

UNITED STATES PATENT OFFICE

2,632,882

ALARM SYSTEM FOR COMPASS REPEATERS

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Application December 16, 1950, Serial No. 201,210

5 Claims. (Cl. 340—181)

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This invention relates to repeater or data transmission systems, wherein it is essential that the observer of the repeater indicator be able to rely implicitly upon its accuracy. It is therefore essential for the observer to know whenever the repeater is not functioning properly. This is especially important in repeater compasses used on ships and airplanes. In bad weather the navigator relies implicitly on the readings of his steering repeater compass, which is actuated from a master gyrocompass down below decks and serious results would follow if the repeater failed without the navigator's knowledge. Where the ship (or aircraft) is equipped with an automatic pilot from which the ship's course is governed by a repeater compass from a master controller, an alarm system is doubly essential, since failure of the repeater circuit in this case without the knowledge of the human pilot, would be likely to ground the ship or cause a crash.

I am aware that alarm devices have been on the market for some time, which sound an alarm upon failure of the electrical supply to the transmitter and repeater. Such an alarm, however, does not sound in all cases where the electrical system is faulty. Thus, if there is an open circuit in the common supply lead beyond the alarm relay, an alarm may not sound, or in case of a short circuit in the repeater, or other trouble causing a greater current flow than usual through the repeater and transmitter.

According to my invention, I have devised an additional alarm circuit which will sound an alarm in cases where the present alarm system fails to function, and thus improve the safety of instrument navigation.

The primary object of the present invention is to provide an electrical system of this character that includes an alarm device situated at the bridge of the ship that is operable when the system is not functioning correctly due to any electrical failure such as short or open circuits therein or when the voltage supplied by the primary supply falls below a predetermined value or when the power supply fails.

One of the features of the invention resides in the provision of a circuit including an alarm device rendered effective by the operation of a relay controlled by a normally balanced differential relay having a series coil and a shunt coil in the primary supply of the system. The improved system further includes a holding circuit for the relay operating the alarm circuit that by-passes the differential relay of the system. The system also includes a switch that is operable to render both the holding and alarm circuits ineffective.

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Other objects, features and structural details of the invention will be apparent from the following description when read in relation to the accompanying drawing which shows a schematic view and circuit diagram of the improved system.

With reference to the drawing, a data transmission system embodying the present inventive concepts is shown to include a primary circuit energized from a suitable source of direct current electrical energy containing a data transmitter indicated at 1 and a repeater motor indicated at 2. As shown, the positive terminal of the D. C. supply is connected to the transmitter by way of lead 3. Lead 4 connects the repeater motor 2 to the negative terminal of the source energizing the system.

As shown, the D. C. electrical transmitter includes a commutator 5 and a cooperating roller carriage 6. The commutator is suitably fixed and the carriage is rotatably mounted at the center of the commutator being operatively connected by way of suitable gearing 7, 8, 9 and 10 to the phantom ring 11 of a gyrocompass 12. A contact arm 13 held in place by a spring (not shown) connects the carriage 6 to the supply lead 3. The rollers of the carriage 6 contact the commutator 5 and the position of the carriage as determined by the gyrocompass or other reference device provides the data transmitted to the repeater motor 2.

The commutator shown comprises twelve segments and correspondingly spaced segments *a* are interconnected by lead 14. Segments *b* and segments *c* are connected by leads 15 and 16 respectively. The repeater motor 2 is provided with a pair of coils for each of the commutator segments *a*, *b* and *c*. Coils *c'* of the step-by-step D. C. motor 2 are connected to segments *c* of the commutator by way of lead 17. Coils *b'* are connected to the segments *b* of the commutator by way of lead 18. Lead 19 connects the coils *a'* and the segments *a* of the commutator. Coils *a'*, *b'* and *c'* are connected by an output lead 20 which is connected in turn to lead 4 of the system. The armature of the motor 2 is indicated at 21. Armature 21 is rotatably mounted and is operatively connected to an azimuth position indicator or compass card 22 of the repeater compass 2 by way of suitable gearing 23, 24 and 25.

In the position of the system shown in the drawing, the carriage 6 is contacting opposite segments *a* of the commutator and only coils *a'* of the repeater motor 2 are energized. The armature 21 accordingly takes the position shown in the drawing in alignment with the coils *a'*. In explanation of how the transmitter and repeater

motor operates, it will be assumed that carriage 6 moves in a clockwise direction as viewed in the drawing so that the right-hand roller contacts the adjacent segment *b* while the left-hand roller still remains on segment *a*. In this condition coils *a'* and *b'* of the motor 2 are energized equally and the armature 21 moves clockwise to assume a position midway between the coils *a'* and *b'*. With further movement of the carriage 6 in the same direction, the carriage will only contact segments *b* of the commutator. This steps the armature of the motor around to a position in alignment with coils *b'* of the repeater motor. In this manner, the repeater compass 22 is operated to repeat the information provided by the master compass, the card of which is indicated at 26. Card 26 of the gyrocompass 12 is fixedly connected to the phantom ring 11.

Inasmuch as the repeater at the bridge is utilized in course determination and steering of the craft, it is necessary that the information thereat correspond with the information provided by the master compass at all times. In this connection, an alarm device 23 is provided at the bridge to call attention to the fact that the repeater is not operating correctly. The alarm device is shown diagrammatically and may take the form of a buzzer, bell or light. Heretofore, alarm devices of this character have been utilized in repeater systems but the same has only been rendered operable when the voltage of the energizing source for the system fails or diminishes below a predetermined value. As long as the voltage supplied the system from the source is up to value, the alarm device would not be effective even though the information transmitted by the system to the repeater motor is in error. In the improved system, short or open conditions that cause incorrect data transmittal are detected and the alarm device rendered effective to indicate the same.

In accordance with the invention, the improved system includes a normally balanced differential relay 29 with a coil 30 connected in series in the primary energizing circuit including lead 3, transmitter 1, leads 17, 18, 19, motor 2, a fuse 31, and lead 4. Relay 29 also includes a coil 32 arranged in shunt relation in the primary circuit by lead 33 to lead 3, resistor 34, variable resistor 35, and lead 36 connected to lead 4. The armature 37 is normally biased to an open position relative to contact 38 by spring 39 whose tension can be adjusted by a thumb screw 40. Contact 38 is connected to lead 4 by way of lead 41. In the relay 29, the ampere turns of the shunt coil 32 are adjusted by means of the resistors 34 and 35 to an equivalent of the average of the ampere turns in the series coil 30 with the motor 2 having either two or four coils energized. For example, assume the relay shunt coil 32 is wound with 280 turns and the relay series coil is wound with 360 turns. Also, assume that in a two coil position of the motor 2, .2 ampere flows through the repeater circuit. In this position, only a pair of coils such as coils *a'* are energized. Further, assume that in a four coil position of motor 2, .4 ampere flows through the repeater circuit. This position corresponds to one where both pairs of coils *a'* and *b'* are energized. Therefore in the differential relay series coil 30, the ampere turns, with a double coil position of the motor 2, are 72 provided by multiplying .2 with 360. In the four coil position of the motor 2, the ampere turns in series coil 30 are 144 provided by multiplying .4 with 360. The average ampere turns of coil 30 are 108. The shunt coil 32 is then adjusted for 108 ampere

turns. Screw 40 is adjusted so that the spring 39 holds the armature so that it will not pull in under either of these conditions. The spring 39 consequently takes care of approximately 36 ampere turns unbalance to prevent the relay from closing when the carriage 6 goes from an *a* position to an *a, b* position for from an *a, b* position to a *b* position.

In the event an open circuit condition should develop between the transmitter 1 and motor 2, say for example in lead 19, no current flows when the carriage is positioned at shown and the series coil 30 would therefore be deenergized. As the shunt coil is energized at this time, the 108 ampere turns thereof overcomes the 36 ampere turns of the spring 39 and the armature 37 of the relay engages the contact 38. The same condition occurs with an open in the circuit at the fuse 31.

In the event of a short circuit condition across the segments of the commutator 5, for example, the carriage 6 is then positionable to energize coils *a'*, *b'* and *c'* of the motor 2. In this instance, .6 ampere would flow through the motor 2 and the energization of series coil 30 would correspond to 216 ampere turns. This causes an unbalance of 108 ampere turns at the differential relay which being greater than the 36 ampere turns taken care of by spring 39 would cause the armature 37 to close against contact 38.

The normally ineffective or open circuit including the alarm device 23 contains lead 42, the arm 43 of a normally closed switch 44, lead 45, contacts 46, 47 for the armature 48 of a second relay 49, lead 50, a separate source of D. C. electrical energy such as battery 51 and lead 52.

A holding circuit is provided for relay 49 including lead 53 to lead 3, coil 54 of the relay, leads 55, 56, arm 57 of switch 44, lead 58, contacts 59, 60 for armature 61 of relay 49, and lead 62 to lead 4. The armatures 48 and 61 of relay 49 are biased to an open position relative to the respective contacts 46, 47 and 59, 60 by means of spring 63. The normally ineffective or open holding circuit by-passes the differential relay 29 of the improved system and is included in the primary energizing circuit. Operation of the relay 49 renders effective or closes the alarm circuit when the armature 48 connects the respective contacts 46, 47. The holding circuit for the relay 49 is closed or rendered effective by operation of the differential relay 29 when the armature 37 thereof connects the contact 38. A circuit for rendering the holding circuit effective by closing the same at the contacts 59, 60 by armature 61, includes lead 4, lead 41, contact 38, armature 37, lead 64, lead 55, coil 54 for relay 49 and lead 53 to lead 3. Thus, any condition sufficient to operate relay 29 whether the same is fluctuating or constant is effective to hold the relay 49 so that the alarm device functions as intended. Switch 44 is operable to open or render ineffective the holding and alarm circuits of the system when desired.

The described alarm circuit is also operable apart from the relay 49 by a third relay 65 connected to close the circuit when the voltage supplied by the primary D. C. energizing circuit falls below a predetermined value. Coil 66 of relay 65 is connected across leads 3 and 4. The alarm circuit in this instance includes lead 67 to lead 45, contact 68, armature 69 of relay 65 and lead 70 to battery 51, lead 52, device 28, lead 42 and switch arm 43. The armature 69 is normally held in an open position relative to the contact

68 by the energization of coil 66 by the primary circuit. If, however, the voltage of the primary circuit falls below a predetermined desired value, the spring 71 connected to the armature 69 is effective to pull the armature 69 against contact 63 and close the alarm circuit. This circuit is also broken by means of switch 43 when desired.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A compass repeater system comprising a transmitter, a repeater, a normally balanced differential relay having a first winding and a second winding, an electrical current supply, said transmitter, repeater, and first winding being connected in series across said supply, said second winding being connected in parallel with the series connection of said transmitter, repeater, and first winding, and an alarm means, said differential relay being connected to control said alarm means, whereby the occurrence of an open or short circuit condition in the series connection of said transmitter, repeater, and first winding unbalances said differential relay to operate said alarm means.

2. The compass repeater system as defined in claim 1, wherein the alarm means comprises a second relay having a winding adapted to be connected across said supply by said differential relay and having a pair of normally open contacts, an electrical alarm device, and a separate current source for said alarm device, said alarm device, pair of contacts, and separate supply forming a normally open series circuit, whereby said differential relay, on the unbalance thereof, operates to energize the second relay to close said series circuit and thereby operate said alarm device.

3. In a compass repeater system, a transmitter, 45 a repeater, a first source of electrical current, a normally balanced differential relay including a first winding, a second winding, and a pair of normally open contacts, said transmitter, repeater and first winding being connected in series across said first current source, said second winding being connected in parallel with the series connection of said transmitter, repeater and first winding, a second relay including a winding connected in series with said differential relay con-

tacts across said supply and including a pair of normally open contacts, an alarm device having a second source of electrical current, said alarm device, second source of current and pair of second relay contacts forming a normally open series circuit, whereby upon the unbalance of said differential relay, said differential relay contacts close to energize said second relay thereby closing said series circuit to operate the alarm device therein.

4. The compass repeater system of claim 3, wherein the second relay further includes a holding circuit adapted to connect the winding of the second relay across said first source of current upon the energization of said winding through said differential relay contacts thereby to maintain a continuous operation of said alarm device.

5. A compass repeater system comprising a D. C. electrical transmitter having a plurality of pairs of stationary commutator segments and a cooperating rotatable contactor element adapted rotatably to be driven by a compass, a step-by-step D. C. repeater motor having a plurality of stationary pairs of coils corresponding to said pairs of commutator segments and a cooperating rotatable armature element adapted rotatably to drive a compass repeater card, said corresponding pairs of segments and coils being electrically connected together, a D. C. source of supply, a normally balanced differential relay having first and second windings, said contactor being adapted to interconnect corresponding pairs of segments and coils in series circuit with the first winding of said differential relay across said supply, said second winding of the differential relay being connected in parallel with said series circuit, and an alarm means, said differential relay being connected to control said alarm means, whereby the occurrence of an open or short circuit condition in said series circuit acts to unbalance said differential relay and effect operation of said alarm means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,229,939	Goldstein -----	June 12, 1917
2,022,758	Corderman -----	Dec. 3, 1935
2,052,057	Reid -----	Aug. 25, 1936
2,278,939	Muehter -----	Apr. 7, 1942
2,461,075	Naylor -----	Feb. 8, 1949