

July 4, 1933.

B. A. WITTKUHNS ET AL

1,916,706

REMOTE CONTROL SYSTEM

Filed Oct. 8, 1930

2 Sheets-Sheet 1

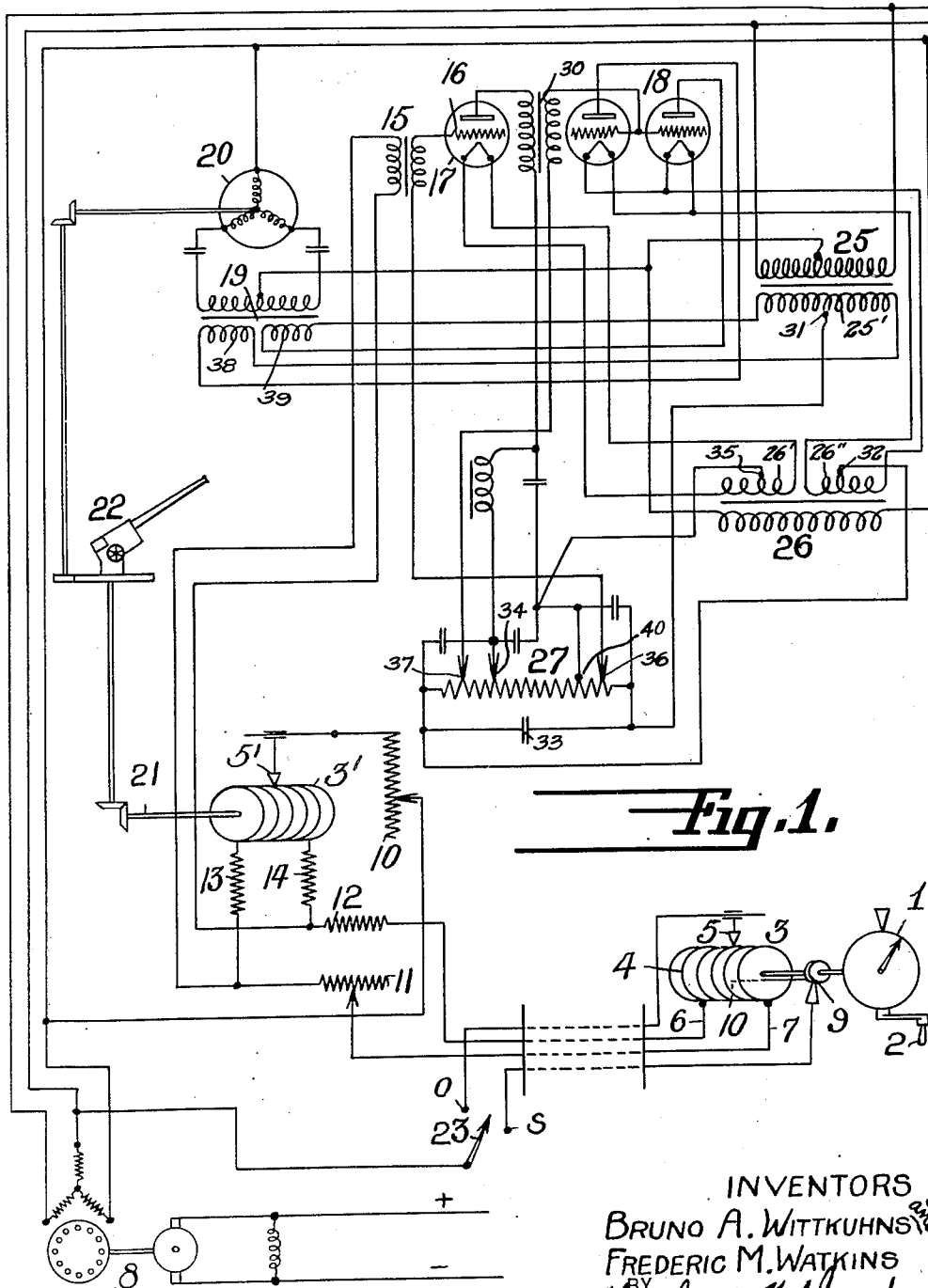


Fig. 1.

INVENTORS
 BRUNO A. WITTKUHNS
 FREDERIC M. WATKINS
 BY *Herbert H. Thompson*
 ATTORNEY.

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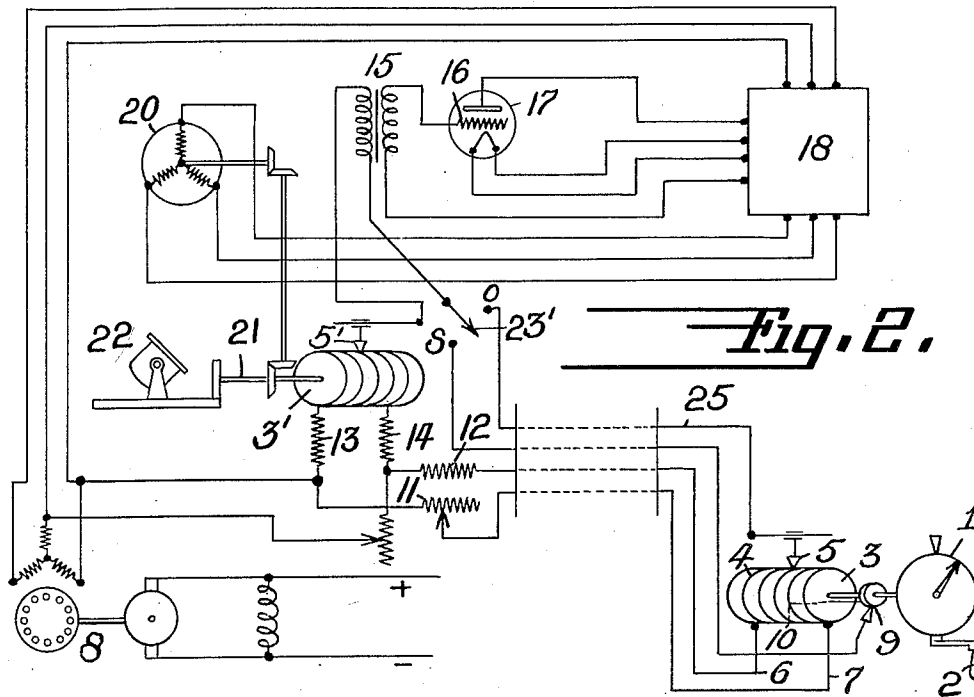
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INVENTORS
BRUNO A. WITTKUHNS and
FREDERIC M. WATKINS
BY
Herbert H. Thompson
ATTORNEY.

UNITED STATES PATENT OFFICE

BRUNO A. WITTKUHNS, OF CHATHAM, NEW JERSEY, AND FREDERIC M. WATKINS, OF FOREST HILLS, NEW YORK, ASSIGNORS TO SPERRY GYROSCOPE COMPANY, INC., OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK

REMOTE CONTROL SYSTEM

Application filed October 8, 1930. Serial No. 487,358.

This invention relates to a remote control system for the turning of comparatively heavy objects, such as guns, searchlights, and the like, in accordance with the movements of the distant controller. Satisfactory means have been devised for the remote control of indicators which require very little torque, among which may be mentioned the so-called Selsyn system. Such a system, however, is not adapted for the turning of objects requiring appreciable torque, since the Selsyn motors were only accurate if not loaded. Such a system can only be used to turn heavy objects, therefore, by the employment of an auxiliary power motor at the receiver. One purpose of the present invention is to devise a remote control system which is accurate and at the same time which has sufficient torque for the rotation of objects having appreciable resistance and without the employment of an auxiliary power motor in addition to the repeater motor. According to our invention we make use of variable impedances, preferably resistances, one unit of which is connected to the sending instrument and another is driven by the receiving device. Alternating current, preferably three phase current, is used in connection therewith, one phase being fed through the resistances and the differential output amplified by a vacuum tube amplifier unit. The power motor is preferably directly operated from the output of the amplifier unit by having one of the three phase windings thereof directly connected to one phase of the supply, the other two phases being connected to the output of the amplifier unit through a split phase connection. Our three-phase motor at the receiver, therefore, is quite different from the ordinary A. C. repeater motor in that it is supplied with ample current to exert full torques on the receiver even though the displacement of the receiver from the proper position is very slight.

Referring to the drawings,

Fig. 1 is a wiring diagram showing one form of the invention they assume, and

Fig. 2 discloses a wiring diagram of a modified form of the invention showing a different

method of leading in the supply current to the instruments.

In the drawings the sending instrument is represented by a dial 1 having a crank 2. Connected so as to be driven from the dial is a variable resistance 3 which is shown as constructed in the form of a drum or cylinder on which is spirally wound the resistance wire 4. A slidable contact 5 is shown as engaging the wire and it will be understood that as the drum is revolved the contact 5 slides along the wire, thus increasing the amount of resistance wire on one side of the contact and decreasing it on the other side as the drum is revolved in one direction. The opposite ends of resistance wire 4 are led through long conductors 6 and 7 to a similar drum 3' at the receiver.

In the form shown in Fig. 1, the polyphase supply is furnished by a motor generator set 8 and one wire thereof is connected to the sliding brush 5 on drum 3 and another wire is connected to corresponding sliding brush 5' on the drum 3'. Preferably a variable resistance 10 is inserted between one side of the line and brush 5' and also a variable resistance 11 and a resistance 12 are placed in a circuit between the two drums so that the resistances may be properly balanced to synchronize the sending and receiving instruments. Additional resistances 13 and 14 are also shown for this purpose and to balance the resistance of the long transmission wires (6 and 7).

The aforesaid resistances are balanced against each other somewhat in the form of a Wheatstone bridge in which all four legs are variable and the differential output is carried to an amplifier unit. As shown, the output is carried to an input transformer 15, the output of which is led to the grid 16 of the first tube 17.

We prefer to use as an amplifier unit 18 the unit described and claimed in the copending application of Bruno A. Wittkuhns, one of the joint inventors hereto, Serial No. 433,562, filed March 6, 1930, another form of which is disclosed in the copending application of applicants, No. 381,660, filed July 27, 1929. According to our invention, all the

current for the resistors, motors and amplifying unit is furnished from a common poly-phase supply, no other source of current being necessary. For supplying current of the proper voltage and phase relation we have shown a pair of transformers 25 and 26, the former being used to supply plate potentials to the push-pull amplifier 18 and the latter supplying the heating current for the tubes. As shown, the filament of the first tube is heated by secondary winding 26' of the transformer 26. The output of the first tube passes through the inter-stage transformer 30 and thence to a pair of power tubes 18 arranged in push-pull fashion. These tubes have their filaments lighted from the secondary 26'' of transformer 26 and alternating current of opposite potential is supplied to the plates thereof by connecting said plates to the opposite ends of the secondary 25' of the transformer 25.

We also employ a variable resistor 27 connected between the mid point 31 of winding 25' and the mid point 32 of the winding 26'' or in other words in series with the tubes 18. On account of the rectifying action of the push-pull tubes 18 acting as a full wave rectifier, an analysis will show that the current flowing through the resistor will be pulsating direct current which may be smoothed out by condensers 33 in a well known manner. We also connect to said resistor, preferably at an intermediate point 40, the mid point 35 of the winding 26'. The resistor 27 thus completes a circuit through the first tube as well as the others and by connecting the grid of the first tube to an intermediate point 36 on the resistor, the grid negative bias for this tube may be obtained. A feed-back coupling is thus also obtained through the resistor. Also the proper D. C. positive plate potential is obtained from the same resistor by an intermediate tap 34 on the other side of point 40 from tap 36 and connected through transformer 30 to the plate of the first tube. The grid bias for tubes 18 is obtained from said resistor by connecting the grids thereof to point 37 on said resistor. The final output of the tubes is led through the output transformer 19. This transformer has two primaries 38—39 connected respectively between the plates of the two tubes 18 and the secondary 25' of transformer 25. The secondary of said transformer has a center tap cross connected to a center tap on the primary of transformer 25, thus forming a Scott connection by which two phases are supplied to the motor 20, the third phase being supplied directly from the third phase of the supply line. The result is that two phases of the motor 20 will be reversed whenever the indicator handle 2 is reversed in direction, thus causing the motor 20 to drive the receiver 22 and resistance 3' in the proper

direction to restore synchronism. The motor 20 is shown as geared to the receiver 22 which, as explained, may be any type of receiver, such as an indicator, searchlight, or gun, and to which is connected the resistance drum 3' on shaft 21.

For the purpose of synchronizing the sending and receiving instruments we have shown a synchronizing switch 23 which is preferably located adjacent the receiver. Switch 23 serves to break the connection from the supply to the brush 5 on the sending instrument and to make a connection from the supply to collector ring 9 on the receiver, which is connected to the mid point 10 of resistance 4. By throwing switch 23, therefore, from the operating position 0 to the synchronizing position S, the receiver operator may ascertain at once whether his receiver is synchronized since he knows that when the switch is on S his receiver should read zero or some other known center reading. If it does not read properly he adjusts resistance 11 until proper readings are obtained, when the switch is thrown back on 0. It may be noted that this synchronizing operation may be effected without interfering with or notifying the sending operator or his instrument.

It should also be noted that very accurate following is obtained by our invention because of the double variation in resistances, that is, as one side of the two part resistance is increased the other is diminished, thus giving double the accuracy of any resistance arrangement which contemplates the mere variation of one leg of a Wheatstone bridge.

According to Fig. 2, instead of leading in the supply to the resistances through the sliding contacts 5 and 5', the supply may be led into the resistances through the two ends thereof, the resistances thus being connected in parallel across one phase of the supply. In such case the sliding brushes are connected to the input transformer 15 and the switch 23' is placed in the wire 25 leading from the brush 5 to the transformer, the point S on the switch being connected as before to the collector ring 9.

In accordance with the provisions of the patent statutes, we have herein described the principle and operation of our invention, together with the apparatus which we now consider to represent the best embodiment thereof, but we desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described our invention, what we

claim and desire to secure by Letters Patent is:

1. In a remote control system, a sending device comprising a two-part resistance and variable means for increasing one part as the other is decreased, a controlled device including an A. C. motor, a two-part resistance, and means driven by said motor for varying the same as said first named resistance is varied, a thermionic amplifier unit in circuit between said resistances and motor, including a detector tube, a pair of amplifier tubes arranged in push-pull fashion, and a resistance connected in series with the latter, and a common A. C. source connected to said amplifier unit, said resistances and unit and also to said motor which supplies all the current necessary for the operation of the system.

2. In a remote control system, a sending device comprising a two-part resistance and variable means for increasing one part as the other is decreased, a controlled device including a three-phase motor, a two-part resistance, and means driven by said motor for varying the same as said first-named resistance is varied, an amplifier unit in circuit between said resistances and motor, and a three-phase source having a phase connected to said resistances and another phase connected to said motor.

3. In a remote control system, a sending device including a variable resistance, a receiver including a similar variable resistance, a three-phase motor for adjusting the latter resistance to correspond to the adjustment of the first-named resistance, a thermionic phase-shifting amplifier unit in circuit between said resistances and motor, and a three-phase supply source having a phase connected to said resistances and amplifier unit, and another phase connected to said motor.

4. In a remote control system, a sending device comprising a two-part resistance and variable means for increasing one part as the other is decreased, a controlled device including an A. C. motor, a two-part resistance, and means driven by said motor for varying the same as said first-named resistance is varied, an amplifier unit in circuit between said resistances and motor, an A. C. source connected to said resistances and unit and also to said motor, and means for synchronizing the controlled device including a throw-over switch for temporarily connecting the said device to a predetermined fixed point on the first-mentioned resistance.

5. A remote control system as claimed in claim 3 wherein said A. C. supply furnishes all potentials for the operation of the amplifier unit.

6. In a remote control system, a sending device including a variable resistance, a receiver including a similar variable resistance, a three-phase motor for adjusting the latter resistance to correspond to the adjustment of the first-named resistance, a thermionic amplifier unit in circuit between said resistances and motor, including a detector tube, a pair of amplifier tubes arranged in push-pull fashion, and a resistor connected in series with the latter, a three-phase supply source having a phase connected to said resistances and amplifier unit and another phase connected to said motor, said source supplying all current necessary for the operation of the system and a synchronizing switch adapted to connect the receiver to a predetermined point on the sending resistance.

In testimony whereof we have affixed our signatures.

BRUNO A. WITTKUHNS.
FREDERIC M. WATKINS.

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