Dec. 8, 1942. H. MYERS 2,304,702

SYNCHRONIZING SYSTEM

Filed Oct. 23, 1941 2 Sheets-Sheet 1

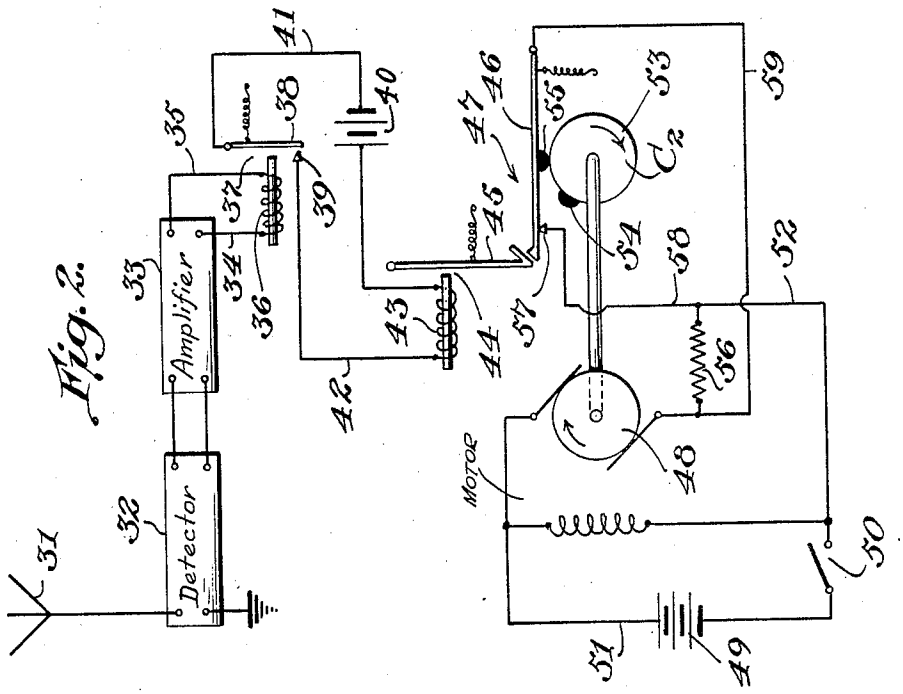


Fig. 2.

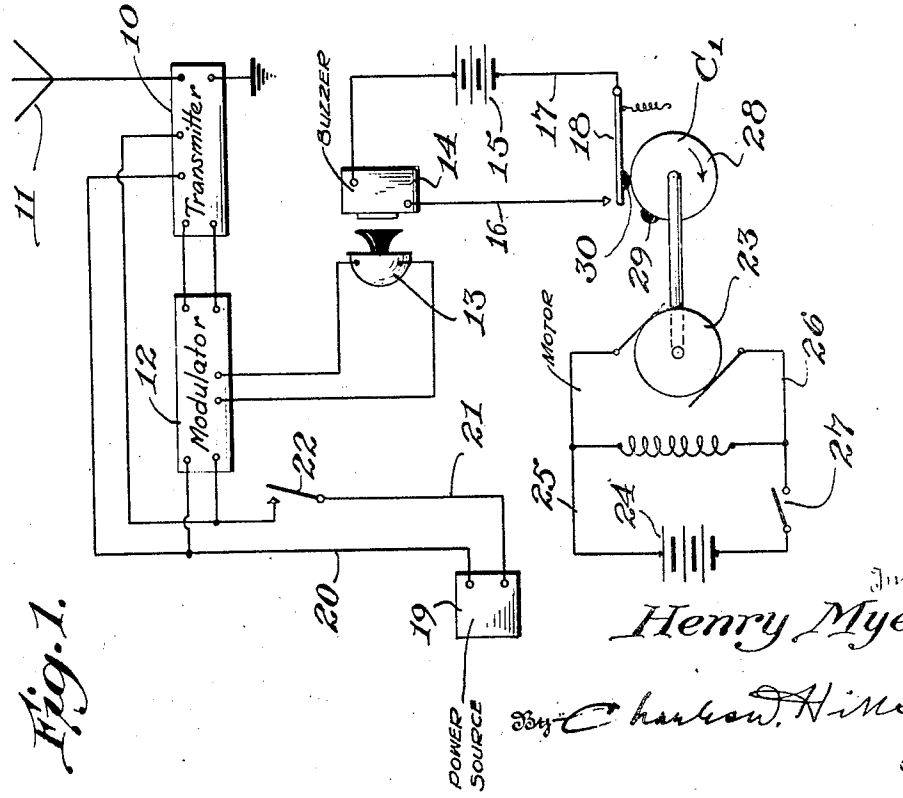


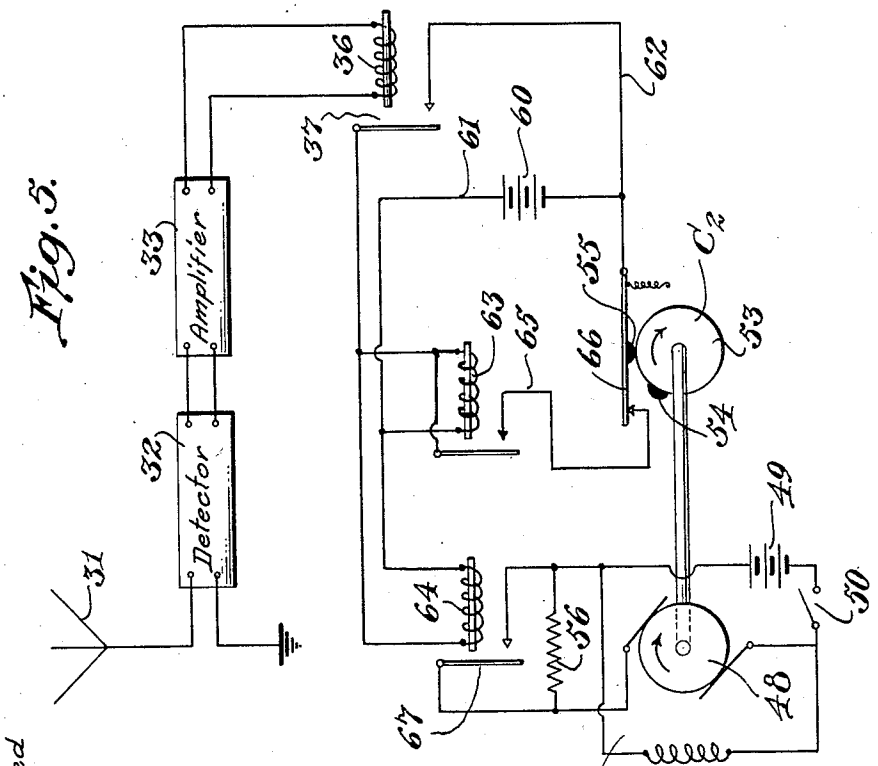
Fig. 1.

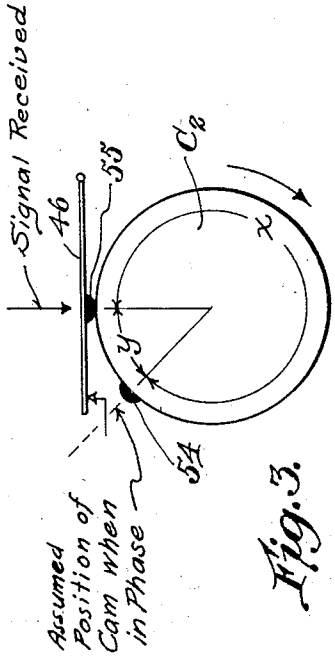
Inventor
Henry Myers
By Charles W. Hills
Attorneys

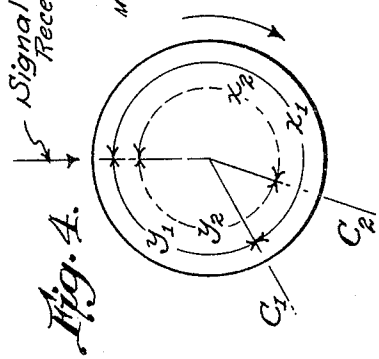
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SYNCHRONIZING SYSTEM

Filed Oct. 23, 1941 2 Sheets-Sheet 2







Inventor

Henry Myers

By Charles W. Hills

Attorneys

Patented Dec. 8, 1942

2,304,702

UNITED STATES PATENT OFFICE

2,304,702

SYNCHRONIZING SYSTEM

Henry Myers, Colonie, N. Y.

Application October 23, 1941, Serial No. 416,265

12 Claims. (Cl. 250—2)

This invention is related to means for maintaining synchronism between revolvable motor means at a transmitting station and revolvable motor means at a distant receiving station.

It is an object of this invention to maintain a revolvable element at a distant receiving station in phase with a revolvable element at a transmitting station.

It is a further object of this invention to provide means for maintaining revolvable elements at spaced apart radio transmitting and radio receiving stations, respectively, in phase with each other.

Other and further objects and advantages of my invention will be apparent from the following description taken in connection with the accompanying drawings.

In the drawings:

Figure 1 shows diagrammatically the means for normally transmitting a sustained radio carrier and means for momentarily and at regular time intervals modulating the carrier at audio frequencies;

Figure 2 shows diagrammatically means at a radio receiving station for controlling the phase position of a revolving element in response to the reception of a modulated radio carrier;

Figures 3 and 4 are descriptive diagrams of the method of controlling the phase position of the revolving element at the receiving station; and

Figure 5 is a diagrammatic showing of a modification of the controlling means of Figure 2.

In Figures 1 and 2 there are shown a sending station and a receiving station, respectively, which includes motor-driven elements to be maintained in phase with each other by means described hereinafter.

A conventional radio transmitter **10** is suitably connected to an antenna **11**, and the carrier is modulated by a conventional modulator **12**, connected to the transmitter to modulate the carrier at audio frequencies in a manner well understood in the radio art.

The modulating means comprises a microphone **13** connected to the modulator in a conventional manner, and the microphone is actuated by sound waves from a conventional buzzer **14** placed adjacent thereto. The buzzer is energized by a battery **15** connected by wires **16** and **17** in series with a switch **18** actuated by a cam indicated generally at C_1.

The modulator and the transmitter are connected to a source of power, indicated at **19**, by wires **20** and **21**, in series with a switch **22**.

An electric motor **23** of the conventional shunt type is connected to a source of power, indicated at **24**, by wires **25** and **26**, in series with a normally closed switch **27**, and this motor drives a cam **28** to actuate the switch **18**.

It is convenient to consider the cam **28** as a disk having a projection **29**, engageable with a follower **30** on the arm of the switch **18**.

It will now be obvious that when the switch **22** is closed to energize the transmitter a carrier will be emitted by the antenna **11**, and that when the motor **23** is rotating, following the closing of the switch **27**, the switch **18** will be closed once per revolution of the disk **28** to momentarily actuate the buzzer **14** and so modulate the output of the transmitter at audio frequencies.

The microphone and buzzer have been shown for the ready illustration of means to modulate the carrier at audio frequencies, but it is obvious that other means may be employed to modulate the carrier at audio frequencies in response to the closing of the switch **18**, and that the means shown are for illustration and not by way of limitation.

At the receiving station, shown in Figure 2, the carrier is received by an antenna **31** connected to a conventional receiving set employing electron tubes, and this set comprises a conventional tuned detector, indicated at **32**, and a conventional amplifier, indicated at **33**, and the receiving set includes the usual power sources (not shown).

The output circuit of the amplifier **33** is connected by wires **34** and **35** to the coil **36** of a relay **37**. The relay **37** includes an armature **38** and a contact **39** to form a switch to close a circuit including a battery **40**, wires **41** and **42**, and the coil **43** of a latching relay **44**.

The relay **37** is adjusted, in cooperation with the detector and amplifier, so that its armature moves to circuit-closing position only while the carrier is modulated upon the closing of the switch **18** at the sending station.

When the sending and receiving stations are a moderate distance apart, the relay **37** is normally biased towards closing by the direct current output of the receiving set while the unmodulated carrier is being received.

The latching relay **44** includes an armature **45** as a latch to normally retain an arm **46** of a switch **47** seated thereon, and to release the arm **46** for movement to circuit-closing position when the relay **44** is energized.

A conventional shunt type electric motor **48** is suitably connected to a power source indicated at **49** through a normally closed switch **50** and wires **51** and **52**.

The motor drives a cam, indicated generally at C_2, and which comprises a disk **53** having a projection **54** engageable with a follower **55** on the arm **46**, so that the cam may raise the switch arm **46** to be latched by the latch **45**.

When the switch **47** is open, with the arm **46** latched, current flow to the motor is from the

source, through the motor armature, through a resistor 56, and through wire 52, so that the motor runs at reduced speed because of the insertion of the resistor in the armature circuit. When the switch 47 is closed, it shunts the resistor 56 through the arm 46, contact 57, and wires 58 and 59, so that the motor now runs at normal speed.

It will now be obvious that the momentary reception of the modulated carrier results in the actuation of the latching relay 44 to release the switch arm 46 to cause the motor to run at normal speed, provided that the arm 46 has been latched, and that the cam C_2 will, once per revolution, open the switch 47 to reduce the speed of the motor if the switch 47 is closed.

Figures 3 and 4 are employed in connection with what follows to describe how the disks 28 and 53 are held in phase.

Referring to Figure 3, the time interval between signals is that required to complete a cycle and is denoted by T. The time required for the disk 53 to make a complete cycle at reduced speed is t_s, and that to make a complete cycle at normal speed is t_f.

When the disk 53 is in phase with the disk 28, then $x+y=1$, and $T=xt_s+yt_f$, where x and T are given the values desired. A value of t_f is selected, and a value of t_s is then calculated. x and y are fractional parts of a complete cycle.

Referring now to Figure 4, if the cam 53 is out of phase when the signal is received, as indicated at C_1, then

$$x_2=\frac{T-y_1t_f}{t_s}$$

and $y_2=1-x_2$.

The values T, t_s, and t_f have been selected for that value of x which places the cam in the desired phase relation. The values of x and y will change in each time interval T until x reaches the predetermined value for phase position, and x will thereafter retain that value even if the projection 54 reaches the follower 55 at the same instant, immediately before, or immediately after the signal arrives.

A modified form of the motor control means at the receiving station is shown in Figure 5. Similar numerals have been employed to indicate parts similar to those shown in Figure 2. The relay 37, responsive to the modulated carrier, momentarily closes a circuit which comprises a battery 60 and wires 61 and 62 to energize relays 63 and 64, and relay 63 closes to form a holding circuit comprising the battery 60, wires 61 and 65, and the cam-operated switch 66, so that if the switch 66 is closed, then the relay 64 is held closed to close its switch 67 to shunt the resistor 56 in series with the armature of the motor 43.

When the switch 66 is opened, once per revolution, by the projection 54 engaging the follower 55, the holding circuit is broken, and the relay 64 becomes deenergized so that its switch 67 opens to again insert the resistance 56 in series with the armature of the motor 43. Thus, the relays 63 and 64 function to normally shunt the resistor after being once energized, and to insert the resistor when the switch 66 opens until they are again energized by the modulated carrier with the switch 66 closed. The modification shown in Figure 5, therefore, functions to obtain the result of the circuit arrangement of Figure 2.

According to the provisions of the patent statutes, I have set forth the principle and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiments. However, I desire to have it understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically illustrated and described.

I claim as my invention:

1. Synchronizing means comprising radio transmitting means to transmit a normally sustained carrier, means momentarily actuatable at regular time intervals to modulate said carrier, a motor, a source of current connected to said motor, a resistor, means actuatable by said motor to insert said resistor in series with said source to reduce the speed of the motor, and means responsive to the modulating of said carrier to shunt said resistor to thereby cause the motor to run at a predetermined normal speed.

2. Synchronizing means comprising radio transmitting means to transmit a normally sustained carrier, means momentarily actuatable at regular time intervals to modulate said carrier, a motor, a source of current connected to said motor, a resistor in series with said source, a switch including an element movable to closed position to shunt said resistor and thereby cause said motor to run at a predetermined normal speed, means driven by said motor to open said switch and thereby cause said motor to run at a reduced speed, relay means to latch said element in open position, and means including said relay means responsive to the modulating of said carrier to release said element for movement to closed position.

3. Synchronizing means comprising radio transmitting means to transmit a normally sustained carrier, means momentarily actuatable at regular time intervals to modulate said carrier, a motor, a source of current connected to said motor, a resistor in series with said source, switch means closable to shunt said resistor and thereby cause said motor to run at a predetermined normal speed, means actuatable by said motor to effect opening of said switch and thereby cause said motor to run at a reduced speed, and means responsive to the modulating of said carrier to effect movement of said switch to closed position.

4. Synchronizing means comprising a first relay, means momentarily actuatable at regular time intervals to energize said relay for closing, a second relay, a third relay, a motor, a source of current connected to said motor, a resistor in series with said source to cause said motor to run at a reduced speed, said third relay being energizable to shunt said resistor and thereby cause said motor to run at a predetermined normal speed, a battery, a first circuit connecting said first relay, and said second relay and said third relay in circuit with said battery for momentary energization of said second relay and said third relay upon momentary energization of said first relay, a normally closed switch, a second circuit connecting said battery with said switch and second relay and said third relay to provide a holding circuit for said second and third relay upon momentary energization of said first relay, and means driven by said motor to effect opening of said switch and the opening of said second circuit.

5. Synchronizing means comprising a first relay, means momentarily actuatable at regular time intervals to energize said relay for closing, a motor, a source of current connected to said motor, a resistor in series with said source

to cause said motor to run at reduced speed, a switch having an arm movable to closed position to shunt said resistor and thereby cause said motor to run at a predetermined normal speed. means driven by said motor to move said arm to open position, means to latch said arm in open position, a second relay, a battery, a circuit connecting said second relay and said battery with said first relay, said circuit being closable upon energization of said first relay to effect release of said switch arm.

6. Synchronizing means comprising a radio transmitter to transmit a normally sustained carrier, means actuatable momentarily and at regular time intervals to modulate said carrier, a radio receiver, a relay connected to said receiver and normally biased towards closing position by said carrier, said relay being arranged actuatable to closed position only upon the modulating of said carrier, a motor, a source of current connected to said motor, a resistor in series with said source to cause the motor to run at reduced speed, a switch movable to closed position to shunt said resistor to cause said motor to run at a predetermined normal speed, means driven by said motor to effect opening of said switch, and means responsive to the closing of said relay to effect movement of said switch to closing position.

7. Synchronizing means comprising a motor, a source of current connected to said motor, a resistor in series with said source to cause the motor to run at reduced speed, a switch closable to shunt said resistor to cause said motor to run at a predetermined normal speed, said switch including a follower, a cam driven by said motor to engage said follower when said switch is in closed position to thereby move said switch to open position, means to hold said switch in open position, and means momentarily actuatable at regular time intervals to release said switch for movement to closed position.

8. Synchronizing means comprising a motor, a source of current connected to said motor, a resistor in series with said source to cause the motor to run at a reduced speed, a first electromagnetic switch energizable to shunt said resistor to cause the motor to run at a predetermined normal speed, a switch including an arm normally in circuit-closing position and with the arm including a follower, a cam driven by said motor and engageable with said follower to open said switch, a second electromagnetic switch energizable to effect closing of said first electromagnet switch, said normally closed switch arm being in series with said second electromagnetic switch, means momentarily actuatable at regular time intervals to energize said second electromagnetic switch, and means including said second electromagnetic switch actuatable upon momentary energization of said second electromagnetic switch to maintain said first electromagnetic switch energized until said switch arm is moved by said cam to open position.

9. Synchronizing means comprising a source of current, a first motor connected to said source, a resistor in series with said motor to cause the motor to run at reduced speed, a switch closable to shunt said resistor to cause the motor to run at a predetermined normal speed, said switch including an arm having a follower, cam means driven by said first motor engageable with said follower to open said switch, means to thereupon hold said arm in open position, electromagnetic means energizable to release said arm for movement to closing position, a second motor, and means driven by said second motor actuatable to momentarily and at regular time intervals effect energization of said electromagnetic means.

10. Synchronizing means comprising a radio transmitter to normally emit a sustained carrier, means connected with said transmitter to modulate the carrier momentarily and at regular time intervals, said means including a first switch arm carrying a first follower, a first revolvable cam having a first element engageable with said follower once per revolution of said cam to close said switch, and a first motor in driving connection with said cam, means to effect running of said motor at a predetermined constant speed, radio receiving means, a source of current, a second motor connected to said source, a resistor in series with said motor to cause the motor to run at reduced speed, circuit means normally shunting said resistor to cause the motor to run at a predetermined normal speed, said circuit means including a second switch arm carrying a second follower, a second revolvable cam driven by said second motor and having a second element thereon engageable with said second follower once per revolution of said second cam to open said circuit means, and relay means connected with said receiving means and energizable in response only to the modulated carrier operable to close said circuit means for a period of time responsive to the phase position of said second element at the moment of energization of said relay means.

11. Synchronizing means comprising a first motor at a radio transmitting station, power source means connected to said motor to effect operation of said motor at a predetermined constant speed of operation, radio transmitting means to transmit a normally sustained carrier, means connected momentarily actuatable by said first motor at regular time intervals to modulate the carrier at audio frequencies, a second motor at a receiving station, a source of current, circuit means connecting said source of current with said second motor, radio receiving means at said receiving station, means including said radio receiver means connected responsive to the modulated carrier to condition said circuit means to effect operation of said second motor at a predetermined normal speed, and means connected actuatable by said second motor to condition said circuit means to cause said motor to run at a speed less than normal.

12. Synchronizing means comprising radio transmitting means to transmit a normally sustained carrier, means to momentarily modulate said carrier at regular time intervals, a source of current, a motor, circuit means connecting said motor to said source to effect operation of said motor at one predetermined speed, radio receiving means, and means including said radio receiving means connected operable to condition said circuit means to effect operation of said motor at another predetermined speed in response to the modulated carrier.

HENRY MYERS.