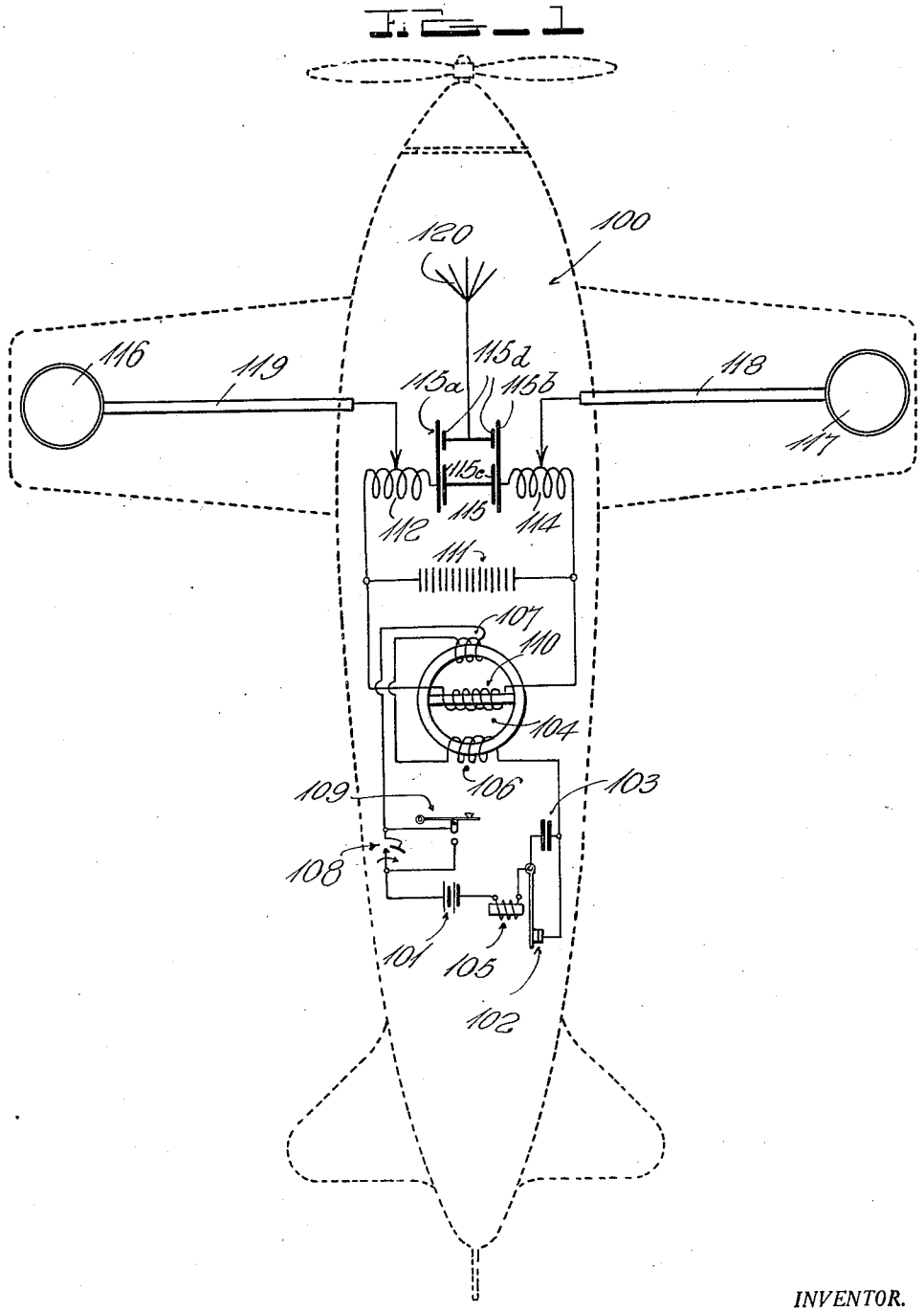
Oct. 20, 1931. S. L. McFADIN 1,828,672

RADIO CONTROL SYSTEM

Filed Sept. 3, 1929 3 Sheets-Sheet 1



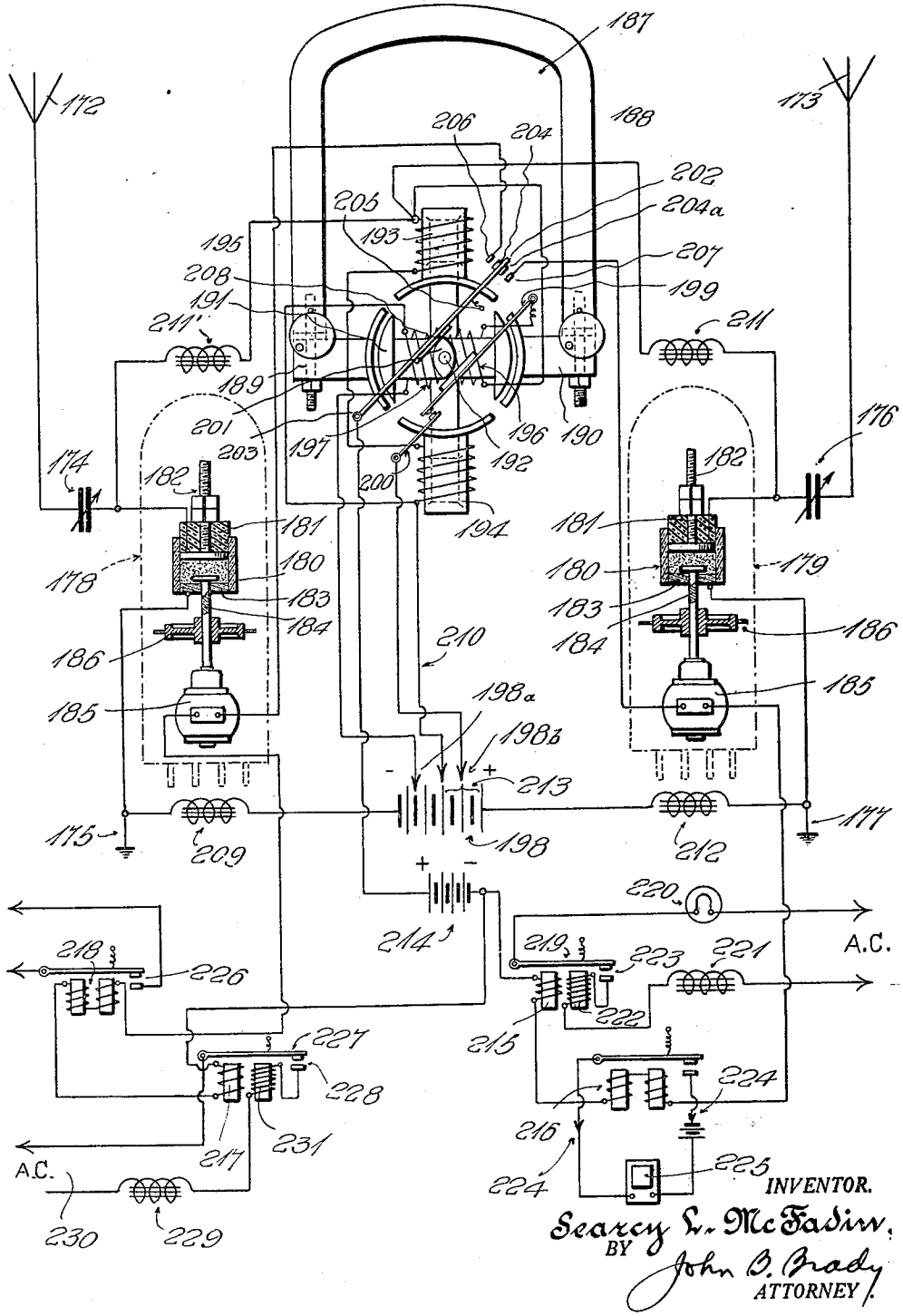
INVENTOR.
Searcy L. McFadin,
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RADIO CONTROL SYSTEM

Filed Sept. 3, 1929 3 Sheets-Sheet 2

FIG. 2



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Patented Oct. 20, 1931 1,828,672

UNITED STATES PATENT OFFICE

SEARCY L. McFADIN, OF BORGER, TEXAS, ASSIGNOR TO EDWARD W. HINES, TRUSTEE, OF CORDELL, OKLAHOMA

RADIO CONTROL SYSTEM

Application filed September 3, 1929. Serial No. 390,148.

My invention relates broadly to radio control systems and more particularly to a system for increasing safety in air navigation.

One of the objects of my invention is to provide a radio control system for operation from aircraft for actuating selected circuits on an aircraft landing field for indicating to the pilot the geographical location of the landing field and the available landing area on the field.

Another object of my invention is to provide a radio control system for operation between a mobile body and a multiplicity of fixed stations whereby the operator on the mobile body may actuate selected control circuits at the fixed station or stations.

A further object of my invention is to provide a radio transmitter control system whereby a signal of predetermined length may be emitted for actuating a receiving device for closing a selected circuit at the receiver.

A still further object of my invention is to provide an arrangement of receiving system for a remote control apparatus in which a multiplicity of circuits are provided at the receiver responsive to control signals emitted at different frequencies for controlling a circuit closer at the receiver and actuating selected circuits at the receiver.

Another object of my invention is to provide a construction of control device for a transmitter for predetermining the length of emission of the signaling energy for operating a control at a remotely located receiver.

Other and further objects of my invention reside in the arrangement of control circuits which are substantially permanent in character and which do not require replacement of parts over extended periods of operation as set forth more clearly in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of an aircraft equipped with the transmitter control apparatus of my invention; Fig. 2 diagrammatically illustrates the receiving system which is employed in proximity to a landing field for air craft for controlling the circuits on the landing field upon receipt of signals from the aircraft transmitter; Fig. 3 is a cross-sectional view taken on line 3—3 of Fig. 5 through the transmitter control device which is carried in the aircraft; Fig. 4 is a lateral cross-sectional view taken through the transmitter control device on line 4—4 of Fig. 3 and showing the transmitter control device in normal position prior to the emission of signaling energy; Fig. 5 is a lateral cross-sectional view taken through the transmitter control device and showing the control moved to a position where the radio transmitter is actuated and the emission of the signaling energy has commenced; and Fig. 6 is a lateral cross-sectional view through the transmitter control where the signal emission has been completed for operation of a control and the transmitter device is being restored to normal position.

Referring to the drawings in detail, reference character 1 diagrammatically shows an air craft 100 on which the control apparatus of my invention is carried. The control equipment is energized either from a wind driven generator or a battery source represented diagrammatically at 101. A circuit interrupter in the form of a vibrator or buzzer is illustrated at 102—105 with the contacts thereof shunted by condenser 103, the circuit interrupter being interposed in series between the source of power 101 and the primary windings 106—107 of the transformer 104, the circuit being completed through the transmitter control device 108 or the shunt positioned key 109. The transformer system 104 includes secondary windings 110 which connect to an oscillation circuit including quenched gap 111 and a balanced circuit comprising inductance elements 112 and 114 interconnected through condenser system 115. The condenser system 115 includes plate members 115*a* and 115*b* which connect respectively with the inner terminals of inductance elements 112 and 114. The condenser plates 115*a* and 115*b* are capacitatively coupled through condenser plates 115*c*. A counterpoise system 120 is connected with the radiating system through a capacity connection formed by condenser plates 115*d*

windings 193 and 194 the cam 201 operates to shift the spring device 202 either into contact with the fixed contact member 206 or fixed contact member 207. If an impulse is supplied to windings 193 and 194 which will shift armature 191 in a counter-clockwise direction the circuit will be made between contact 204 and contact 206. If, however the armature is shifted in a clockwise direction contact will be made between movable contact 204*a* and fixed contact 207. At the same time that contacts 204 and 206 are closed the connection between spring member 199 and contact 200 is completed by the action of cam 201 against spring member 199, thereby energizing the main armature winding 197, insuring the positioning of the armature in the position in which it has been moved and maintaining the contact between 204 and 206 in closed relation. This operation continues so long as windings 193 and 194 are energized, but when deenergized armature 191 is restored to its normal position in alignment between the pole pieces 189 and 190 by virtue of the permanent path of magnetic lines of force passing through the magnetic system 188. It will now be seen that connections are taken from windings 193 and 194 to the receiving circuits which connect with the antennæ 172 and 173.

Considering first one part of the receiving system, I have shown an audio frequency choke coil 211[1] disposed between one side of the responsive device circuit and the winding 193. The opposite side of the responsive device circuit connects through audio frequency choke coil 209 to the battery system 198 from which connection 210 extends to the winding 194 which is series connected with winding 193. It will be observed that a conductive path established by signaling energy passing through the permanent rectifier 178 permits the flow of current through the windings 193 and 194 from battery 198, thereby setting up a turning torque in the armature to close contact 204 and contact 206. Similarly, the receiving circuit employing antennæ 173 is connected to the windings 193 and 194 through audio frequency choke coils 211 and 212 for impressing energy upon that portion of battery 198 which I have designated as 213 upon windings 193 and 194 operating to produce a turning torque upon armature 191 and moving spring device 202 in the opposite direction to close contacts 204*a* and 207. The control circuit leads are taken from contact 206, leaf spring 202 and contact 207.

In order to provide for the opening of the signal receiving circuit after the close of each signaling period, the motor device 185 or 185*a* is connected in series with the control circuit to the respective contacts 206 and 207, thereby applying the source of potential from battery 214 to the motor and rotating the agitator within the responsive device, thereby opening the circuit to the windings 193 and 194 when a signal is not being received. The paths to the control circuits from contacts 206 and 207 are shown as including a relay winding 215 and a relay winding 216 in circuit with contact 207 while contac 206 includes a circuit through relay winding 217 and relay windings 218.

The purpose of the relay 219 which is actuated by winding 215 is to close a circuit to an emergency light 220 in circuit with the alternating current supply on the field, current limiting coil 221, relay winding 222 and contacts 223. The red emergency light indicates to the pilot that a predetermined side of the circuit is in use and calls to the attention of the field operators or personnel that a particular portion of the control circuit is energized. In other words, a warning is given that one part of the receiving system is in use, and should it be desired to operate a communication channel over this portion of the receiving circuit, a telegraph receiving circuit may be connected to the terminals 224 of the relay system 226, as I have represented by buzzer device 225. The other side of the receiving system includes relay 218 which operates the control circuit 102 by movement of contacts 226 and also controls an auxiliary circuit through relay 217 for actuating lights on the field. The relay 217 includes movable armature 227 and contacts 228 which connect through current limiting coil 229 to the auxiliary circuit 230, which may lead to any desired signaling lights or control apparatus on the landing field in circuit with the source of alternating current. Winding 231 when energized maintains the armature 227 in closed position with respect to contact 228 and this circuit is maintained in energized condition regardless of the signals which may be received in the receiving system and the impulses which may pass through electromagnetic winding 217. Circuit 230 therefore can be locked for a given period of time, depending wholly upon the characteristics of current limiting coil 229, which when its resistance rises, due to heat and inductance change, will so lower the current through winding 231 as to change the magnetic properties of winding 231 and release armature 227, opening the circuit to contact 228, which can only be restored by receipt of a succeeding signal transmitted from the aircraft.

It will be observed that the rectifying systems or responsive devices 178 and 179 are each hermetically sealed in containers which I have designated by dotted outline, which containers are provided with a base portion with contact members extending therefrom to permit the device to be plugged into connections to the remaining parts of the equipment. The fact that permanent radiant energy responsive devices are employed avoids the necessity of replacing major parts of the

receiving apparatus which would normally be required where electron tubes are employed.

The system of my invention may be installed on aircraft landing fields where it is not practicable to maintain continuous illumination of all parts of the field as provided by the multiplicity of control circuits which may be actuated by the pilot as he approaches the field in the system of my invention. In many instances, it is not practicable to maintain electron tubes in a continuous condition of energization at relatively isola ed landing fields and under such circumstances, the receiving system of my invention is highly desirable.

The permanently fixed responsive devices are capable of instant response to the control signals as the aircraft approaches the landing field, and the only power source which is required continuously at the receiving circuit is the battery system 198 and 214 and auxiliary sources such as 224 and the alternating current supply circuit for the landing field control circuits. All of the power circuits at the receiving station may be taken directly from the lighting line or a gas engine driven power equipment.

Referring to Figs. 3–6, control which governs the time interval through which the signaling energy is admitted from one or both of the capacity areas 116—117 and counterpoise 120 constituting the radiating system will be more clearly understood. The control includes a housing 121 which is supported by screw members 121 or against the supporting surface 121*d*. A cover 121*a* extends across the casing 121 and is secured by means of screw members 121*b* extending from the lower portion of the casing 121 through the cover 121*a*. The center of casing 121 is provided with an inwardly projecting central portion 122 into which the screw device 124 is inserted which serves to journal the sleeve 123 to which is secured the hand knob 125 wherein laterally extending arm 130 is pivotally mounted on the screw device 124 and is maintained in a predetermined position by means of spiral spring 128 which anchors at one end 126 in sleeve 123 and is secured at the opposite end with respect to arm 130 by a pin member 127 as illustrated. The laterally extending pivotally mounted arm 130 abuts against an inwardly protruding stop 136 carried by casing 121 and is maintained in such position by spring 128 assisted by coil spring 144 which is secured to the rearwardly extending portion 145 of the laterally extending lever 130. The laterally extending lever 130 carries a contactor 132 which is pivotally mounted to 131 adjacent the end of lever 130 and is controlled in position by flat spring 134, one end of which projects through a slotted rotary member 135 in lever 130. The interior walls of casing 121 are covered with insulating material shown at 138 and secured in position by screw members 139, which insulation material terminates adjacent one side of the casing to receive the conductive shoe 141 which is secured in position by means of screw devices 142, each of which are carefully insulated from casing 121. The shoe 141 is insulated from casing 121 by insulated sheet member 143. The surface of the shoe is directed inwardly from the interior insulated walls 138 to a position where it is wiped by the contactor 132 during the movement of the hand knob 125. The contactor 132 is provided with two beveled faces, one of which is conductive as designated at 132*a*, and the other of which is covered with insulation material designated at 133. An adjustable set screw 146 is provided in one side of the casing and is adjusted and set in position to properly move the contactor 132 to a predetermined angle against the action of spring 134 preparatory to the transmission of signaling energy over a predetermined time period governed by the sweeping of contact surface 132*a* with the interior surface of shoe 141 as shown in Fig. 5. The casing 121 carries binding posts 147 which are substantially insulated from the casing. One of the binding posts connects through flexible lead 147*a* to the contactor 132. The other binding post connects through flexible lead 147*b* to the conductive shoe 141, leads being taken from the binding posts 147 to the control circuit at 108 in the transmitter shown diagrammatically in Fig. 1.

If the laterally extending lever 130 has been moved to its extreme clockwise position as limited by stop 137, the hand control 125 is released. Contactor 132 reverses its position and returns in a manner shown in Fig. 6, where the insulated portion 133 wipes the interior surface of the conductive shoe 141. The laterally extending lever 130 is restored under the torsion of spring 128 and tension of spring 144.

When it is desired to emit a continuous signal instead of an intermittent signal of predetermined length, the hand key 109 is maintained closed. Where the operator desires to transmit a control signal for operating the circuits at the receiver as diagrammatically shown in Fig. 2, the hand control 125 is revolved thereby emitting signaling energy over a predetermined time period and operating the circuits at the receiver. The relay system will be actuated through that receiving circuit which receives energy at greater amplitude. If signaling energy emitted on one frequency is received at greater amplitude, than signaling energy received on another frequency, then the circuit containing the energy of greater amplitude will prevail upon the relay for the closing of the circuit to the remote control system.

As heretofore pointed out, emergency

light 220 is operated when the relay is operated by signaling received on antenna system 173. To guard against the continued illumination of the emergency light 220, the circuit opening device including reactor 221 and winding 222 on relay 219 is provided. By adjusting the tension on relay 219, the magnetic force which is required to hold the armature in closed position for holding contacts 223 closed may be determined. As the temperature in reactor 221 rises, the current through relay winding 222 decreases and armature 219 is released opening contacts 223 and cutting off the emergency light 220 after a lapse of a substantial period of time for the reception of a subsequent control signal. This action is entirely automatic and avoids the necessity of an attendant at the landing field. In the control circuit which employs relay system 227, I provide a similar temperature control means in the form of reactor 229 which insures the cutting off of any signal lights or control apparatus in auxiliary circuits connected in circuit 230 with the source of alternating current supply. The rise in temperature through reactor 229 decreases the current to relay winding 231, thereby opening contacts 228 and cutting off the circuit to the control apparatus which connects to circuit 230. The main control relay 218 having contacts 226 forms the master control for connection to the input control circuit of the apparatus described in my copending application Serial No. 390,147, filed September 3, 1929.

While I have described preferred embodiments of my invention, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

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

1. In a remote control system, a high frequency oscillation generator, a radiating system, means for establishing connection between said high frequency generator over predetermined time periods for transmitting signals from said radiating system comprising a fixed contact member, a movable contact member, means for shifting said movable contact member while in electrical connection with said fixed contact member for rendering said oscillation generator effective upon said radiating system for predetermined time intervals, means for reversing the direction of movement of said movable contact member with respect to said fixed contact for restoring said movable contact member to its original position while maintaining said oscillation generator ineffective with respect to said radiating system.

2. In a remote control system a transmitter comprising a high frequency generator, a radiating system, means for exciting said radiating system from said high frequency generator over successive time intervals, comprising a fixed contact member, an angularly movable contact member, means for shifting said angularly movable contact member with respect to said fixed contact member for a predetermined time period for rendering said high frequency generator effective upon said radiating system over a corresponding time period, and means for restoring said movable contact member to normal position while maintaining said high frequency generator ineffective with respect to said radiating system during the restoring time period.

3. A receiving system for remote control circuits comprising a pair of high frequency energy collecting systems each tuned to different frequencies, means in each of said circuits responsive to energy corresponding to the frequency to which said circuits are adjusted, a relay controlled by said means, said relay being shiftable to a circuit closing position, means for maintaining said relay in the shifted position thereof and control circuits operative by said relay on receipt of signaling energy of predetermined time periods.

4. In a receiving system for remote control circuits, a multiplicity of high frequency energy collecting circuits attuned to separate frequencies, means in each of said circuits responsive to the frequencies to which the corresponding circuit is attuned, a relay connected to said means, said relay comprising an angularly movable member, a contact member actuated thereby and means for maintaining said relay in shifted position when angularly movable member actuates said contact member upon receipt of control signals of predetermined time period, and a multiplicity of control circuits actuated by said relay.

5. In a receiving system for remote control circuits, a high frequency energy collecting circuit, relay means interconnecting said high frequency energy collecting circuit and said relay and responsive to signaling energy of the frequency to which said high frequency energy collecting circuit is adjusted, control circuits actuated by said relay and means operated by said relay for reconditioning said first mentioned means after the receipt of control signals of predetermined time period preparatory for the reception of succeeding control signals.

6. In a receiving system for remote control circuits, a high frequency energy collecting circuit attuned to a predetermined frequency, a responsive device connected in said receiving circuit and operable by incoming signaling energy of predetermined frequency, relay means controlled by said responsive device, means operative by said

relay means for reconditioning said responsive device after the receipt of each successive control signal and control circuits operative by said relay preparatory for the reception of succeeding control signals.

7. In a receiving circuit for a remote control system comprising a multiplicity of energy collecting circuits each attuned to separate frequencies, means in each of said circuits responsive to the frequency receivable by said circuits, a relay having a multiplicity of positions, connections between said relay and said responsive means whereby said relay may be shifted into any one of said multiple positions, means for maintaining said relay in a shifted position and a multiplicity of control circuits actuated by said relay upon receipt of control signals of predetermined time duration.

8. In a receiving system for remote control circuits, a multiplicity of receiving circuits attuned to separate frequencies, means in each circuit responsive to the frequency to which the circuit is attuned, a relay system having a movable actuator and a contactor controlled by said movable actuator, said contactor being shiftable into a plurality of different positions, connections between said responsive means and said relay system for shifting said contactor into a selected one of said positions, means operative when said contactor is shifted to a selected position for maintaining said contactor in shifted position and a multiplicity of control circuits arranged to be actuated when said contactor is moved to selected ones of the aforesaid positions.

9. In a remote control system, a radio receiving circuit, means in said receiving circuit responsive to control signals of predetermined frequency, means for reconditioning said aforementioned means subsequent to the receipt of each control signal preparatory for the reception of succeeding control signals, a relay actuated by said first mentioned means, a multiplicity of control circuits actuated by said relay and circuits extending from said relay to said reconditioning means for maintaining said first mentioned means in condition for the reception of successive control signals.

10. A relay comprising a rotatable member, a pair of movable members controlled by said rotatable member, a multiplicity of contactors shiftable to different positions in accordance with the movement of said pair of movable members and means controlled by the movement of said contactors for actuating a multiplicity of control circuits.

11. A relay system comprising a movable member, a rotary actuator carried by said movable member, a multiplicity of contactors controlled by said actuator and means operative by said actuator for maintaining the position of said movable member in predetermined position during the receipt of a control signal for completing a circuit to a selected one of said plurality of said control circuits.

12. A signal detecting device comprising an insulated container, conductive filings disposed in said container, an agitating device in said container, a driving motor for moving said agitating device, electrodes at opposite ends of said container connected with a signal receiving circuit for rendering the filings therein conductive upon receipt of incoming high frequency energy for rendering said detecting device conductive to local energy said agitator being initiated in operation upon the cessation of a control signal for rendering the gap between said electrodes nonconductive preparatory for the receipt of a succeeding control signal.

13. A signal detecting device comprising a receptacle, a pair of electrodes therein, conductive filings therebetween, an agitator projecting into said receptacle subjecting said filings to a stirring action, means for normally maintaining said agitator stationary during the reception of a control signal and means for rendering said agitator effective upon cessation of a control signal for rendering said filings nonconductive and preparing said circuit for the reception of a succeeding control signal.

14. A signal detecting device comprising a sensitized gap device connected with a signal receiving circuit, an agitator operative in said sensitized gap for rendering said gap nonconductive, and circuits controlled by said relay for initiating movement of said agitator subsequent to the cessation of the control signal for preparing said gap for the reception of a subsequent control signal.

In testimony whereof I affix my signature.

SEARCY L. McFADIN.

Patented Oct. 27, 1931 1,828,788

UNITED STATES PATENT OFFICE

BUREN I. STOOPS, OF KENVIL, NEW JERSEY, ASSIGNOR TO HERCULES POWDER COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE

EXPLOSIVE

No Drawing. Application filed December 8, 1927. Serial No. 238,719.

My invention relates to an improvement in explosives and more particularly to those types of explosives known as dynamite and gelatines.

Heretofore in the manufacture of dynamites and gelatines, sulphur has been used as one of the ingredients. In the case of ordinary dynamites sulphur has been used because of its cheapness and the fact that it was easy to pulverize and on combustion was practically converted into gases leaving little or no residue. In the case of gelatine the use of sulphur has been of especial advantage in that its use enabled the production of a gelatine composition which was soft, dough-like and flexible and which would readily flow and squeeze through the cartridging machines without undue friction and heating. Sulphur was furthermore of value as an ingredient of dynamites and gelatines in that it is non porous and non absorbent and therefore took up less of the nitroglycerine, or other liquid high explosive present, and hence prevented, or at least did not contribute to, loss of sensitivity of dynamites and the drying of gelatines from a lack of unabsorbed nitroglycerine, or the like.

Various attempts have been made to provide a suitable combustible material for use as a substitute for sulphur, but such attempts have resulted in the selection or production of materials having a greater absorbency than sulphur and which, while in certain cases they may be substituted for sulphur in dynamites, have proved useless as substitutes for sulphur in gelatines since they absorb the nitroglycerine present in the gelatine, and especially in low strength gelatines, to an extent which renders the gelatine too dry for practical purposes, as passing through a cartridging machine.

According to my investigations, I have discovered that the presence of sulphur in dynamites and gelatines, while it serves certain purposes, as indicated, is distinctly disadvantageous in that, contrary to general belief, it reduces the total power exerted by a dynamite or gelatine of given strength, and it can be demonstrated, for example by the well known mortar test, or by the Bureau of Mines' ballistic pendulum test, that a given gelatine or dynamite containing sulphur will not afford the same amount of execution as will a similar dynamite or gelatine without sulphur.

Now in accordance with my invention I have discovered that the combustible ingredient, sulphur, in dynamites and gelatines, and especially in low strength gelatines, may be replaced with a combustible ingredient comprising a combustible absorptive material, preferably an absorptive carbonaceous material, as wood, which has been impregnated with wax, preferably paraffin wax and which may be of ordinary commercial grade, or with a fat, such as tallow or stearine, or the like, a fatty acid, such as oleic acid, stearic acid or the like, or a gum such as damar, which, for the purposes of my invention I intend shall be deemed as equivalents of wax.

In the preparation of the combustible ingredient as a substitute for sulphur in accordance with my invention, for example, about seventy parts of finely divided wood, as wood sawdust, are impregnated with about thirty parts of wax of any desired grade. The combustible ingredient may be prepared by placing, say, thirty parts of paraffin, or wax, in a jacketed kettle provided with stirring arms and blades. The wax is melted by introducing hot water or steam into the jacket of the kettle and when melted, say, about seventy parts of sawdust are added and stirred into the wax. When the sawdust has absorbed or become impregnated with the wax the hot water or steam is shut off from the jacket of the kettle and cold water introduced therein to cool the contents of the kettle, the stirring of the mass being continued meanwhile. When cold the wax impregnated sawdust will be found to be a granular product, containing no lumps, and which does not require screening before use.

The wax impregnated material, for example sawdust, may be used as an ingredient of dynamites and gelatines in substitution for sulphur, within a wide range of proportion, and will be found to perform all the functions heretofore performed by sulphur, especially in low strength dynamites and gela-

tines, without at the same time acting to reduce the total power, or execution capacity of the dynamite or gelatine.

As an example of gelatines involving as an ingredient wax impregnated combustible material in substitution for sulphur, according to my invention, and in comparison with typical gelatines including sulphur as an ingredient, the following will be illustrative:

Table A

	1	2	3	4
Nitroglycerine, or the like	23.5	23.5	23.4	23.5
Nitrocompounds	1.5	1.5	1.5	1.5
Nitrocotton	0.3	0.3	0.3	0.3
Nitrate of ammonia	11.0			11.0
Sodium nitrate	52.2	59.0	62.4	49.5
Ivory meal	3.5	2.5	2.5	2.5
Starch	4.1	2.5	4.0	2.5
Wood pulp				
Wax impregnated sawdust	3.0		4.8	
Sulphur		9.7		8.2
Chalk	1.0	1.0	1.0	1.0
Strength	32.7%	11.6%	23.8%	25.0%

In the above table it will be noted that the gelatines represented by compositions Numbers 2 and 4 contain sulphur, while those gelatines represented by compositions Numbers 1 and 3, and in accordance with my invention, contain wax impregnated sawdust and no sulphur.

As illustrative of the comparison between, for example, a gelatine embodying my invention and one containing sulphur, it will be observed that the gelatine of the composition No. 1, which embodies my invention and which is what is commonly known to those skilled in the art as a 40% gelatine, has an actual strength, for example by the mortar test, of 32.7%, or actual strength closely approximating its strength 32.5%, as calculated by the following, generally accepted strength figures of the explosive ingredients:

Nitroglycerine	23.5 × 1	= 23.5
Nitrocompounds	1.5	
Nitrocotton	0.3	
Ammonium nitrate	11.0	
	12.8 × 0.7	= 9.0
		32.5

On the other hand, the 40% gelatine heretofore known, as illustrated by composition No. 4, including sulphur as an ingredient and having the same explosive ingredients as has composition No. 1 and hence having the same calculated strength, has by actual test a strength of only 25%.

As a further comparison the composition No. 2 is a so-called 25% gelatine and has a strength by actual test of only 11.6% as compared to a strength of 24.7% calculated in the basis of the accepted strength figures of the explosive ingredients, while the gelatine of composition No. 3, likewise a 25% gelatine, but without sulphur and with the addition of wax impregnated sawdust, has a strength by test of 23.8% which closely approximates its calculated strength of 24.7%. It will be noted that when wax impregnated sawdust is substituted for sulphur in the case of a 25% gelatine that the actual strength of the gelatine is so greatly increased that it is approximately of the same strength as the so-called 50% gelatine containing sulphur. In the substitution of wax impregnated sawdust for sulphur the desirable consistency, flexibility and cartridging ability of the gelatine is not in any way affected.

While in more specially describing my invention I have made special reference to gelatines, it will be clearly understood that my invention is applicable to dynamites generally in which inclusion of combustible material, as wax impregnated sawdust in accordance with my invention, whether or not in substitution for sulphur, is of very distinct advantage where it is desired to maintain a film of nitroglycerine, or the like, upon the surface of the other ingredients and so propagate the explosion through a mass of the dynamite, as in a cartridge; and such is especially so in the case of low strength dynamite having low nitroglycerine content, wherein sulphur has been heretofore used on account of its non absorbency, since the elimination of the sulphur results in an increase in the actual strength of such dynamites as in the case of gelatines.

It will be understood that my invention contemplates the use of any suitable combustible material, other than wood, which has wax impregnated therein. For example, I may use any suitable kind of wood as pine, or the lighter woods as balsa and Bongo wood or, in place thereof, I may use bagasse or the waste of sugar mills, corn stalks and the like, or such other combustible materials as may now or hereafter be adaptable for use as ingredients in explosives.

In connection with the above description of the explosive in accordance with my invention, it will be understood that in referring to wax I contemplate, as a part of my invention, the use, in substitution for wax, of a fat, a fatty acid or a gum which respectively I intend for the purpose of my invention shall be deemed equivalents of wax and where in the claims appended hereto wax is specified I intend to include, as equivalents, a fat, a fatty acid or a gum.

Having now fully described my invention what I claim and desire to protect by Letters Patent is:

1. An explosive including as ingredients a liquid explosive substance admixed with carbonaceous material having wax impregnated therein.

2. An explosive including as ingredients a liquid explosive substance admixed with fine-