340-870.15 SR SEARCH ROOM
XR 1,077,706
X7034T
SUBSTITUTE FOR MISSING XR

J. L. HALL.
RANGE TRANSMITTER.
APPLICATION FILED JUNE 27, 1910.

1,077,706.

Patented Nov. 4, 1913.

2 SHEETS—SHEET 1.

Fig. 1.

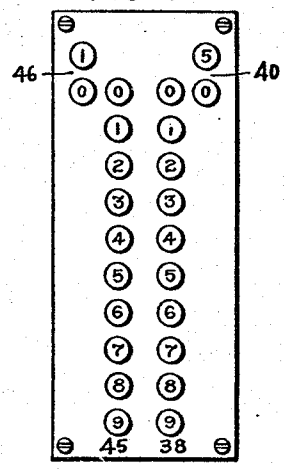


Fig. 2.

Witnesses:
Irving E. Steers.
J. Ellis Glen.

Inventor
John L. Hall,
by Albert G. Davis
His Attorney.

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OR I: 340/318

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2 SHEETS—SHEET 2.

Fig. 3.

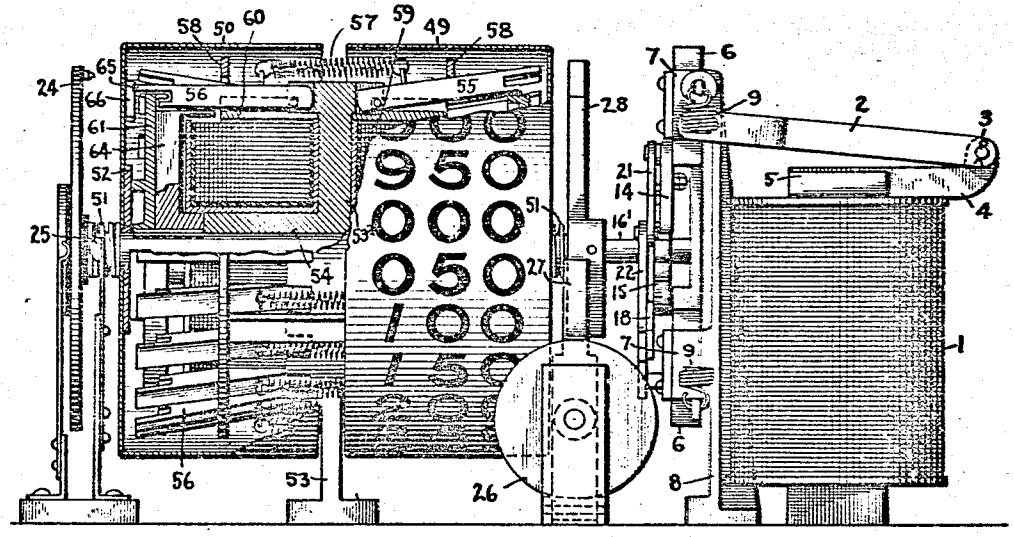


Fig. 4.

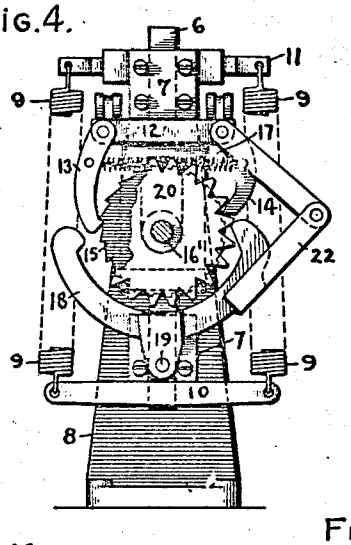


Fig. 5.

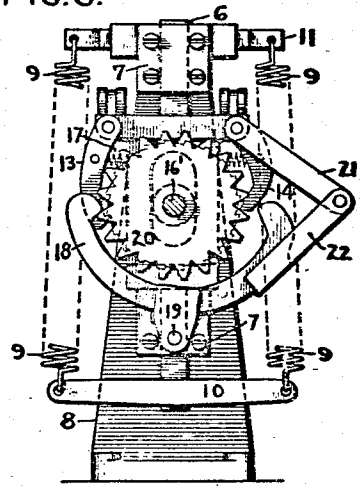


Fig. 7.

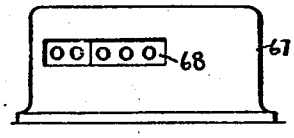
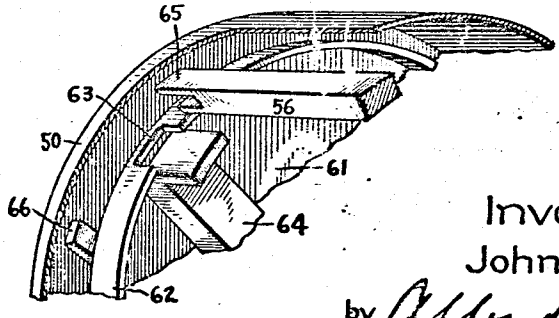


Fig. 6.



Witnesses:

Irving E. Steers.

J. Ellis Glen

Inventor

John L. Hall,

by Albert G. Davis

His Attorney.

UNITED STATES PATENT OFFICE.

JOHN L. HALL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

RANGE-TRANSMITTER.

1,077,706. Specification of Letters Patent. Patented Nov. 4, 1913.

Application filed June 27, 1910. Serial No. 569,009.

To all whom it may concern:

Be it known that I, JOHN L. HALL, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Range-Transmitters, of which the following is a specification.

This invention relates to electric signaling, and its object is to enable the range of a distant object to be communicated from the range finder station to a distant point, as, for instance, to the men serving a battery.

Ranges are usually calculated in yards, and by increments of fifty yards, so that a comparatively compact instrument will transmit ranges up to 19950 yards. It is very desirable to reduce the number of conductors between the range finder station and the battery to as small a number as possible, both on account of cost of installation and to simplify manipulation and repairs. In the present invention I use but four conductors; one for supplying power to the motors, one for synchronizing said motors, and one for each of the two electro-magnets in the indicating apparatus. Even if a return conductor is used the number is only five.

The invention comprises two constantly-operating electric motors, one at the sending station and the other at the receiving station; means for maintaining said motors in synchronism and in phase; a contact-arm driven by the motor at the sending station; a plurality of contact segments cooperating with said contact-arm; a plurality of manually-operated switches respectively in circuit with said contact segments, whereby any given segment can be energized at will by closing its switch; one or more rotating indicating dials or drums at the receiving station driven by the motor at said station by means of friction clutches so that they can be arrested without stopping the motor; a plurality of latches for arresting each of said drums, and a selector rotating in synchronism with the rotating contact arm at the sending station to determine which latch shall be permitted to operate when any given switch is closed. By using a dummy unit cipher and providing one drum with twenty numbers for tens and hundreds and the other drum with twenty numbers for thousands and tens of thousands, it is possible to give 400 indications varying by 50 from 0 up to 19950; using for this purpose twenty switches and two shifting levers.

The details of the invention will be better comprehended from the following extended description, taken in connection with the accompanying drawing, in which—

Figure 1 is an elevation of the manual switchboard panel; Fig. 2 is a diagram of the circuits, showing the mechanism in conventional simplicity; Fig. 3 is a side elevation, partly broken away and in section, of the indicating apparatus or receiver; Figs. 4 and 5 are front elevations of the ratchet-and-pawl driving mechanism of the same; Fig. 6 is a perspective view of a portion of the drum and the selector device; and Fig. 7 is an elevation of the casing for the receiver, on a smaller scale.

The motors which I prefer to use are powerful electro-magnets 1, 1′, each provided with an armature 2 pivoted at 3, preferably to a bracket 4 projecting from the core 5. The free end of the armature actuates driving pawls, preferably by engaging with a slide 6 movable vertically in bearings 7 on an upright standard 8. Springs 9, attached to a cross bar 10 on the slide and to arms 11 on the standard, serve to lift the slide and the armature when the electro-magnet is de-energized. The slide carries a cross-head 12 to which are pivoted two pawls 13, 14 engaging with a ratchet wheel 15 on a shaft 16, 16′. A spring 17 connecting said pawls keeps them in engagement with said wheel. The pawl 13 actuates the ratchet wheel when the slide moves upward, and the pawl 14 imparts a further actuation when the slide moves downward. A double-armed detent 18, like the anchor escapement of a clock, is pivoted at 19 to the standard 8 and cooperates with a star-wheel 20 on the shaft 16, 16′. This detent is positively actuated by a link 21 pivoted to a cross-head 12 and to an arm 22 on said detent. The action of the detent upon the star-wheel not only prevents any backlash or overrunning of the ratchet wheel by reason of the impulse imparted to it by the pawls, but it also insures a regular and uniform angular movement of the shaft at each actuation. The slide may be slotted, as shown, to enable the shaft to pass through it to a journal bearing in the standard. The two electromagnets are connected in series

by the conductors *a*, *b* across the mains A, B. A rotary circuit-breaker 23 is included in the same circuit and is driven by any suitable motor, such as an electric motor (not shown) supplied with current from the mains A, B. The effect of this circuit-breaker is to energize and deënergize the electromagnets at regular intervals, so that they constantly actuate their respective shafts.

In apparatus of this kind it is absolutely necessary that both shafts rotate not only in synchronism but also in phase, so to speak. By this I mean that if an arm is fixed on each shaft, then both arms must occupy identical positions in their respective circles of rotation at all times. In order to insure this and to restore this condition if they become accidentally displaced, I place on each shaft a circular closer 24 which at a [illegible] point in its revolution makes contact [illegible]ith a stationary contact 25. When the shafts are in phase, the circuit closers operate simultaneously and close the circuit *c* of an electro-magnet 26. The armature 27 of said electromagnet stands normally in the path of a stop 28 rotating with one of said shafts, preferably the shaft 16′. But when the electromagnet is energized it withdraws the armature and thus prevents it from engaging with the stop and thereby arresting the rotation of said shaft. The two circuit closers are so disposed on the shafts that when the latter are in phase the circuit of the electromagnet will be closed just before the stop strikes the armature, and as said armature is at that instant temporarily withdrawn the shaft 16′ continues to rotate uninterruptedly. But if the shafts are out of phase, the two circuits closers will not operate simultaneously, and the circuit of the electromagnet will be left open. The stop will strike the armature and the shaft 16′ will be arrested, with its circuit closer closed, in which position it will remain until the circuit closer of the shaft 16 closes, whereupon the electromagnet will release the stop and both shafts will resume their rotation in phase. This result will be effected within one revolution of the shaft 16. Having thus described the means for rotating the two shafts and for keeping them in phase, I will now take up the transmitting mechanism at the sending station.

A contact-arm 29 is mounted on the shaft 16 and sweeps over two circular concentric sets 30, 31 of contact segments and two concentric collector rings 32, 33. The arm carries four brushes coöperating respectively with these segments and rings; the brushes for the segments 30 and the ring 32 being electrically connected, as are also the brushes for the segments 31 and the ring 33. There are twenty segments in each set. Each segment in the set numbered 30 is connected by a conductor 34 to a contact finger 35 or 36; said fingers being arranged in pairs as shown, and each pair coöperating with a switch tongue 37. A push-button 38 connected to the supply main A enables the operator to send current through the switch tongue and thence to one or the other of the segments which it controls. Only a few of the switch tongues and push buttons are shown in Fig. 2, to avoid complexity in the drawing. The tongues are all thrown simultaneously by suitable mechanism, represented conventionally in Fig. 2, by a rod 39 and a two-armed lever 40 having a button at each end. As shown in Fig. 1, these buttons are marked "0" and "5" respectively, while the ten push-buttons 38 are numbered consecutively from "0" to "9". The segments 31 are similarly connected by conductors 41 with fingers 42 and 43 arranged in pairs, each pair controlled by a switch tongue 44 with which a push-button 45 coöperates. The switch tongues are all simultaneously thrown by a two-armed lever 46 carrying a button at each end, marked respectively "0" and "1". The ten push-buttons 45 are numbered consecutively from "0" to "9".

The push-buttons 38, 45 are arranged in two tiers on the switchboard shown in Fig. 1. The buttons on the lever 40 are located adjacent to the top of the tier 38, and those on the lever 46 are near the top of the tier 45. The push-buttons 38, 45 are similar to those disclosed in my patent No. 945,940, and need not be particularly described or illustrated here. Each button is self-locking, but the depression of any one of them releases the one previously depressed in that tier.

The two collector rings 32, 33 are connected by their respective conductors 47, 48 with the indicating apparatus at the distant receiving station. This apparatus is shown in detail in Figs. 3 and 6. For convenience in making the large number of combinations of numerals required in indicating ranges from 0 to 19950, I prefer to use two rotary indicators, such as the drums 49, 50 mounted side by side on the shaft 16′, and turning freely thereon. The drums are made of light rigid material, such as sheet metal, and have one end closed.

Springs 51, abutting at one end against collars on the shaft and at the other end against the closed ends of the drums, press said ends against friction disks 52 secured to the shaft, so that the drums will rotate with said shaft, but can be easily arrested and held stationary when necessary. The open ends of the drums face each other, with space enough between them for a standard 53 which carries a sleeve 54 through which the shaft 16′ passes. That part of the standard concentric with said

sleeve is a circular disk 53ª, to whose periphery is pivoted a number of latches 55, 56, the two sets of latches extending in opposite directions into the drums. The latches in one set are preferably in line with those in the other set, so that each pair can be connected by a spring 57 which tends to lift them against an encircling stop ring 58. Inside the latches and concentric with the sleeve 54 are coils 59, 60 of insulated wire, said coils being respectively connected with the conductors 47, 48 and also with the common return conductor *b*.

Keyed to the shaft adjacent to each friction disk 52 is a wheel 61 having a flange 62 underlying the free ends of the latches extending from that side of the disk standard 53ª. At one point in this flange is a notch 63 large enough to let a latch drop through it. The end of each latch is transversely grooved so that when said latch drops through the notch 63 it will be engaged and held down by the flange 62 during the remainder of one revolution of the wheel. Immediately below the notch 63 is a radial bar 64 secured to the shaft and serving as a revolving armature for the coil adjacent thereto. Whenever said coil is energized, the magnetic flux through said armature attracts whichever latch at that instant stands above it and pulls said latch down as shown at the left-hand end of Fig. 3. This brings a finger 65 on the end of the latch into the path of a lug 66 secured to the inside of the drum, so that said drum will be arrested by said finger when said lug is brought into contact therewith.

The outer surface of the drum 49 carries twenty numbers from "000" to "950", varying by 50. The drum 50 carries twenty numbers running consecutively from "00" to "19". By suitably combining these forty numbers any range from 0 to 19950 can be indicated, varying by increments of 50. The entire receiving mechanism shown in Fig. 3 is inclosed in a casing 67, shown on a small scale in Fig. 7. A window 68 in said casing reveals a single row of numbers across both drums, the numbers changing at each step-by-step movement of the drums.

The operation is as follows: The constantly rotating circuit breaker 23 keeps the two motors 1, 1′ constantly operating in unison, driving their respective shafts, 16, 16′ step-by-step—twenty steps making one revolution. At the dwell between the steps the brushes of the contact-arm 29 rest squarely on the segments of the contact rings 30, 31, and at the same instant the notches 63 in the wheels 61 stand underneath one of the latches 55, 56 in each set of twenty in the receiving mechanism. Now if the circuit of the coil 59 or 60 has been partly closed by pressing down a push-button 38 or 45 as the case may be, then the instant the contact-arm reaches the segment connected with said push-button the circuit will be completed and the coil will attract the latch which at that instant lies over the bar 64. At the next step in the rotation of the contact-arm and the drum, the circuit will be broken, but the latch cannot be lifted by its spring because the flange 62 has engaged the transverse groove in its end. The continued rotation of the drum presently brings the lug 66 against the finger 65 on the depressed latch, whereby said drum will be arrested and held stationary. The numbers on the drum are so arranged that when the drum is thus arrested the number visible through the window 68 corresponds with the push-button which has been depressed at the sending station; this result being due to the relative angular disposition of the contact segments, the latches, the rotating contact-arm 29 and radial armature 64 and the location in the drum of the lug 66. To get the better understanding of this result, let a specific example be taken. Suppose the range finder shows the enemy's vessel to be 10,250 yards distant. The officer at the sending station presses button "1" on lever 46; push-button "0" in the tier 45; push-button "2" in tier 38 and button "5" on lever 40. The final unit in the total number is always 0 and in practice this will not be inscribed on the drum 49, as shown in Fig. 3, but will be painted on the window 68. The depression of the buttons "1" and "5" on the levers 46 and 40 throws them down to the position shown in Fig. 2. The depression of the button "0" in tier 45 connects main A with the segment "10" in set 31, and the depression of button "2" in tier 38 connects said main with segment "25" in set 30. Within the next revolution of the contact-arm 29 it will close the circuit of coil 60 when the brush on the short end of said arm passes over the segment "10", and the brush on the long end of the arm will close the circuit of the coil 59 when it makes contact with segment "25". In both cases the proper latches will be drawn down to arrest the corresponding drums when the numbers "10" and "25" come into view through the window; their combination, together with the permanent final "0" making the number "10,250", which is the range observed. This number will remain in view until some change is desired, because the self-locking buttons keep the circuits closed at the switchboard and the re-current closing of the circuits by the contact-arm occurs at the instant the notches 63 and radial armature bars 64 are passing the latches which are holding the drums, so that said latches will not be released so long as the push-buttons remain depressed. It is of course understood that the frictional engagement of the drums with the disks 52 permits said drums to be held stationary al-

though the motors and shafts continue to operate steadily. If now the range changes, say to 9900 yards, the officer at the sending station pushes down the buttons "0" on the two levers 40 and 46, the button "9" in the tier 45 and the button "9" in the tier "38". The pushing of the first two buttons throws the switch tongue 37, 44 to the upper set of fingers 35, 42 and the depression of the other two buttons connects the main A with the segments "09" in set 31 and "90" in set 30. The depressing of these buttons automatically releases the buttons "0" in tier 45 and "25" in tier 38, so that the latches corresponding therewith will be free to rise when the notches 63 come in line with them. The drums will then instantly begin rotating with the shaft, but will be again arrested when their lugs 66 strike the newly depressed latches corresponding to the buttons "9" in both tiers; so that the number "09900" will now be visible and stationary behind the window 68.

In case the shaft 16' gets out of phase with the shaft 16, it is evident that the wrong latches will be pulled down when the buttons at the switchboard are depressed. But within a single revolution of the shaft 16 the other shaft will be brought into phase, as hereinbefore set forth; and when the proper phase relation is resumed, the wrong latches will be released and the right ones actuated, so that the erroneous reading will not persist for more than one revolution of either shaft, and in most cases will be corrected in less than one revolution. The speed of the shafts depends upon the speed of the circuit breaker 23, and this can be regulated by proper regulation of the motor which drives it. The shafts 16, 16' can be run very readily at a speed of four or five revolutions a minute, so that any error, due to non-synchronism, would be corrected in from 15 to 12 seconds.

My invention, therefore, provides a range transmitter which is durable and efficient, easily operated, and self-correcting; and while requiring but five conductors in the cable connecting the sending and receiving apparatus will nevertheless transmit 400 different ranges varying by 50 yards.

In accordance with the provisions of the patent statutes, I have described the principle of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is illustrative only and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A range transmitter comprising two shafts located respectively at the sending and receiving stations, synchronously operating motors for driving said shafts, an electrical phase correcting device for said shafts, circuit closers for said device operated by said shafts, one or more rotary indicators driven frictionally by the shaft at the receiving station, electromagnetic devices for arresting the rotation of said indicator or indicators, and selective devices for energizing said electromagnetic devices from the sending station.

2. A range transmitter comprising two shafts located respectively at the sending and receiving stations, synchronously operated motors for driving said shafts, a stop on one shaft, an electromagnet having an armature adapted to engage said stop, circuit closers controlling said electromagnet and adapted to be closed by said shafts at a given point in their revolution, one or more rotary indicators driven frictionally by the shaft at the receiving station, electromagnetic devices for arresting the rotation of said indicator or indicators, and selective devices for energizing said electromagnetic devices from the sending station.

3. A range transmitter comprising two shafts located respectively at the sending and receiving stations, synchronously operating motors for driving said shafts, a stop on one shaft, an electromagnet having an armature adapted to engage with said stop, a circuit closer operated by said shaft and in circuit with said electromagnet and arranged to be closed just before said stop is engaged by said armature, a second circuit closer in the same circuit but operated by the other shaft at the same angular point in its revolution as the other circuit closer, one or more rotary indicators driven frictionally by the shaft at the receiving station, electromagnetic devices for arresting the rotation of said indicator or indicators, and selective devices for energizing said electromagnetic devices from the sending station.

4. A range transmitter comprising two shafts located respectively at the sending and receiving stations, means for actuating said shafts synchronously, means for keeping them in phase, one or more rotary indicators driven frictionally by one shaft, a plurality of latches, an electromagnet for actuating any of said latches to arrest the rotation of each indicator, a contact arm driven by the other shaft and in circuit with the electromagnet actuating said latches, a plurality of contact segments cooperating with said arm, and means for energizing any given segment.

5. A range transmitter comprising two shafts located respectively at the sending and receiving stations, means for actuating said shafts synchronously and means for keeping them in phase, one or more rotary indicators driven frictionally by one shaft, a plurality of latches for arresting the movement of said indicator, an electromagnetic

selector having a bar rotating with the indicator, a contact arm driven by the other shaft, and in circuit with said selector, and means for energizing said contact-arm at any desired point in its revolution.

6. A range transmitter comprising two shafts located respectively at the sending and receiving stations, means for actuating said shafts synchronously and means for keeping them in phase, a rotary indicator driven frictionally by one shaft, a plurality of latches for arresting the movement of said indicator, a selector bar for said latches rotating with said shaft, a coil for magnetizing said bar, a contact-arm rotating with the other shaft and in circuit with said coil, a plurality of contact-segments over which said arm sweeps, and a plurality of manual switches each in circuit with its respective segment.

7. In a range transmitter, a receiver comprising a shaft, means for rotating it step by step, a numbered indicator driven frictionally by said shaft, a plurality of latches for arresting the movement of said indicator, means controlled at a distant station for momentarily actuating any desired latch into position to operate, and means for retaining it in operative position during the remainder of one revolution of the shaft.

In witness whereof, I have hereunto set my hand, this 24th day of June 1910.

JOHN L. HALL.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.