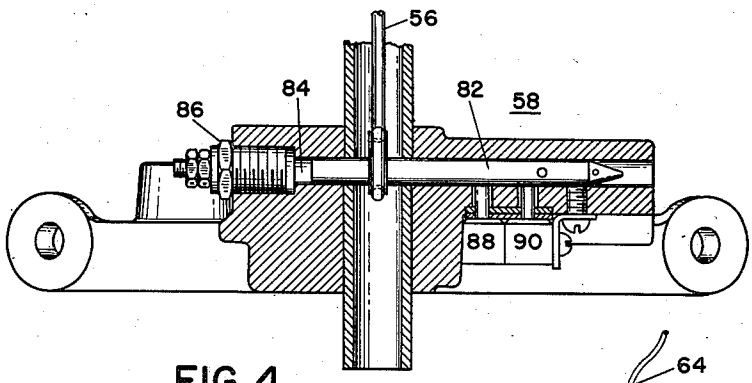

FIG. 4

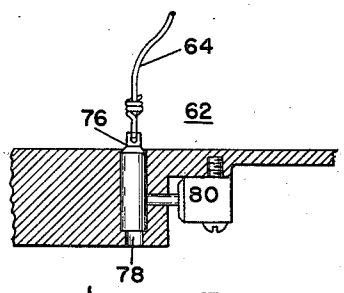

FIG. 3

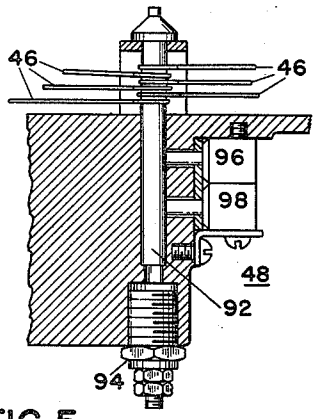

FIG. 5

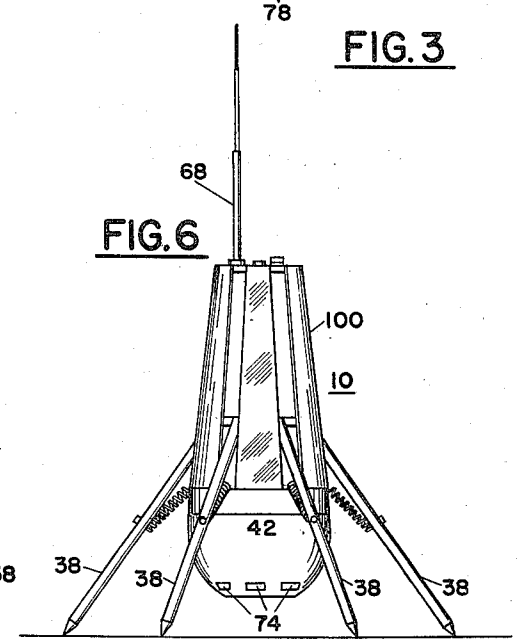

FIG. 6

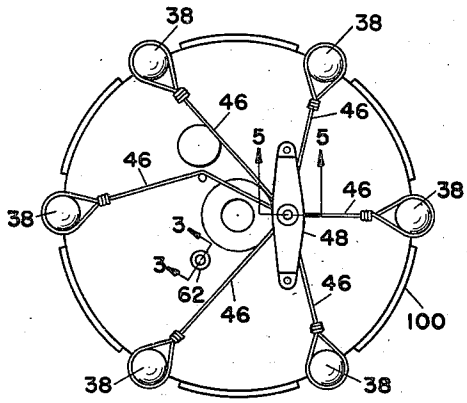

FIG. 7

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UNITED STATES PATENT OFFICE

2,555,867

AIR LAUNCHED RADIO STATION

Robert P. Bennett, White Hall, Md., assignor, by mesne assignments, to the United States of America

Application August 28, 1945, Serial No. 613,151

7 Claims. (Cl. 250—17)

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My invention relates to air-launched portable radio stations, particularly weather stations, which may be dropped by parachute onto remote or hostile territory.

In general, my invention resides in improvements of the air-launched radio station disclosed and claimed in copending application Ser. #600,627, filed June 20, 1945, by Percival D. Lowell et al.

More particularly, the erection of the station to suitable operating position subsequent to its fall to earth is made more certain by one, or the other, preferably both of the following: mounting of the heavier components as close as possible to the nose of the station housing to provide low center of gravity and use of station-erecting legs which have great rotational inertia.

Also in accordance with my invention, the periods of transmission of the station are predetermined, as by a clock-controlled master switch, to facilitate reception from a number of such stations without mutual interference.

Further in accordance with my invention, interlock switches are utilized to ensure release of the parachute and actuation of the erecting legs in proper sequence.

In accordance with another aspect of my invention, the mounting for the telescopic antenna of the station enables axial extension of the antenna upon deformation of the nose portion of the station housing.

My invention also resides in features of construction, combination and arrangement herein described or disclosed.

Referring to the drawings:

Figure 1 is a general sectional view showing the construction of the housing and the location of the major components.

Figure 2 is a circuit diagram of the apparatus mounted within the housing shown in Figure 1 and shows circuit connections between the timing device, the relaxation oscillator, and the radio transmitter.

Figure 3 is a sectional view taken on section 3—3 of Figure 7 and shows the arming pin and associated switch.

Figure 4, a sectional view taken on section 4—4 of Figure 1, shows the explosive release device for the parachute together with associated switches.

Figure 5, a sectional view taken on section 5—5 of Figure 7, shows the construction of the explosive release device utilized to release the legs prior to erection.

Figure 6 is an elevation view showing the device in erected position with legs and antenna extended.

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Figure 7 is a plan view of the device shown in Figure 1, including details of the leg-releasing means.

As shown in Figure 1, the complete assembly is similar in appearance to a bomb and because of its lighter weight is even more readily transported by aircraft. The housing is indicated generally by the numeral 10. The housing includes a main transverse member 12, a spider 14 and an upper shelf member 16. These three members are connected by longitudinal supporting members 18. A resiliently mounted shelf 20 is suspended from the transverse member 12 by shock supports 22. Above the transverse member 12 are mounted the weather-responsive devices consisting of the pressure-responsive device 24, the temperature-responsive device 26 and the humidity-responsive device 28. Mounted on the shelf 20 on the clock 30, the battery power supply 32, the relaxation oscillator 34 and the radio transmitter 36.

Hingedly attached to the spider 14 are a plurality of legs 38 pivoted on pins 40. The legs 38 are spring-biased toward the nose portion 42 by means of powerful springs 44. The legs are held in the unerected position by means of retaining wires 46 held in place by the pin 92 of the explosive release device 48.

A yoke 50 is provided for carrying the station in a standard aircraft bomb-rack. After being released from an aircraft the device is supported by means of a parachute, normally stored between the legs 38 in the space 52, which limits rate of fall to approximately eight feet per second. The parachute supporting line 54 connects the parachute (not shown) to the supporting rod 56. The other end of the rod 56 engages a parachute release device 58 which is mounted at the spider 14 at a point of great mechanical strength. Rod 56 is led into the interior of the station through tube 60 which forms part of the vertical supporting structure. An arming switch 62 is attached to the parachute supporting line 54 by means of lead-line 64 and is released to apply battery power to the nose switches 66 at the time that the parachute opens. Nose switches 66 are effective to release the parachute when the weather station strikes the earth, through the operation of parachute release device 58.

The nose 42 fastened to traverse member 12 is shaped so as to offer litle resistance to motion through the air. The nose 42 is constructed of

thin deformable material such as light gauge metal and will normally be deformed upon striking the earth. Such deformation aids in protecting the internal components from shock since the energy of impact is absorbed in the bending of the metal.

Mounted in close proximity to the inner surface of the nose 42 is a vertical telescoping antenna 67, designed to operate by gas pressure, mounted in a barrel 68. Pressure to elevate the antenna is generated in the explosive chamber erecting device 70 connected to the antenna barrel 68 by the flexible conduit 72. The antenna barrel 68 is slidably mounted in the transverse member 12 and the spider member 14 in order to enable axial translation of the antenna upon inward deformation of the nose 42. In Figure 1 the antenna barrel 68 is shown in contact with the inner surface of the nose 42. However, it will be obvious to one skilled in the art that the antenna barrel need not actually be attached to the nose. The antenna and reservoir have been placed in the position shown in order that the center of gravity of the device may be as low as possible and also to accommodate the length of the antenna, which is appreciable even when in the unerected position. Relative motion of the reservoir and the antenna barrel 68 upon impact is taken up in the flexible conduit 72.

The nose switches 66 are placed at spaced intervals about the nose so that at least one switch is operated regardless of the angle at which the housing may strike the earth. The switches 66 are operated by the switch operators 74 on the outside of nose 42.

Figure 3 is a sectional view of the arming switch 62, consisting merely of a pin 76 normally housed in a bored hole 78. A single pole normally closed switch 80 closes the switch circuit upon the withdrawal of pin 76 by lead line 64.

Figure 4 is a detailed sectional view of the parachute releasing device 58. This device consists of a release pin 82, threading an eye on the end of rod 56. An explosive charge contained chamber 84 is fired by an electric fusible resistance link (not shown) which is energized by terminal 86. Two normally-closed single pole switches 88 and 90 are released to make contact in two circuits upon the ejection of the pin 82.

Figure 5 shows the explosive release device 48 which is similar in construction to that shown in Figure 4. It utilizes a pin 92 engaging the leg releasing wires 46 and ejected by the explosive device 94. The explosive device contains a resistance firing element of a well known type not shown. A normally closed switch 96 and a normally open switch 98, the use of which will be described below, are released upon ejection of the pin 92.

Figure 6 shows the weather station in the erected position as it appears during the transmission of a weather signal. Side panels 100 are shown to better advantage than in Figure 1. These are used to provide mechanical protection and to offer better streamlining.

The electrical portion of the device shown in Figure 2 consists of an electric clock of a well known type to control the erecting of the station and the switching of weather-responsive resistances into the grid circuit of a relaxation oscillator, relays to accomplish this switching, a relaxation oscillator and a transmitter controlled thereby as illustrated in Figure 2, the switches 80, 88, 90, 96, and 98 are shown in the positions in which they are maintained by the pins 76, 82, and 92. These switches are positioned as shown at the beginning of the operating cycle and are in each case changed upon ejection of the associated pin by the operation of the fusible elements 85 and 95. The clock consists of a clock winding 102 operated by a clock battery 103, a clock minute hand 104 and an hour hand 106. The hour hand controls four contacts 108 spaced at three hour intervals. The minute hand controls terminals 110, 112, 114, 116, 118 and 120, controlling the operations to be performed in sequence. Relay 122 operates the explosive leg releasing device 48. Relay 124 operates the antenna elevating device 70. Relay 126 switches the pressure-responsive resistor into the relaxation oscillator circuit while relays 128 and 130 perform this function in the case of the temperature and humidity resistors respectively.

Numeral 24 indicates the pressure-responsive device consisting of a variable resistor 132 and the winding of a clamping device 134. The temperature-responsive device 26 includes a temperature-sensitive resistor 136 while the humidity-responsive device includes a variable resistor 138 and the winding of a clamping device 140. The clamping devices 134 and 140 are electromagnets which act to force the moving element of the associated resistor into firmer contact with the resistance strips during the period of transmission. Numerals 73, 85 and 95 indicate the fusible resistance links controlling detonation of the explosive devices associated with the parachute releasing device, the leg erecting device and the antenna erecting devices respectively. Fusible link 85 of a parachute release device is operated by nose switches 66 in series with arming switch 80. The fusible link 95 in the leg releasing device 48 is operated through contacts 108 and 110 of the clock 30 and contact 88 of the parachute release device 58. The fusible link 73 which sets off the explosive charge in the antenna erecting device 70 is energized by terminal 112 of the clock 30 and receives power through switch 98 of the leg releasing device 48.

Power for the filaments of the vacuum tubes and the fusible links is supplied by battery 142, filament power being controlled by contacts 144 associated with filament relay 146. Relay power is furnished from the relay battery 148. The contacts associated with the relays which are designated as 150, 152, 154, 156, 158, 160, 162 and 163, will be discussed in describing the operation of the electrical portion of the device.

By the means of the clock 30, resistors 132, 136 and 138 and the reference resistor 164 are applied successively on output terminals 166 and 168. The latter terminals lead to the grid circuit of a relaxation oscillator 34. The relaxation oscillator includes a timing capacitor 170, vacuum tube 172, and grid-plate coupling transformer 174 which operates the plate circuit relay 176. The contacts 178 of this relay short out resistor 180 supplying some of the grid bias in the crystal oscillator portion of the transmitter 36. This breaks the transmitted wave up into pulses.

Operation

Before operation the clock 30 is set on true time and the station is assembled as shown in Figure 1. After the device is dropped a static line of the well known type pulls the parachute from space 52 between the legs. The extension of the parachute suspension line 54 applies tension to lead line 64 which pulls the dowel 76 from

the arming switch 62. Upon impact with the ground, nose switch operators 74 actuate one or more of the switches 66 to make contact resulting in the release of the parachute by the operation of the parachute releasing device 58. When the parachute pin 82 has been ejected from the parachute release mechanism 58, the switch 88 on the parachute releasing device applies negative voltage from the relay battery 148 to the hour hand contact 108 of the clock 30. At the same time switch 90 on the parachute releasing device energizes the normally open contacts 150 of relay 122. The weather station normally will lie on its side until the minute hand 104 of the clock makes contact with terminal 110, simultaneously with the completion of contact between the hour hand 106 and one of the contacts 108. At such time the leg releasing relay 122 closes the associated contacts 150 resulting in the firing of the leg releasing device 48. Releasing of the legs causes the device to assume the position shown in Figure 6. It should be noted that heavy leg construction is an advantage in performing this erecting, particularly when the nose member 42 has been more or less flattened by impact with the earth. The high rotational inertia of the legs about pins 46, particularly those legs not in contact with the ground, enables them to carry through to the final erected position when put in motion by the urging action of the springs 44.

Firing of the leg releasing device 48 causes the closing of the associated contacts 98 resulting in the energization of the contacts 54 of antenna erecting relay 124. At the same time contacts 96 open to prevent the leg releasing relay 122 from ever subsequently drawing power from the relay battery 148. It will be apparent from an inspection of the wiring diagram in Figure 2 that the relay 146 is connected in series with the relays 124, 126, 128, and 130, so that energization of the relays 124, 126, 128, and 130 by the minute hand 104 through the contacts 112, 114, 116, 118, and 120 also energizes the relay 146 to apply filament power to the several vacuum tubes. Contact between the minute hand 104 and contact 112 next causes erection of the antenna through the action of the antenna erecting relay 124 and the closing of contacts 154 which fires the antenna erecting device 70. At the same time, the closing of contact 152 switches the reference resistor 164 across terminals 166 and 168 leading to the grid circuit of the relaxation oscillator 34. Simultaneously with operation of relay 124 the relay 146 closes its associated contacts 144 applying filament power to the oscillator and transmitter portion of the station.

With the reference resistor 164 in parallel with the capacitor 170 in the grid circuit of the relaxation oscillator 34, the oscillator will produce pulses at a rate dependent upon the value of the reference resistor 164. The pulse rate will be approximately two pulses per second. Pulses of current in the plate circuit of vacuum tube 172 cause interrupted action of the plate relay 176 which periodically shorts out portion 180 of the grid bias resistor of the crystal oscillator of the transmitter 36. Since the reference resistor 164 has a fixed resistance, its calibrated pulse rate is known and in actual operation of the device may be used to determine whether the associated relaxation oscillator circuit is still in calibration. The operation of the oscillator and use of the reference resistor is described in greater detail in the patent application of Lowell et al. mentioned above.

Following transmission of the reference pulses, the minute hand 104 moves away from terminal 112 removing the reference resistor 164 from the circuit and moves into contact with terminal 114 closing the pressure-responsive relay 126. Closing of the latter relay causes the circuit to be made through contacts 156 to apply the resistor 132 across terminals 166 and 168. At the same time the circuit is completed through contacts 158 causing operation of the clamping device 134 which, as stated above, is effective to reduce contact resistance between the moving elements of the variable resistor 132. The use of a clamping device is old in the art and will not be discussed in detail. With pressure-responsive resistor 132 in the circuit of the relaxation oscillator 34 the transmitter will transmit pulses at a rate dependent upon the existing resistance of this resistor. The pulse rate is interpreted at the receiving station in terms of barometric pressure.

Subsequently, the minute hand 104 makes contact with terminal 116 on the clock 30 causing contacts 160 of relay 128 to switch the temperature-responsive resistor 136 across terminals 166 and 168. This produces a transmitted pulse rate dependent upon the temperature existing at the device at the time of transmission. Next, the making of a circuit at terminal 118 of the clock through the action of relay 130 and contacts 162 switches the humidity-responsive resistor 138 into the circuit of the relaxation oscillator 34. A clamping magnet 140 operated in the same manner as discussed in connection with the clamping device 134 is energized through the contacts 163 on relay 130.

Finally, the reference resistor 164 is again cut into the relaxation oscillator circuit by means of terminal 120 of the clock 30. Upon completion of the transmitting sequence just described, the electronic circuits are de-energized and do not become operative until hour hand 106 makes contact with the next contact 108, three hours later. A resistor corresponding to each of the functions described is designed to be in the circuit for approximately 45 seconds followed by a 15 second period of silence. However, it will be obvious to one skilled in the art that the program can be changed to suit the specific requirements by proper spacing of terminals 110 through 120. It will also be obvious to one skilled in the art that other information in addition to pressure, temperature and humidity may be included in the program by the addition of clock contacts, relays and a condition-responsive resistor similarly connected.

It will be seen from above that a weather station constructed in accordance with my teachings will enable impact to be absorbed by deformation of the light nose portion while the construction of the antenna mounting and the erecting device is such as to enable effective erection and reliable transmission in spite of the deformation occurring in the nose portion. It will also be seen that I have provided an interlocked switching system which insures proper sequence of the erecting and transmitting functions regardless of the time indicated by the clock at the time the weather station is dropped.

When the station is to be used only as a beacon, the radio transmitter and its control mechanism may be simplified merely to transmit a signal which may be used to guide, for example,

other craft equipped with radio director-finding apparatus.

While I have shown and described but one embodiment of my invention, it will appear to those skilled in the art that various changes and modifications may be made without departing from my invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A portable radio transmitting station designed to be dropped from aircraft comprising a bomblike housing, a light gauge deformable convex nose on said housing, a radio transmitter including a telescoping antenna operated by gas pressure, an antenna barrel housing said antenna, said antenna barrel being slidably mounted in alignment determining apertures in said housing and extending into proximity with the inner surface of said nose, a rigidly-mounted gas reservoir within said housing, a flexible connection between said reservoir and said antenna barrel, whereby axial translation of said antenna barrel upon inward deformation of said nose portion is permitted and the likelihood of damage to said antenna upon impact with the earth is reduced.

2. A portable radio transmitting station designed to be dropped from aircraft comprising a bomblike housing, a light gauge deformable convex nose on said housing, the center of gravity of said station located near said nose, legs for the erection and support of said housing, said legs being hingedly attached about the waist of said housing at a level above said center of gravity and each arranged to swing in a plane which includes the axis of said housing, retaining means to hold said legs along said housing in a direction away from said nose, biasing means to urge said legs toward said nose to erect said housing upon release of said retaining means, said legs being of large rotational inertia whereby the erection of said housing is facilitated in spite of deformation of said nose upon impact with the earth.

3. A portable automatic radio transmitting station designed to be dropped by parachute from aircraft comprising a parachute releasing device and erecting devices required to be operated in a predetermined order, means initiated upon impact with the earth to operate said paratchute releasing device, a clock having switch means to cause the operation of each of said erecting devices in sequence at a predetermined true time, normally open interlock switches operated by said parachute releasing device and each of said erecting devices respectively, said switches being closed upon operation of the associated device, said interlock switches being so connected to said clock switch means that the operation of each of said interlock switches is prerequisite to the operation of the erecting device designed to be operated next in order, whereby said clock is ineffective to operate said erecting devices except in the predetermined order regardless of the time indicated by said clock at the time of dropping said station.

4. A portable automatic radio transmitting station designed to be dropped by parachute from aircraft comprising a parachute releasing device, erecting devices and a transmitting device required to be operated in a predetermined order, means initiated upon impact with the earth to operate said parachute releasing device, a clock having switch means to cause the operation of each of said erecting devices and said transmitting device in sequence at a predetermined true time, normally open interlock switches operated by said parachute releasing device and each of said erecting devices respectively, said switches being closed due to operation of the associated device, said interlock switches being so connected to said clock switch means that the operation of each of said interlock switches is prerequisite to the operation of the erecting device designed to be operated next in order, whereby said parachute releasing device and each of said erecting devices operates only in a predetermined order and whereby all erecting functions are performed before energization of said transmitting device regardless of the time indicated by said clock at the time of dropping said station.

5. A radio station as claimed in claim 4 including an arming switch operated upon dropping of said station from aircraft, said arming switch being effective before it is operated to prevent said clock switch means from energizing said erecting devices or said transmitting device.

6. A portable radio transmitting station designed to be dropped by parachute from aircraft comprising a bomb-like housing, an erecting device controlled by an erecting device interlock switch, a parachute releasing device, means effective upon contact of said station and the earth to operate said releasing device, said parachute releasing device including a dowel pin adapted to be axially translated to perform the releasing function, an erecting device interlock switch comprising a spring biased operating plunger, said plunger being positioned to move into the space normally occupied by said dowel pin to operate said interlock switch, whereby closing of said interlock switch and operation of said erecting device is not possible until ejection of said dowel pin.

7. An air-launched radio transmitting section comprising a parachute, an extensible antenna, a radio transmitter, a time-controlled switch for determining the periods of energization of said transmitter, and electrical control system comprising switch gear responsive to impact with earth for controlling release of said parachute, extension of said antenna and functioning of said time-controlled switch, and interlock switches included in said system to ensure release of said parachute and extension of said antenna in predetermined sequence.

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