Nov. 9, 1948. C. H. WRIGHT ET AL 2,453,173

REMOTE CONTROL SYSTEM

Filed Aug. 25, 1937 2 Sheets-Sheet 1

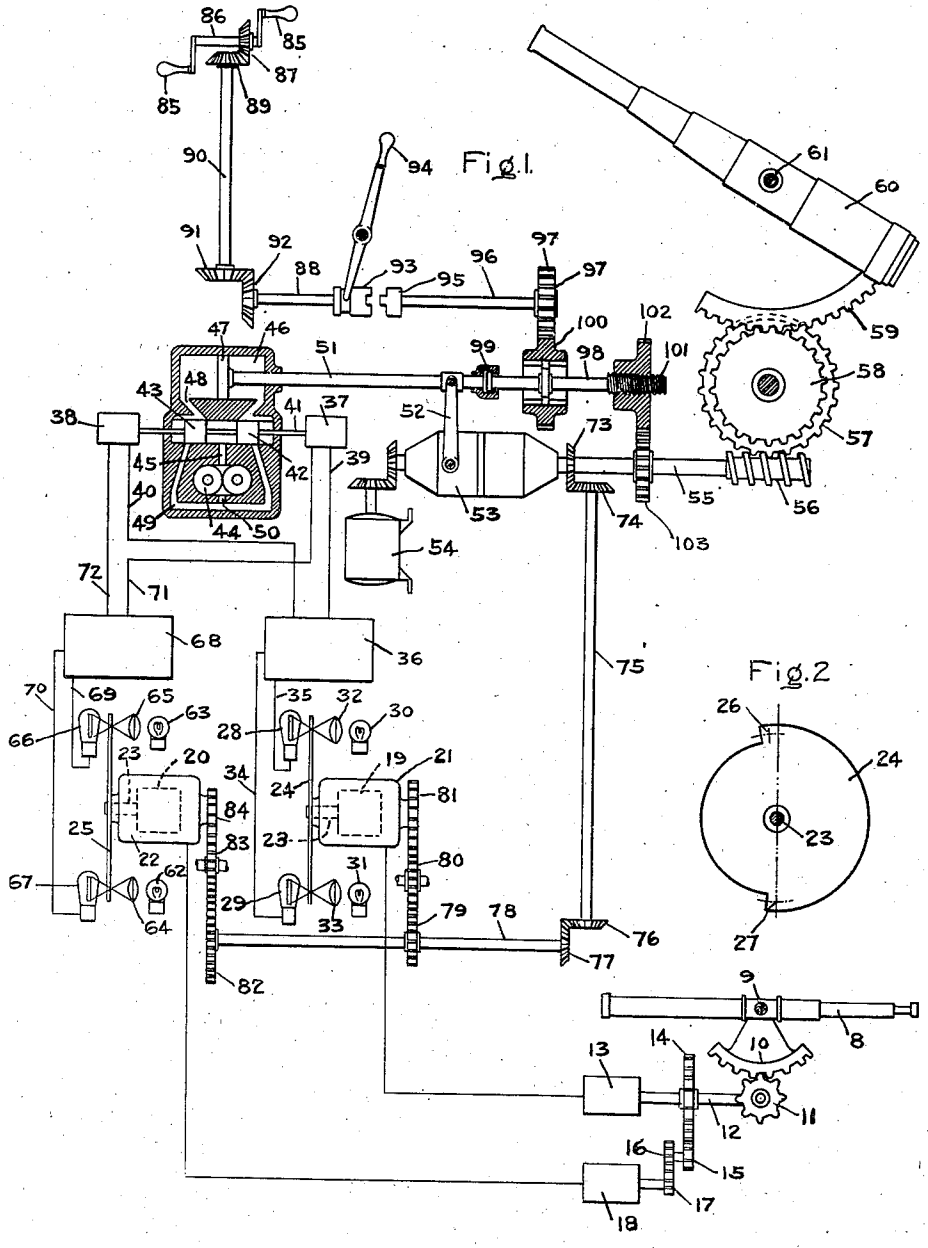


Fig. 1.

Fig. 2.

INVENTORS
C.H.WRIGHT
GEO.A.CHADWICK
PAUL W.BURK
BY Robert A. Saunders
ATTORNEY

Nov. 9, 1948. C. H. WRIGHT ET AL 2,453,173

REMOTE CONTROL SYSTEM

Filed Aug. 25, 1937 2 Sheets-Sheet 2

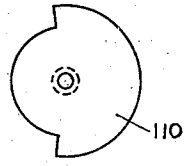


Fig. 7

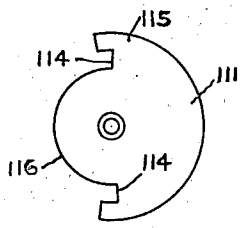


Fig. 6

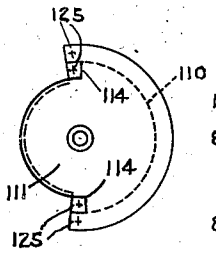
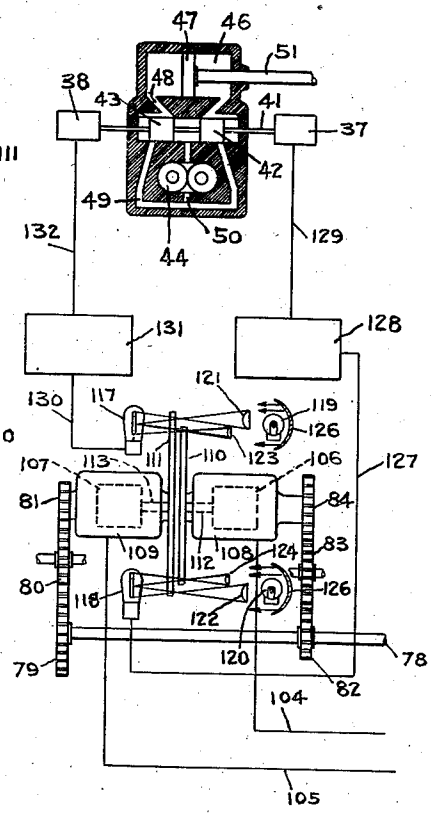


Fig. 4.

Fig. 3.



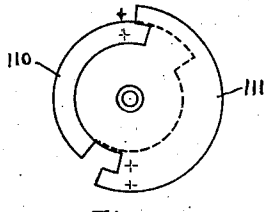


Fig. 5

INVENTORS
C.H.WRIGHT
GEO.A.CHADWICK
PAUL W.BURK
BY Robert A Lavender
ATTORNEY

Patented Nov. 9, 1948

2,453,173

UNITED STATES PATENT OFFICE

2,453,173

REMOTE CONTROL SYSTEM

Carleton H. Wright, United States Navy, and George A. Chadwick and Paul W. Burk, Washington, D. C.

Application August 25, 1937, Serial No. 160,936

2 Claims. (Cl. 250—41.5)

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

1

This invention relates to means for controlling a member that is to be mechanically moved at a distance from the controllnig member, and has, among its several objects, that of providing a simpler system than those heretofore used for the laying of guns at a distance from the director and for the remote control of like mechanisms in general.

In the drawings:

Fig. 1 is a diagrammatic showing of one system embodying our invention;

Fig. 2 is a face view of one of the shutters or light control discs;

Fig. 3 is a schematic showing of a modified form of our invention;

Figs. 4 and 5 are face views of the two shutter discs of Fig. 3 in different relative positions; and

Figs. 6 and 7 are separate face views of the two shutter discs of Fig. 3.

The mechanism shown in Fig. 1 is for elevating and depressing the gun and is controlled by the pointer's telescope 8 that is rotatable about a horizontal axis 9 and is fixed to a gear quadrant 10 meshed with a pinion 11 on the shaft 12 of the rotor of the low speed transmitter 13 of the Selsyn type. Fixed on shaft 12 is a gear 14 which, through the gears 15, 16 and 17, drives the rotor of the high speed transmitter 18, also of the Selsyn type. The construction and operation of the Selsyn transmitters and receivers are so well known that no detailed description thereof will be given herein. The transmitters 13 and 18 are operatively connected to the rotors 19 and 20 of the Selsyn receivers 21 and 22, the said connection being represented by a single line in each case for purpose of simplifying the drawing.

Upon the shafts 23 and 23' of the rotors 19 and 20, respectively, are mounted the shutters or light control discs 24 and 25. These shutters are identical in construction but for purpose of convenience in description and discussion they are given different reference characters. As is shown in Fig. 2, the disc 24 consists of two parts having different radii, the portion of greater radius being somewhat more than a semi-circle in angular extent. The crosses 26 and 27 in Fig. 2 indicate the positions on the shutter of the beams of light controlled by the shutter when the shutter is in its neutral position. The photoelectric cells 28 and 29 are mounted adjacent the disc 24 on one side thereof, the light sources 30 and 31 are mounted on the opposite side of the disc, and the converging lenses 32 and 33 are positioned between the light sources 30 and 31 and the photoelectric cells 28 and 29, respectively, so that the focus of the

2

lens lies in the plane of the disc. Thus, the cross section of the beam in the plane of the disc is small and a quick cut-off is attained, the said focus striking the disc at the point 26 or 27, Fig. 2, as the case may be. It is to be understood that, instead of focusing the beams of light, the cross sectional area thereof may be limited by a mask adjacent the disc, provided with a slot or small aperture for the passage of light.

The photocells 28 and 29 are connected, as indicated at 34 and 35, to two amplifiers in the box 36 and these amplifiers are respectively connected to solenoids 37 and 38 as indicated at 39 and 40, respectively. It is apparent that clockwise rotation of disc 24 in Fig. 2 will permit the light from source 30 to pass to the photocell 28 and the output of the cell will be amplified to energize the solenoid 37 which will draw toward the solenoid the pilot valve stem 41 and move the valve pistons 42 and 43 to permit a flow of liquid under pressure from the gear pump 44 through passage 45 into servomotor cylinder 46 to move the piston 47 toward the left, the return of fluid from the left-hand side of piston 47 taking place through passages 48, 49 and 50.

The connecting rod 51 is connected to piston 47 and also to the control lever 52 that actuates the tilting box of a reversible hydraulic gear 53 of the Waterbury type or the like. The gear 53 is driven by a motor 54 and the output of the gear is transmitted by shaft 55 to a worm 56 meshed with gear 57 to which is connected a gear 58 meshed with a gear sector 59 to tilt the gun 60 about its trunnion 61. In like manner, the photocell 29 will be exposed to light when the disc 24 rotates in the counter-clockwise direction and the output thereof is amplified and transmitted to the solenoid 38 to move the piston valves 42 and 43 to the left, thus permitting a flow of liquid under pressure from pump 44 into the left-hand end of cylinder 46 which moves connecting rod 51 to the left and changes the setting of the tilting box of gear 53 to move gun 60 in the opposite angular sense about its trunnions. The hydraulic mechanism for operating the tilting box may be omitted and suitable solenoids be directly connected to the tilting box control lever 52, if desired.

The gears 15, 16 and 17 multiply the rotation of shaft 12 and, consequently, turn the rotor of transmitter 18 faster than the rotor of transmitter 13 is driven by shaft 12. The light from sources 62 and 63 is focused by the lenses 64 and 65 and is intercepted by the disc 25 when in its neutral position or light from one of the other of the sources 62 and 63 is permitted to reach the

photocell 66 or photocell 67, depending upon the direction of rotation of the disc 25 in the same manner as has been heretofore described in connection with disc 24. The box 68 contains two amplifiers respectively connected to the photocells 66 and 67 by wires 69 and 70 and the amplified output currents are transmitted to the solenoids 37 and 38 by conductors 71 and 72 to control the output of the hydraulic gear 53 as above described. The output of the amplifiers in 36 is greater than that from the amplifiers in 68 so that the former will always take charge when both are in operation, which provides a fine control from amplifier 66 after the amplifier 36 is deenergized by shutting off the light to cells 28 and 29.

As is well known in this art, the movement of disc 24 is, for a given movement of the telescope 8, relatively samll and gives a coarse or high speed control while the rotation of disc 25 is several times as great for each movement of the telescope 8 and gives a fine or low speed control. For example, a rotation of the telescope through one degree may be inadequate to move the disc 24 sufficiently to permit one of the photocells 28 or 29 to be energized whereas that same small movement may cause the disc 25 to be rotated through several degrees and, hence, will cause a small movement to be imparted to the gun. It is obvious both the high speed and the low speed mechanism energize the same solenoid at any given time, except when the coarse control disc is in position to cut off the light while the fine control disc is still displaced from the light-intercepting position.

Miter gear 73 on shaft 55 is connected through gear 74, shaft 75, and gears 76 and 77 to shaft 78 which in turn is connected through the train of gears 79, 80 and 81 to the stator of receiver 21 and through the train of gears 82, 83 and 84 to the stator of receiver 22. These stators are rotatably mounted and the system of gears and shafts just mentioned constitutes a follow-up system by which the rotation of shaft 55 causes the movement of discs 24 and 25 back to their neutral positions so that light is cut off from all the photocells when the gun has moved through the angular distance corresponding to any given movement of telescope 8, it being understood that the rotation of the stator of receiver 21 is in the same proportion to the rotation of the stator of receiver 22 as is the angular movement of the rotor of transmitter 13 to the angular movement of the rotor of transmitter 18.

It may happen that a casualty will render the remote control system above described inoperative and we have, therefore, made provision for manual control of the hydraulic gear 53. Cranks 85 are connected to shaft 86 upon which is fixed a bevel gear 87 which drives shaft 88 through gear 89, shaft 90, and gears 91 and 92. A clutch member 93 is feathered on shaft 88 to be slidable therealong by means of lever 94 whereby the clutch member 93 may be engaged with or disengaged from the clutch member 95 or shaft 96 upon which is fixed the gear 97. A shaft 98 is connected to shaft 51 by a collar 99 so that longitudinal movement of shaft 98 will be transmitted to lever 52 but the shaft 98 is free to rotate independently of the connecting rod 51. A gear 100 is meshed with gear 97 and has a splined connection to shaft 98 so that rotation of the gear 100 will be imparted to the shaft 98 but the shaft may move longitudinally with respect to the gear. The free end of shaft 98 is provided with threads 101 of high pitch which engages threads in a gear 102 that is meshed with gear 103 on shaft 55. The gear 102 is mounted to be held against movement parallel to shaft 98 and, therefore, when the clutch members 93 and 95 are engaged and the handles 85 are turned, the rotation of shaft 98 through the gears and shafts connecting the handles 85 to shaft 98 will cause the shaft 98 to move longitudinally due to the engagement of threads 101 with the threads in gear 102 and so will move lever 52 to change the position of the tilting box of hydraulic gear 53 and change the elevation of gun 60. It is apparent that the rotation of shaft 55 will be imparted to gear 102 through gear 103 and, therefore, a follow-up action is secured that will move the control lever 52 to its neutral position when the gun has executed an angular movement about its trunnions 61 proportionate to the rotation of cranks 85. The thread 101 is made with high pitch so that longitudinal movement of rod 51 by piston 47 will push the shaft 98 through the gear 102 in spite of the threaded connection. This will result in rotation of shaft 98 but the only effect thereof will be to cause gears 100 and 97 to turn idly.

In Fig. 3 there is shown a form of our invention that requires but two photoelectric cells. The conductors 104 and 105 connect the rotors 106 and 107 of receivers 108 and 109 to the high speed transmitter 18 and the low speed transmitter 13, respectively. As in the form of invention above described, the rotors of the receivers 108 and 109 are rotatable and the shutter discs 110 and 111 are respectively mounted on the shafts 112 and 113 of rotors 106 and 107. The shutter disc 110 is shown in face view in Fig. 7 wherein it is seen that it is similar to discs 24 and 25. However, the shutter disc 111 has notches 114 cut back into it from the radial face between the portion 115 of greater radius and the portion 116 of less radius, the radially outermost face of each of the notches 114 being of the substantially same radius as the portion of greater radius in the disc 110. The discs 110 and 111 are mounted close together and in their neutral positions they are as shown in Fig. 4 wherein the notches 114 are blanked off by the portion of greater radius of disc 110. Photocells 117 and 118 are mounted on the opposite sides of the discs from light sources 119 and 120 and are so disposed that the light from the said sources focused by the lenses 121, 122, 123 and 124 is cut off from the photocells by the discs when in their neutral position, the points on the discs corresponding to the said foci being indicated by the crosses 125 in Fig. 4. Reflectors 126 are provided to concentrate the light from the sources upon the several lenses.

The output from cell 118 passes through conductor 127 to an amplifier 128 and the amplified current is transmitted over conductor 129 to solenoid 37. Likewise, photo cell 117 is connected to solenoid 38 through conductor 130, amplifier 131, and conductor 132.

As may be seen by an inspection of Fig. 4, a small rotation of shutter disc 110 will permit the passage of light through a notch 114 to energize one of the photoelectric cells and so move the piston valves 42 and 43 as to cause a small change in the elevation of the gun controlled thereby. If a considerable rotation is given to the telescope 8, the disc 111 will be moved in the same direction as is 110 and since, as in the other modification of our invention, the low speed or coarse control is designed to take charge when both the coarse and the fine controls are actu-

ated simultaneously, it is immaterial what position is thereafter assumed by the disc 110. Since the disc 110 moves through several times the angle that is passed through by the disc 111, due to its greater rotation for a given movement of the telescope 8, the disc 110 may assume a position with respect to disc 111 as shown in Fig. 5.

Return of the discs 110 and 111 to their neutral positions is accomplished by the follow-up system including shaft 28, gears 82, 83 and 84 for the fine control and shaft 78, gears 79, 80 and 81 for the coarse control.

According to the provisions of the patent statutes we have set forth the principle and mode of operation of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we 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.

The invention herein described and claimed may be used and/or manufactured by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

We claim:

1. A remote control system for mechanism, comprising a movable control object, a high speed and a low speed transmitter operated thereby, a high speed receiver and a low speed receiver each having a rotor respectively operatively connected to be operated by said transmitters, the shafts of said rotors being aligned with their ends juxtaposed, a disc on the high speed rotor shaft having a portion of less radius than the remainder of said disc and of slightly less than a semicircle in angular extent, a disc on said low speed rotor shaft having a portion of the same radius and angular extent as the said portion of less radius on the high speed disc while the remainder of the low speed disc is of substantially greater radius than is the portion of greater radius on the high speed disc, said low speed disc having notches concentric with the disc cut back from each end face of the portion of greater radius, the radius of the inner side of said notch being the same as that of said portion of less radius while the radius of the outer side of said notch is slightly less than the radius of said part of greater radius on the high speed disc whereby said notches are covered by the high speed disc when the discs are in their neutral positions but one or the other

of said notches will be uncovered upon small rotation of the high speed disc, a light source disposed adjacent each of said notches, a photoelectric cell so disposed opposite each of said sources that a portion of a photoelectric cell is excited when a notch is uncovered and a different portion of a cell will be excited when said low speed disc is rotated from said initial position but a cell will not be excited while said discs remain in the initial position, and power means controlled as to direction and magnitude of movement by the output of said cells.

2. A remote control system, comprising two discs mounted to rotate about a common axial line, the periphery of each of said discs being cut away over an angular extent somewhat less than a semicircle, the radii of said cut away portions being equal, the remaining portion of the periphery of one disc being of greater radius than the remaining portion of the periphery of the other disc and having a notch cut in the radial face at each end thereof, the discs being so disposed in their neutral positions that said other disc covers said notches, a source of light disposed adjacent the neutral position of each notch, a respective photoelectric cell disposed adjacent each source but on the opposite side of said discs from the source, rotation of said one disc in either direction exposing a said cell to light from the source adjacent thereto over the periphery of the other disc, and rotation of said other disc in either direction from the neutral position exposing a photoelectric cell to light from the source cooperating therewith through a said notch, and means controlled for operation in opposite directions by the currents from said photoelectric cells.

CARLETON H. WRIGHT.
GEORGE A. CHADWICK.
PAUL W. BURK.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,122,942	Kaminski	Dec. 29, 1914
1,472,885	Perham	Nov. 6, 1923
1,585,210	Roux	May 18, 1926

FOREIGN PATENTS

Number	Country	Date
381,202	Great Britain	Sept. 26, 1932