J. L. HALL.

SIGNALING SYSTEM.

APPLICATION FILED APR. 1, 1907.

946,431.

Patented Jan. 11, 1910.

3 SHEETS—SHEET 1.

Fig. 1

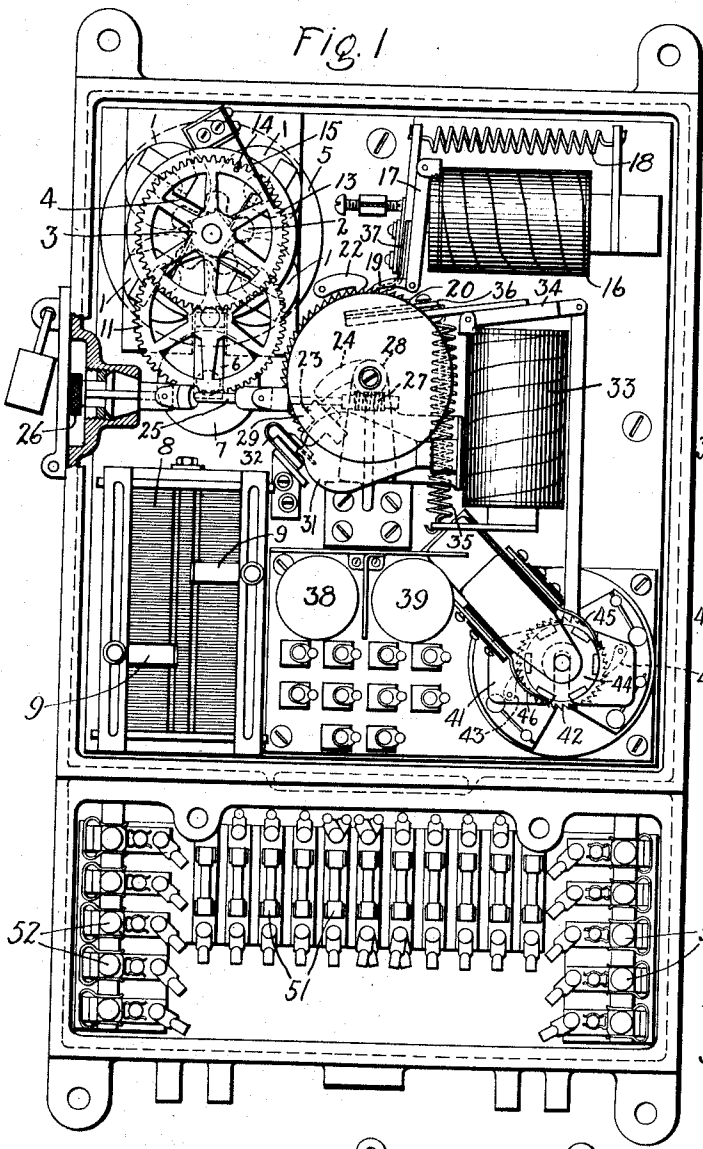


Fig. 2

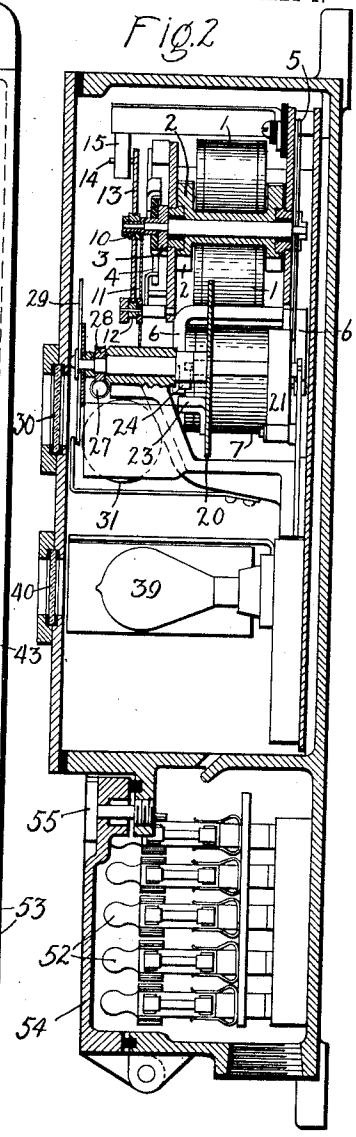


Fig. 3

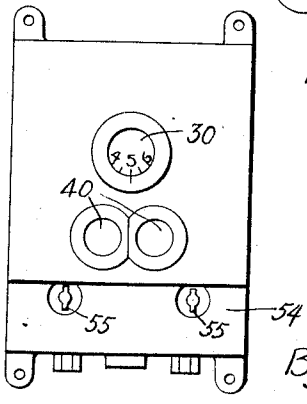
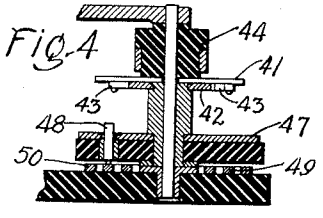


Fig. 4



Witnesses:

Lloyd C. Bush

J. Ellis Glen

Inventor:

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By Albert G. Davis

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3 SHEETS—SHEET 2.

Fig. 6

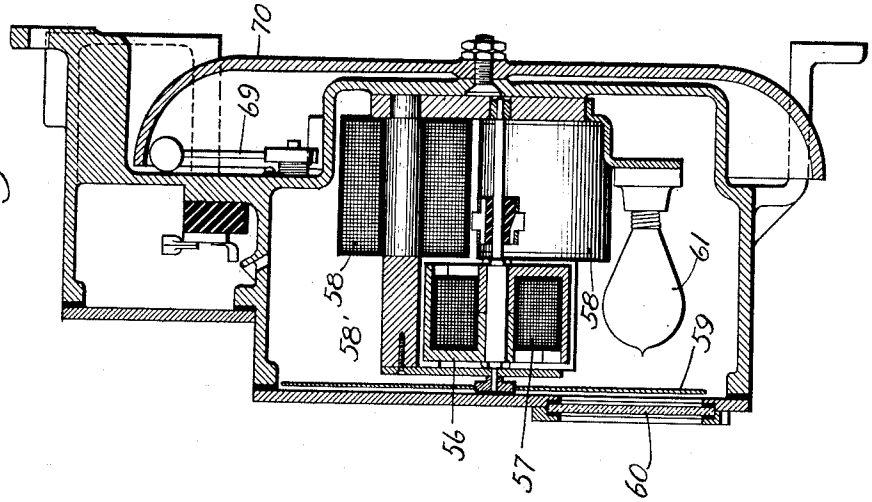


Fig. 5

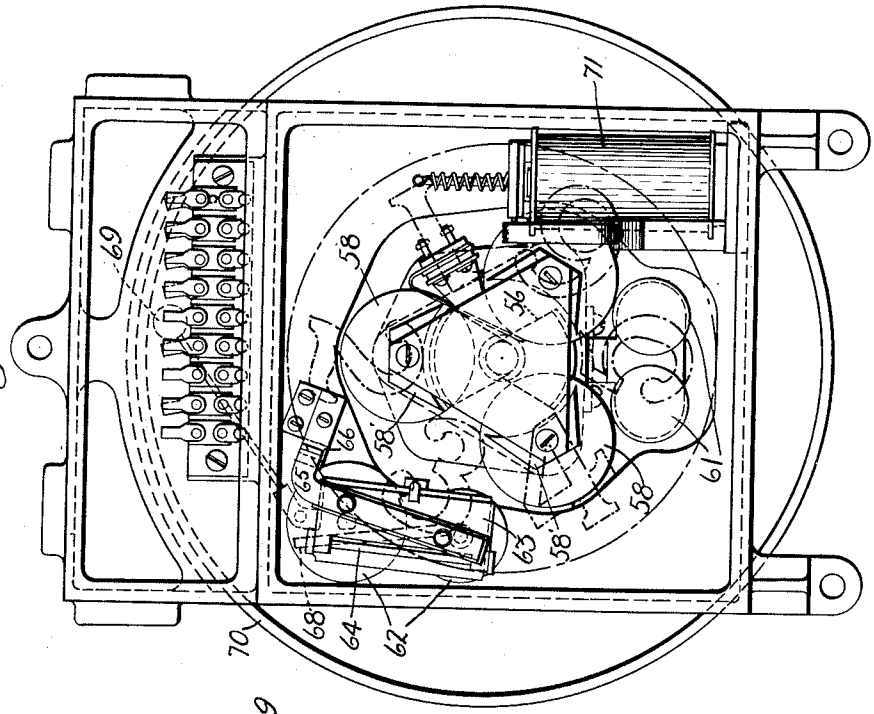
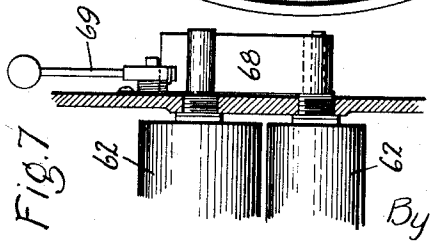


Fig. 7



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3 SHEETS—SHEET 3.

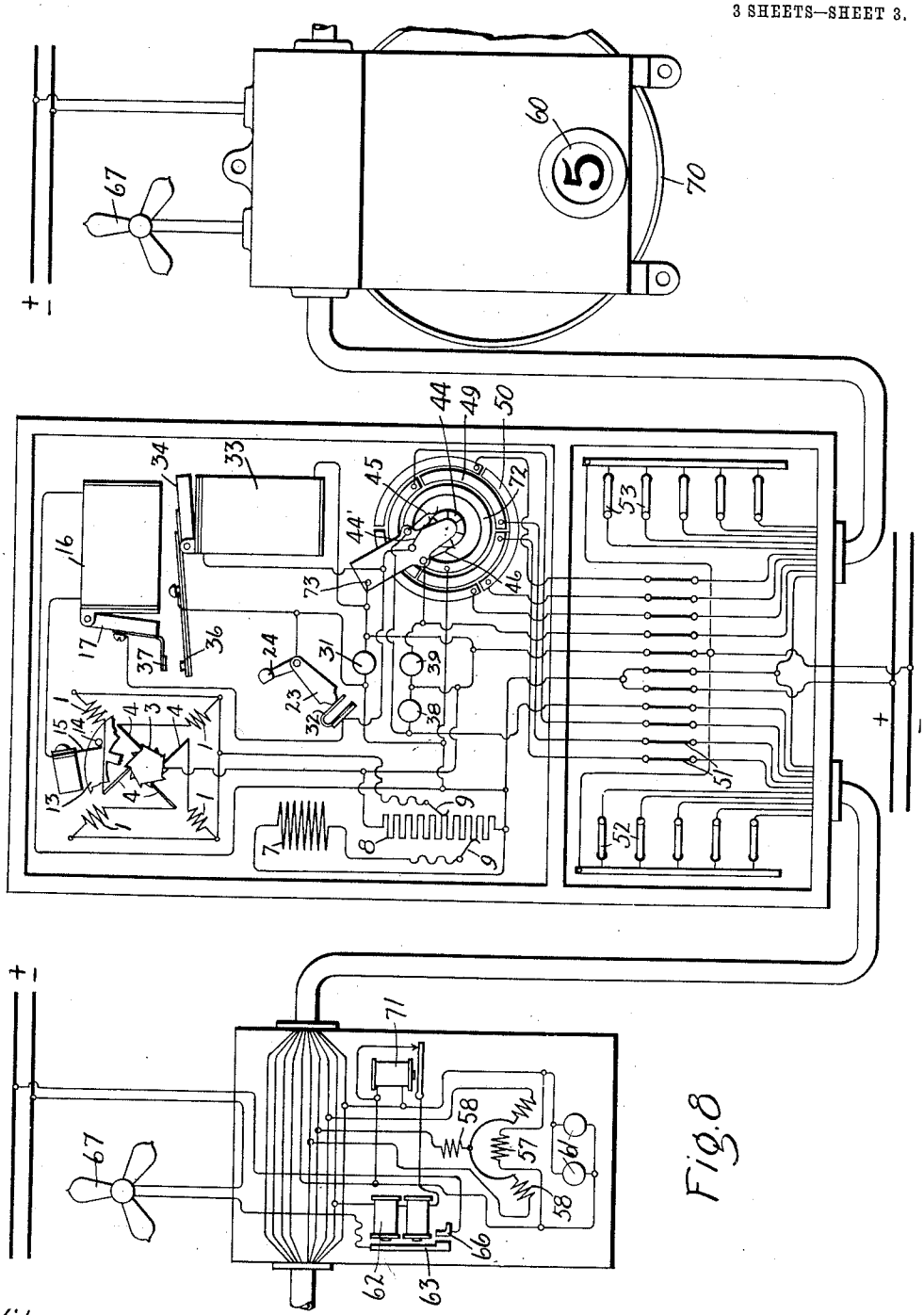

Fig. 8

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Att'y

UNITED STATES PATENT OFFICE.

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

SIGNALING SYSTEM.

946,431. Specification of Letters Patent. **Patented Jan. 11, 1910.**

Application filed April 1, 1907. Serial No. 365,696.

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 Signaling Systems, of which the following is a specification.

My invention relates to signaling systems for transmitting indications at predetermined intervals, the length of which is adjustable, and particularly to systems for use on board ship for signaling from the engine-room to the fire-room the times for firing the several furnaces. In a former patent, No. 918,848, issued to me Apl. 20, 1909, I have disclosed a system of this character, comprising a plurality of electrically-operated indicators arranged to display successively signals corresponding to the several furnaces, and a transmitting device embodying time-operated means for rendering the receivers operable at constant intervals of time, with means for varying at will the time-intervals.

My present invention consists in an improvement in the system of my former application.

In my former system each receiver was provided with a dash-pot, so that when energized to give one of its indications, it would remain energized for a certain length of time determined by the dash-pot.

One feature of my present invention involves the elimination of the dash-pot by providing means in the transmitter for maintaining the transmitting circuits for a predetermined time. I accomplish this by providing a magnet in the transmitter, which is momentarily energized periodically to transmit the current impulses, with circuit-maintaining contacts, so that when the magnet is energized, it is maintained energized until its maintaining circuit is interrupted, after a certain time, by means provided for that purpose.

Another feature of my invention consists in adapting the system for the separate control of signals for the star-board and port sides of the ship. There may be half a dozen fire-rooms on each side of the ship with half a dozen furnaces in each, and it is frequently desirable, not only to indicate the time for firing each of the furnaces in each room successively, but also to alternate the firing on the star-board and port sides of the ship. I, accordingly, provide switch contacts arranged to make circuit-changes in the transmission circuits for the star-board and port sides of the ship alternately; together with an actuating magnet for the switch contacts, and a step-by-step device periodically operated and controlling the magnet.

A further feature of my invention consists in the substitution for the clock mechanism which formed the motor in the transmitter of my former system, of a small electric motor arranged to operate at constant speed, and of a simple and efficient design.

My invention will best be understood by reference to the accompanying drawings, in which Figure 1 shows a front elevation of the transmitter with the cover of the casing removed; Fig. 2 shows a side elevation of the same in cross-section; Fig. 3 shows on a reduced scale a front elevation of the transmitter with the cover in place; Fig. 4 shows a cross-sectional detail plan view of the circuit-changing switch in the transmitter; Fig. 5 shows a front elevation of the receiver with the casing cover removed; Fig. 6 shows a cross-sectional side elevation of the same; Fig. 7 shows a side elevation of a detail of the receiver; and Fig. 8 shows diagrammatically the connections and arrangements of parts of the system.

In the drawings 1—1 represent the stationary field-magnets of a small electric motor of special design. There are four of these magnets, as shown in Fig. 1. The motor armature 2 is unwound and comprises an axial portion, extending parallel with the axis of the field-magnets, and terminating at each end in a five-pointed star-shaped member, the poles of which extend close to the poles of the stationary magnets, as shown in dotted lines in Fig. 1. As the magnets are successively energized, the armature 2 is rotated step-by-step. In Fig. 1 the armature is shown in the position which it occupies when the lower left-hand magnet 1 is energized. If this magnet is deënergized, and an adjacent magnet is energized, the armature will be shifted a twentieth of a revolution; there being four magnets and five poles on the armature, so that said adjacent magnet is displaced from the armature-pole which it attracts by a distance corresponding to one-fourth of a revo-

lution minus one-fifth of a revolution,—that is, one-twentieth of a revolution. To shift the current from one field magnet to another, the commutator 3 is placed on the shaft of the armature. This commutator, which may be of any well known construction, is shown in the drawings as composed of two star-shaped members placed side-by-side, as most clearly shown in Fig. 8. One of these members is of conducting material and the other of insulating material. As this commutator rotates, the brushes 4, which are connected to the terminals of the field-coils 1, bear alternately on the insulating and conducting members, so as to cut the field-coils successively into and out of circuit.

Mounted on the shaft of armature 2 is a conducting disk 5. This disk is embraced by poles 6 of the drag-magnet 7, which, by the eddy currents which it induces in the disk, retards the rotation of the motor.

8 represents a resistance by means of which both the torque of the motor and the strength of the retarding magnet may be varied. This resistance may be of any suitable construction, but I have indicated a coil with the insulation removed from the coil-conductors along two parallel strips. Adjustable contacts 9 bear at their extremities on the uninsulated portions of the conductors. If the resistance 8 is connected across the source of the current, as will be hereinafter explained, and if the magnet 7 and field-coils 1 each have a terminal connected to one of the movable contacts 9 and their other terminals connected to the source, then by adjusting the contacts 9, the torque of the motor and the strength of the drag-magnet may be independently adjusted, so as to secure any desired speed of the motor. The shaft of the armature 2 drives the speed-reducing gearing formed by a pinion 10 on the armature shaft engaging the gear 11, which in turn drives a pinion 12 engaging a gear 13 loosely mounted on the armature shaft.

The gear 13 carries a contact 14, which once in every revolution of the gear engages a stationary contact 15. When this engagement occurs, a circuit is closed, as will be hereinafter explained, in which the electro-magnet 16 is included. Consequently, at every engagement of contacts 14 and 15, magnet 16 is energized. The armature 17 of this magnet is normally held away from the magnet, as shown in Fig. 1, by the spring 18. The armature carries a pawl 19, which engages a ratchet-wheel 20, so that every time the magnet 16 is energized and deënergized, the ratchet wheel is advanced one step. This ratchet-wheel is provided with a flat spiral spring 21, shown in Fig. 2, which tends to rotate the ratchet in a clock-wise direction, as viewed in Fig. 1, while the pawl 19 moves the ratchet in a counter-clockwise direction against the spring tension. A retaining pawl 22 is provided for preventing the return of the ratchet-wheel when armature 17 is attracted by magnet 16. The ratchet-wheel carries a stop 23, which, when the ratchet-wheel is released from the pawls 19 and 20, as will be hereinafter explained, is brought into engagement with a stop 24 by the rotation of the ratchet-wheel under the influence of the spring 21. This stop 24 is carried on an adjustable member which forms one bearing for the spindle of the ratchet-wheel 20. This stop 24 is adjustable in position by means of a rod 25 provided with a milled head 26 outside the casing, as shown in Fig. 1, and carrying a worm 27 engaging a worm-wheel 28 secured to the member carrying stop 24. Thus, by rotating the milled head 26, the position of the stop 24, and consequently the position to which the ratchet-wheel is returned by its spring 21 when released by the actuating pawls, may be adjusted as desired. In order that the position of the stop 24 may be known to the person adjusting it, the spindle which carries the stop is provided with a numbered dial 29. In Fig. 1 these numbers are omitted from the dial, in order to avoid confusing the drawing, but these numbers are shown in Fig. 3, as seen through a small glass window 30 in the cover. This dial is preferably of glass or other transparent material, and has lamp 31 behind it to illuminate it. The numbers on the dial may be so placed as to indicate the number of minutes between successive impulses for which the transmitter is set. The member 23, besides serving as a stop for limiting the backward movement of the ratchet-wheel, may also serve as a contact, which, in one position of the ratchet-wheel engages a stationary contact 32. It will be seen that the position of the member 24 determines the number of steps which the ratchet-wheel must be moved to bring the contact 23 from its original position into engagement with the contact 32. It is by this adjustment of the stop 24, and consequently, of the number of operations required to close the contacts 23 and 32, that the interval between the impulses transmitted is adjusted.

33 represents a magnet which is in circuit with the contact 32, and is energized when this contact is engaged by the movable contact 23 on the ratchet-wheel. The armature 34 of this magnet is normally held in the position shown by the spring 35. This armature is provided with an extension which, when the armature is attracted by the magnet, engages the pawls 19 and 22, and lifts them from the ratchet-wheel; allowing the ratchet-wheel to be returned to its original position by the spring. Consequently, engagement between contacts 23 and 32 is only

momentary, since, when they engage each other, magnet 33 is at once energized and releases the ratchet, so as to separate contacts 23 and 32. In order to prevent the immediate opening of the transmission circuits which are momentarily closed by contacts 23 and 32, the extension of the armature 34 is provided with a contact 36, which, when armature 34 is attracted, engages a contact 37 on the armature 17 of magnet 16. The engagement of these two contacts closes a shunt circuit around the contacts 23 and 32, and so, although these latter contacts are immediately separated, their circuit is not opened, and magnet 33 is maintained energized and the transmission circuits closed. This continues until magnet 16 is again energized by the engagement of the motor-driven contacts 14 and 15. When this occurs, contact 37 is drawn inward toward magnet 16 away from contact 36, and the circuit is broken.

As has been said heretofore, the transmitter is adapted for the alternate control of transmission circuits on the port and star-board sides of the ship. Lamps 38 and 39 are provided in the transmitter behind glass windows 40, and are connected as will hereinafter be explained, so that they are illuminated when an impulse is being sent over the port and star-board transmission circuits, respectively. For the operation of the circuit-changing switch for controlling both port and star-board circuits, the armature 34 of magnet 33 carries a slotted plate 41, which moves up and down over the spindle of a ratchet-wheel 42. This plate carries pawls 43 engaging the ratchet 42, so that the ratchet is moved forward two teeth every time the plate 41 is lowered and raised by the energization and deënergization of magnet 33. The spindle of ratchet 42 carries a commutating-switch 44 having alternate conducting and insulating segments. On this commutator bear two brushes 45 and 46, which are connected to the lamps 38 and 39, and to the port and star-board transmission circuits, respectively. When the brush 46 is on a conducting segment, as shown in Fig. 1, and when the transmission circuits are closed at contacts 36 and 37, lamp 39 is illuminated and the star-board transmission circuits energized. When brush 45 is on a conducting segment and contacts 36 and 37 are closed, lamp 38 is illuminated and the port transmission circuits energized.

Since each indicator must display a number of different signals successively, the circuit-changing switch must not only alternately energize the star-board and port circuits, but must produce other changes in the transmission circuits. Any suitable construction may be employed for producing the necessary changes, and the particular construction shown forms no part of my invention. I have illustrated for this purpose a member 47 carried on the spindle of ratchet 42, and carrying contacts 48 bearing on arc-shaped strips 49 and 50. These strips, as shown in Fig. 8, are arranged in two concentric circles, the strips 49 being connected to the port transmission circuits, and the strips 50 to the star-board transmission circuits. The spaces between adjacent strips of one set are staggered with respect to adjacent strips of the other set, so that if the member 47 of Fig. 4 is rotated sixty degrees, it will produce a change in the circuit connections of either the port or star-board transmission circuits without affecting the other; and in the next movement of sixty degrees, will produce changes in the other transmission circuit. The leads from the transmitter are carried through suitable fuses 51 and switches 52 and 53 to a source of current, and to the star-board and port transmission circuits. By means of the switches 52 any fire-room on the port side of the ship may be disconnected, and by the switches 53 any receiver in any fire-room on the star-board side may be disconnected from the system.

The construction of the receiver shown in Figs. 5 and 6 is substantially the same as that shown in my former application, but somewhat simplified, owing to the omission of the dash-pot. The receiver comprises a rotatable armature 56 provided with an energizing winding 57. This armature 56 has an S-shaped cross-section, as shown in Fig. 6, the shape of its poles at each end of the armature being fan-shaped, as shown in dotted lines in Fig. 5. Three stationary magnets 58 are arranged with their poles 58′ adjacent to the armature 56. The current for the field-magnets is sent in through one magnet and taken out through the other two in parallel. By varying the connections of the three magnets, the armature 56 may be caused to assume any one of six different positions. By increasing the number of field-magnets, the number of positions of the armature could be increased. The armature carries on its shaft a transparent dial 59, which is provided with numbers, as shown in dotted lines in Fig. 5, to indicate the particular furnace which is to be fired. A glass window 60 is placed in the front of the casing, and lamps 61 are placed behind the dial to illuminate it. The receiver also comprises a pair of magnets 62, which are provided with an armature 63 pivotally mounted on an axis 64 and carrying a contact 65, which, when the magnets 62 are energized, is pressed into engagement with a stationary contact 66. These contacts, as shown diagrammatically in Fig. 8, control the circuit of a cluster of lamps 67, which, by their illumination, attract attention to the indicator when the indicator dial is actuated.

In order further to attract attention to the indicator, the poles 62 are extended through the casing, as shown in Fig. 7, and an armature 68 is provided, which, when the magnets are energized, strikes the hammer 69 of a gong 70. A cut-out magnet 71 is also provided to cut the receiver from circuit when the switch for that receiver is opened at the transmitter.

The construction of the several parts being as heretofore explained, the operation of the system as a whole will best be understood by reference to Fig. 8, which shows diagrammatically the several parts of the system and their circuit connections. In this figure the source of current for the system is indicated by conductors or mains to which plus and minus signs are applied. It will be seen that the resistance 8 is connected directly across the source. The damping-magnet 7 has one terminal connected to the positive main and its other terminal connected to a movable contact 9 on the resistance 8. The circuit of the field-magnets 1 may be traced from the other movable contact 9, through one of the field-magnets and commutator 3 to the negative main. As the commutator 3 rotates, the field-coils 1 are connected successively across a portion of the resistance 8, determined by the position of the movable contact 9. The circuit of magnet 16, which, as was heretofore explained, actuates the ratchet-wheel, may be traced from the positive main to the right-hand terminal of the magnet, from the left-hand terminal of the magnet through contacts 15 and 14, and gear 13 which is electrically-connected to the commutator 3, as shown in Fig. 2, and thence to the negative main. The circuit of magnet 33, which releases the ratchet-wheel and operates the circuit-changing switch, may be traced from the positive main to contact 23, contact 32, the upper terminal of the magnet, and from the lower terminal magnet to the negative main. Thus, this magnet is energized whenever contacts 23 and 32 are closed. Contacts 36 and 37 are connected in shunt to contacts 23 and 32. Lamp 31 is connected directly across the mains.

A circuit extends from the negative main to the junction of lamps 38 and 39. The other terminal of lamp 38 is connected to brush 45, and the other terminal of lamp 39 is connected to brush 46. These brushes are connected through the commutator 44 to a terminal connection, indicated in Fig. 8, by the brush 44′, which is connected to contacts 32 and 37, so that when contact 23 is in engagement with contact 32, or when contact 36 is in engagement with contact 37, a circuit is closed through lamp 38 or 39 (according to the position of the commutator 44) through one or the other of contacts 32 or 37 to the positive main; thereby indicating that the port or star-board transmission circuits are energized. Brush 45 is also connected to one of the transmission wires of the port circuit. This wire is the second from the right in the left-hand group in the transmitter, and is represented by the second wire from the bottom at the receiver at the left of the figure. Consequently, when brush 45 is bearing on a conducting segment of commutator 44, and when contacts 32 and 23 or 37 and 36 are closed, a circuit may be traced from the positive main through contacts 23 and 32, or contacts 36 and 37, to terminal 44′, commutator 44, and brush 45, and through the second conductor of the port circuit to the magnets 62. The other terminal of these magnets is connected through the armature of the cut-out magnet 71 to the sixth conductor of the port circuit, which, at the transmission station, is connected through the upper switch 52 to the negative main. Magnets 62 are consequently energized, closing contacts 65 and 66, thereby lighting the lamp 67, and striking the gong 70. This occurs at the instant when the ratchet-wheel has been moved forward by the magnet 16 sufficiently to bring contact 23 into engagement with contact 32, and though contact 23 is immediately returned to its original position, the circuit of magnet 62 is maintained closed by contacts 37 and 36, as has been heretofore explained. Thus, attention is called to the indication of the dial at the receiver. The number which is displayed by the dial is determined by the position of the switch member 47 of Fig. 4, which connects one of each set of contacts 49 and 50 with a circular contact 72 (shown in Fig. 8) connected to the positive main, and connects the other two contacts of the set to the terminal connection 73 (shown in Fig. 8) which is connected to the negative main. The position of the dial is determined by the connection of one or the other of the set of contacts 49 to the positive or negative mains. The armature 57 of the dial-shifting device, and the illuminating lamps 61 are connected between the first and sixth conductors of the transmission circuit. The sixth conductor, as has been already pointed out, is connected to the negative main, while the first conductor is connected to the positive main, as is best seen from Fig. 8, so that the armature 57 and dial illuminating lamps 61 are always energized.

The operation is then as follows: With the motor of the transmission mechanism in operation, the magnet 16 is energized periodically, advancing the ratchet-wheel step-by-step, until contact 23 is brought into engagement with contact 32. Magnet 33 is then energized, bringing contacts 36 and 37 into engagement and releasing the ratchet-wheel. At the same time, the downward movement of the plate 41, controlled by the armature 44 of the plate 43, shifts the

ratchet 42, so as to shift the contacts of member 47. This does not move commutator 44 far enough to affect its circuits. A conducting segment of the commutator is already under brush 45. The star-board circuits are opened at brush 46, and the movement of the member 47 does not affect the connections of the arc-shaped contacts 50, which are connected to the star-board circuits; but does affect the connections of the contacts 49, so as to vary the connections of the magnets 58 at the receiver, and thereby to shift the dial. At the same time, the circuit of magnets 62 at the receiver is closed through brush 45, commutator 44, contact terminal 44′, and contacts 37 and 36, to the positive main. The lamps 67 are lighted, and the gong struck, calling attention to the fact that an indication is being displayed. The lamps 67 remain lighted until magnet 16 is again energized; thereby separating contacts 37 and 36, and deënergizing magnet 33. The circuits of magnets 62 at the receiving station, and of lamp 38, which has been lighted, indicating that a signal has been transmitted to the port receiver, are broken at these contacts 36 and 37. At the same time the slotted plate 41 is raised, due to the retraction of armature 34 by the spring 35, and the ratchet 42 and switch member 47 are advanced by an amount corresponding to one tooth on the ratchet. This movement shifts commutator 44 so as to bring an insulating segment under brush 45, and a conducting segment under brush 46, so that the next time contacts 23 and 32 are closed, the star-board circuits will be energized. It will be seen that the transmission circuit is broken at the contacts 37 and 36, so that all arcing at the commutator 44 is avoided. Magnet 16 again periodically advances the ratchet-wheel until contact 23 again engages contact 32. Magnet 33 is again energized, closing contacts 36 and 37, and consequently closes the star-board transmission circuits. At the same time, switch member 47 is advanced, so as to vary the connections of the arc-shaped contacts 50, and display a new indication in the star-board receiver. The connections of the contacts 49 are not changed by this movement, so that the indications of the port receivers are not changed.

The function of cut-out magnet 71 is simply to cut out the receiver when its switch 52 at the transmitter is opened. When the switch 52 is opened, magnet 71 is deënergized, thereby opening a circuit which would otherwise exist through magnet 33 at the transmitter, and magnets 62 and armature winding 57 at the receiver in series, whenever magnet 33 was energized by the closing of contacts 23 and 32 or 36 and 37.

I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

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

1. In a signaling system, a transmitter comprising a motor, contacts controlled thereby for closing a circuit momentarily at predetermined intervals, a magnet in said circuit, contacts controlled by said magnet connected in shunt to the first-mentioned contacts to form a maintaining circuit for said magnet, and means controlled by said motor for opening said maintaining circuit after a short predetermined interval, and a receiver controlled by said magnet.

2. In a signaling system, a transmitter comprising a motor, contacts controlled thereby for closing a circuit momentarily at predetermined intervals, means for maintaining said circuit closed after said contacts have opened, and means controlled by the motor for rendering said maintaining means inoperative after a short predetermined interval, and a receiver controlled by said circuit.

3. In a signaling system, a transmitter comprising a motor, contacts controlled thereby for closing a circuit momentarily at predetermined intervals, means for adjusting the length of said intervals, means for maintaining said circuit closed after said contacts have opened, and means controlled by the motor for rendering said maintaining means inoperative after a short predetermined interval, and a receiver controlled by said circuit.

4. In a signaling system, a transmitter comprising a motor, contacts arranged to be closed periodically by said motor, a magnet controlled by said contacts, a step-by-step device actuated by said magnet, contacts arranged to be closed momentarily by said device, a magnet arranged to be energized by the contacts of said device and to maintain itself energized, a circuit controlled by the second magnet, and means controlled by the first magnet for deënergizing the second, and a receiver controlled by said circuit.

5. In a signaling system, a transmitter comprising a motor, contacts arranged to be closed periodically by said motor, a magnet controlled by said contacts, a pawl actuated by said magnet, a ratchet actuated by said pawl, a contact controlled by said ratchet, a second magnet controlled by the ratchet contact, a circuit controlled by the second magnet, means controlled by the second magnet for releasing the ratchet from said pawl, and contacts controlled by the first magnet and controlling the second, and a receiver controlled by said circuit.

6. In a signaling system, a plurality of transmission circuits, receivers connected to the several circuits, and a transmitter comprising switch contacts arranged to make

circuit changes in said transmission circuits alternately, a magnet for operating said switch contacts, a step-by-step device, actuating means therefor, contacts controlling said magnet arranged to be closed upon the movement of said device through a predetermined number of steps, means for adjusting said number, and means for adjusting over wide ranges the time interval between successive steps.

In witness whereof, I have hereunto set my hand this 30th day of March, 1907.

JOHN L. HALL.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.