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2,317,419

FIRE CONTROL SYSTEM

Filed Jan. 4, 1940

2 Sheets-Sheet 1

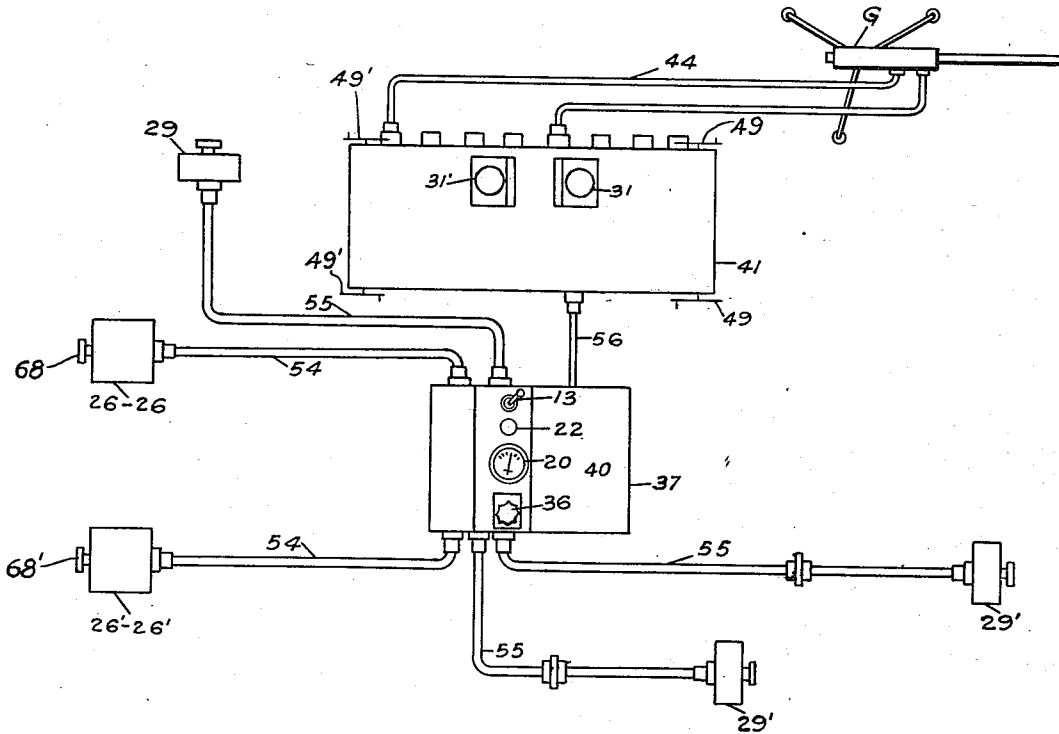


Fig. 1-

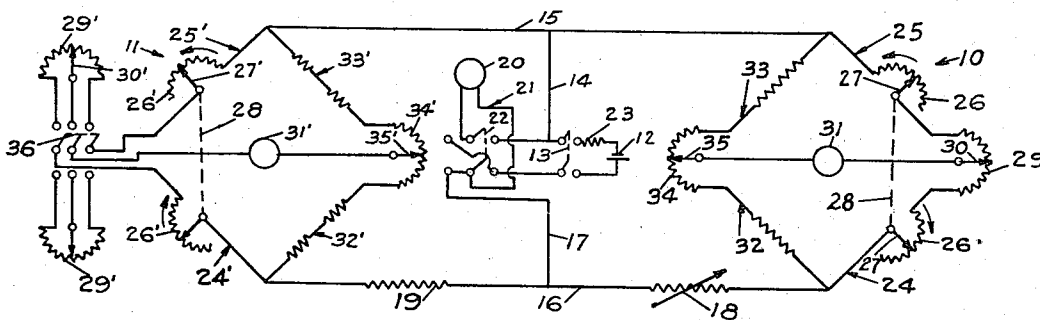


Fig. 2-

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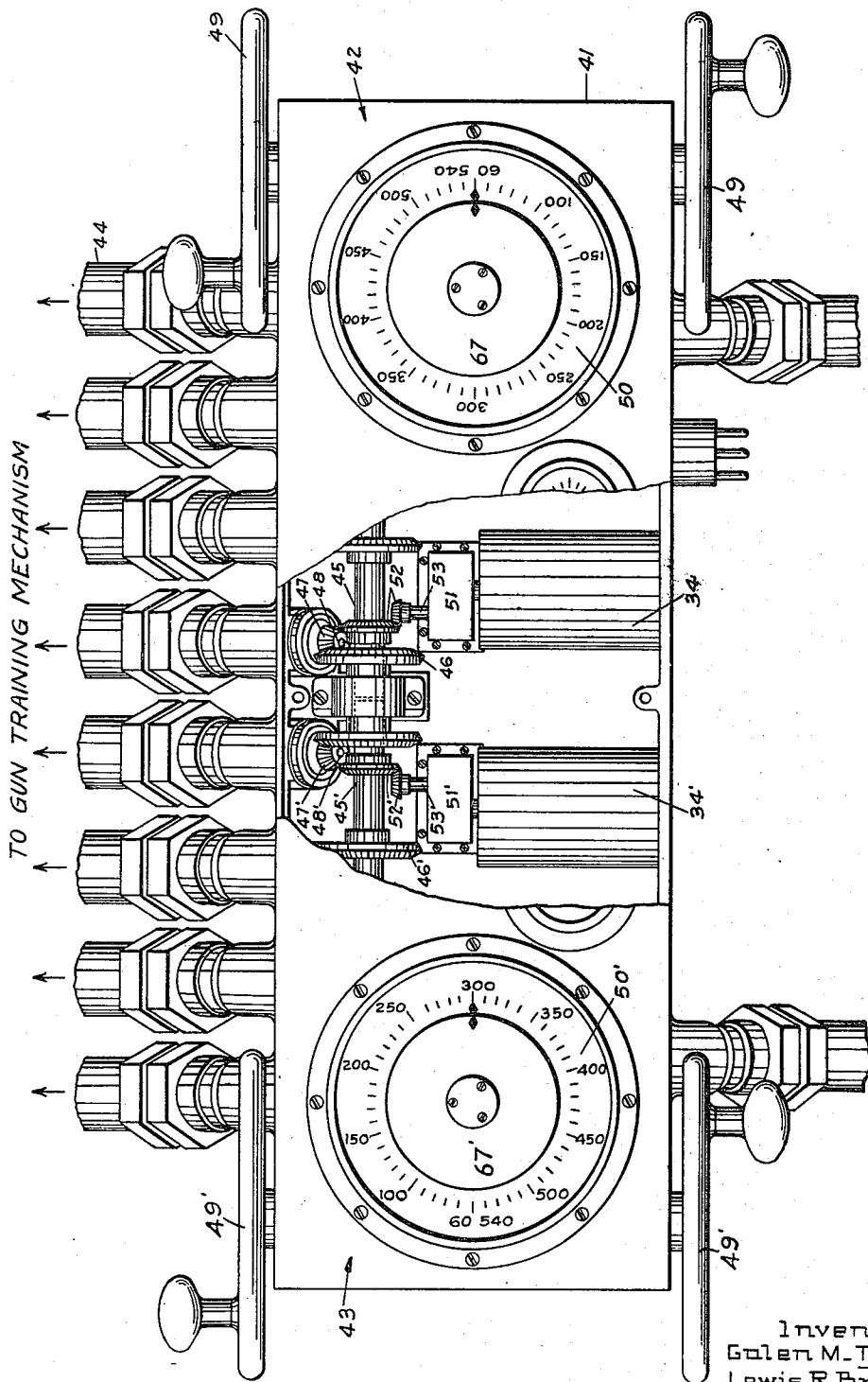
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UNITED STATES PATENT OFFICE

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FIRE CONTROL SYSTEM

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4 Claims. (Cl. 89—41)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to a fire control system to be employed in directing gun fire on fast moving aerial or similar targets and is intended for operation in accordance with the system of observation as disclosed in U. S. Patent No. 2,186,007 issued to Frederick R. Chamberlain, Jr., on January 9, 1940.

It is an object of the present invention to provide an electrical data transmission system adapted for use with the control box disclosed in our U. S. application No. 312,380 filed on even date herewith.

It is a further object of the invention to provide a simple relative inexpensive electrical data transmission system that is capable of permitting the use of transmission lines of relative short or long lengths as desired, without necessitating the use of complex or expensive means for compensating for the variable resistances introduced in the system by the use of such lines.

A further object of the invention is to provide an electrical data transmission system having a small power requirement.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

Fig. 1 is a diagrammatic view of a fire control system in accordance with the present invention;

Fig. 2 is a schematic view of the circuit comprised in the electrical data transmission portion of the fire control system shown in Fig. 1;

Fig. 3 is an enlarged plan view of the control box used in the fire control system of Fig. 1 partially broken away to more clearly show certain elements of the electrical data transmission system.

Referring now to the drawings by characters of reference and more particularly to Fig. 2, an electrical data transmission circuit comprising a Wheatstone bridge generally indicated at 10 for transmitting horizontal deflections and another Wheatstone bridge generally indicated at 11 for transmitting vertical deflections is shown. The bridges 10 and 11 are connected in parallel with a common power supply 12 through the two pole single throw switch 13, and conductors 14, 15, 16 and 17. For a purpose subsequently herein made clear the conductor 16 has a variable resistance

18 in its horizontal deflection bridge branch and a fixed resistor 19 in its vertical deflection bridge branch. In order to test the condition of the battery or other source of power 12, and bridge circuits when energized, a single milliammeter 20 and circuit 21 therefor are arranged to be thrown in series or parallel with the source of power 12 by means of the series-parallel switch 22. A multiplying resistor 23 is inserted in the circuit of source of supply 12 to render it possible to use meter 20 as a voltmeter in testing the condition of the battery or other source of supply 12.

The horizontal deflection bridge 10 is provided in each of its arms 24 and 25 with a principal horizontal deflection potentiometer transmitter 26 arranged with the sliding contacts 27 thereof on a common shaft 28 in such manner that the resistance or potential fall across one of the potentiometers will increase while the resistance or potential fall across the other potentiometer will correspondingly decrease upon rotation of the shaft 28 about its axis in either clockwise or counterclockwise direction. An additional potentiometer transmitter indicated at 29 for transmitting horizontal spot corrections and having a sliding contact 30 is adapted to be inserted in the circuit of bridge 10 with its resistor unit in series with the arms 24, 25 of the bridge and its sliding contact 30 conductively connected with the milliammeter 31. The arms 32, 33 of the bridge have resistances therein of proper ratio with respect to the resistances of the potentiometer transmitters in the arms 24, 25 and are also connected in series with the resistor unit of a potentiometer receiver 34 having a sliding contact 35 connected with the milliammeter 31.

The vertical deflection bridge 11 is similar to the horizontal deflection bridge 10, such changes as are necessary in the value of the resistances to properly transmit the principal vertical and vertical spot corrections will be made as is obvious to those skilled in the art. Elements in the bridge 11 corresponding to similar elements in the bridge 10 have been identified by the same character "primed" and therefore, the description of the elements of the horizontal deflection bridge 10 will suffice also as a description of the corresponding elements in vertical deflection bridge 11. In the case of the vertical deflection bridge 11, however, provision is made to alternatively throw either one of two vertical spot potentiometer transmitters 29' in series with the bridge arms 24', 25' by means of a three pole double throw selector switch 36.

For convenience in organization a junction box 37 (Fig. 1) serves to house a terminal block on which all electrical interconnections are made between the various potentiometer transmitters and potentiometer receivers as well as the milliammeters 31, 31' in accordance with Fig. 2. The junction box is formed to also function as a packing and transportation chest for the source of supply 12, potentiometer transmitters and milliammeters 31, 31' for which purpose it may be fabricated of any desirable configuration and material, but is preferably formed of steel to provide a chest of generally rectangular shape in cross section and having a storage compartment 40 suitably sub-divided to receive and house the potentiometers 26, 26', 29, 29' and meters 31, 31'. The milliammeter 20 and switches 13, 22 and 36 are carried by a removable switch panel normally positioned in the junction box above the battery or other source of supply 12.

In the fire control system shown in Fig. 1 a control box 41 housing a horizontal deflection transmitter 42 and vertical deflection transmitter 43 for manually transmitting these deflections to the lateral and vertical elements of the training mechanism of one or more guns G (only one gun being shown) through flexible cable assemblies 44 is provided. The control box also houses the potentiometer receivers 34, 34' and is formed to detachably mount the milliammeters 31, 31' in any desirable or conventional manner.

As more particularly shown in Fig. 3 the control box 41 is of the same general construction as the control box of our co-pending application No. 312,380 filed on even date herewith in so far as the mechanism for transmitting the deflections manually is concerned. In the instant case, however, the mechanical means for combining the spotting corrections with the principal deflections have been omitted as the latter functions are accomplished electrically by the system of this invention.

The horizontal deflection transmitter 42 comprises a horizontally disposed rotatable shaft 45 having one or more gears 46 fixed thereon and meshing respectively with corresponding gears 47 of predetermined ratio therewith fixed to output shafts 48 for driving the rotatable shafts in the flexible cable assemblies 44 attached to the horizontal deflection elements of the training mechanisms of the guns for displacing the same in accordance with the horizontal or lateral deflections transmitted. Shaft 45 is rotatable by means of the dual handwheels 49, 49' which are operatively connected in any suitable manner, as by the means shown in our co-pending application above referred, to the shaft 45. To apprise an operator of the magnitude of the horizontal deflection transmitted by the shaft 45 an indicator having a movable index bearing member 67 connected by a suitable gear train to shaft 45 and movable with respect to a stationary scale bearing member 50 formed with an appropriate scale thereon is provided. Potentiometer receiver 34 is housed in a housing of insulating material, such as "Bakelite" and has its sliding contact 35 connected to a gear train housed in the gear housing 51 and driven by the gearing 52 and shaft 53 through shaft 45.

The vertical deflection transmitter 43 is substantially identical with the horizontal deflection transmitter 42, corresponding elements being identified by corresponding reference characters "primed."

Meters 31, 31' are supported detachably 75

through detachable electric connectors adapted to be connected with corresponding connectors carried by meter blocks supported in insulated relation on the top wall of the control box.

All potentiometer transmitters are housed in insulated casings and are adapted to be plugged into receptacles located in the junction box 37 through adapters carried by cables of the proper number of conductors and any desirable length. In the case of the principal lateral and vertical deflection potentiometer transmitters 26—26 and 26'—26' respectively four conductor cables 54 are used to connect the transmitters to the junction box receptacles, while in the case of the lateral and vertical spot potentiometer transmitters 29 and 29' three conductor cables 55 are used to connect the transmitters to the junction box receptacles. A six conductor cable 56 connects the meters 31, 31' and potentiometer receivers 34, 34' in the control box to the junction box receptacle which in turn connects these elements into the bridge circuits shown in Fig. 2.

All potentiometers may have dials attached to the shaft carrying the sliding contact thereof graduated in proper units for the purpose of apprising the operator of the magnitude of any deflections transmitted and such dial may be slipped with respect to the shaft for the purpose of zeroizing the potentiometer.

In operation the milliammeters 31, 31' having been zeroized are inserted in the meter blocks on the control box 41 and all potentiometer transmitters are zeroized and arranged with their dials set at zero deflection. Likewise the handwheels 49, 49' are rotated until the indices on members 67, 67' indicate zero deflection on the scales of members 50, 50' which in the illustration made in Fig. 3 is "300" on scale 50'. The potentiometer transmitters 26—26, 26'—26', 29, 29' and their cables of any required length are next plugged into the proper receptacles of the junction box 37. The device is now ready for testing and is connected to constitute the circuits shown in Fig. 2. Main switch 13 is closed energizing the bridge circuits 10 and 11 and the series parallel switch 22 is arranged to put the meter 20 in parallel with the source of supply 12 to test the battery or other source of supply. If the source of supply 12 is found to be in condition the series-parallel switch 22 is next arranged in series with the source of supply to determine the condition of the bridge circuits. If it is found that the circuits have current flowing therein it is evident that the bridges are unbalanced, perhaps due to the particular length of cables being used in the particular setup. The bridges 10 and 11 are balanced out by the variable resistance 18 if necessary. The data transmission system is now ready for the transmission of data. The operator of the principal horizontal or lateral deflection potentiometers 26—26 will turn the common shaft 28 by means of knob 68 so that the indicating dial thereon will indicate the principal lateral deflection which comes from any appropriate source, such as a lead computer. Turning the shaft 28 clockwise or counterclockwise will move the sliding contacts 27 in the same direction, the resistances being so arranged that when one is increased in magnitude the other is decreased, and vice versa and disturb the balance of the bridge 10. When the balance of bridge 10 is upset current will flow between the branches of the bridge through milliammeter 31 deflecting the needle thereof. The horizontal or lateral deflection operator on con-

trol box 41 will note the deflection of the needle of meter 31 and restore the same to zero by rotating the handwheel 49, shaft 45, gearing 52, shaft 53, and the sliding contact 35 of horizontal or lateral potentiometer receiver 34 until the balance of the bridge 10 is restored as indicated by the meter 31. Rotation of shaft 45 in main-
 5 taining the needle of meter 31 at zero will rotate the gears 46, 47 and shaft 48 to in turn rotate the cable in the one or more horizontal or lateral
 10 deflection cables 44 which will correspondingly displace the training mechanism of the gun or guns in horizontal or lateral deflection.

The same mode of operation appertains to operation of the vertical deflection mechanism 43
 15 as outlined above in regard to the horizontal deflection mechanism 42. As it is found advantageous to have two flank observers for observing vertical deviations two vertical spotting potentiometer transmitters 29' are provided and either
 20 may be put into the circuit of bridge 11 by the selector switch 36 at the will of the operator at the junction box 37.

If desired the bridges may be employed with the principal deflection transmitters 26—26
 25 26'—26' alone omitting the spotting transmitters from the bridge circuits by simply removing the adapters on cables 55 from their receptacles in junction box 37.

Having now described what we at present regard a preferred embodiment of the present invention we claim and desire to secure by U. S.
 30 Letters Patent:

1. A fire control system comprising in combination, a control box, a gear train mounted in the control box movable proportionally to data to be set upon the training mechanism of a gun, a flexible transmission cable assembly connected with said gear train adapted to transmit motion from the latter to said training mechanism, a
 35 data transmitter comprising a variable resistance, a receiver comprising a variable resistance mounted in the control box, means connecting the variable element of the resistance of said receiver to the gear train for movement thereby, means
 40 interconnecting the transmitter and receiver into a Wheatstone bridge circuit, and a milliammeter

connected across the arms of the bridge and detachably mounted on the control box; whereby data may be transmitted electrically from a station remote from the control box thereto by unbalancing the bridge and mechanically from the control box to the training mechanism by balancing the bridge.

2. A fire control system comprising in combination, a control box, a gear train mounted in the control box movable proportionally to data to be set upon the training mechanism of a gun, a flexible transmission cable assembly connected with said gear train adapted to transmit motion from the latter to said training mechanism, a data transmitter comprising a pair of variable resistances synchronously variable to increase the resistance of one and decrease the resistance of the other or vice versa, a receiver comprising a variable resistance mounted in the control box, means connecting the variable element of the resistance of said receiver to the gear train for movement thereby, a junction box, conductors detachably interconnecting said transmitter and receiver through the junction box into a Wheatstone bridge circuit with a variable resistance of the transmitter in each arm thereof and a milliammeter connected across the arms of the bridge detachably mounted on the control box; whereby data may be transmitted electrically from a station remote from the control box thereto by unbalancing the bridge, and mechanically from the control box to the training mechanism by balancing the bridge.

3. The structure of claim 2 wherein a second transmitter is detachably connected in said bridge circuit through the junction box adapted to transmit spotting corrections.

4. The structure of claim 2 wherein two additional transmitters are detachably interconnected with the junction box and means are provided for selectively interconnecting either one of said additional transmitters in the bridge circuit for transmitting spotting corrections.

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