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D. MURRAY

TELEGRAPH SYNCHRONIZING SYSTEM

Filed Feb. 15, 1924 2 Sheets-Sheet 1

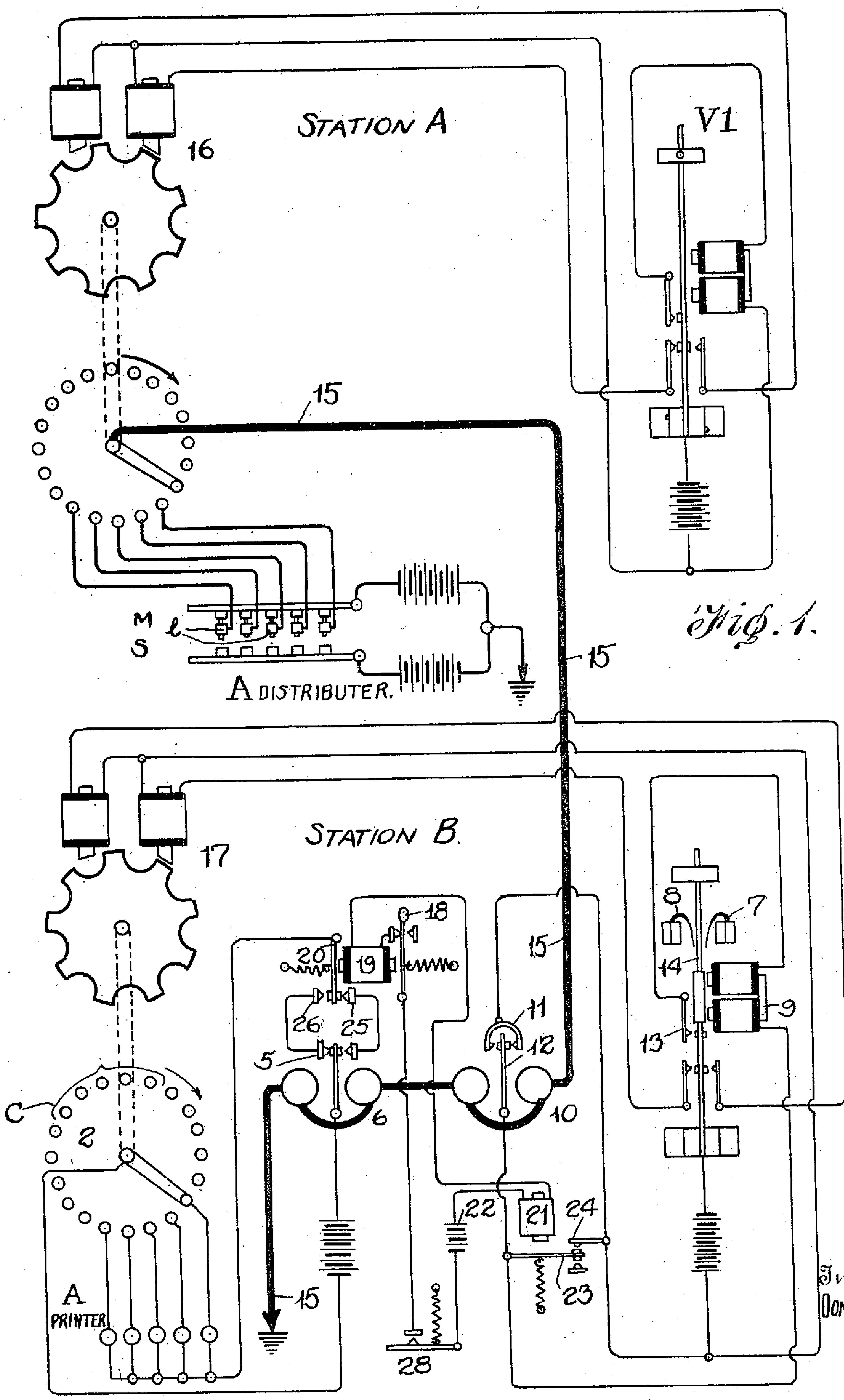

Fig. 1.

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2 Sheets-Sheet 2

Fig. 2.

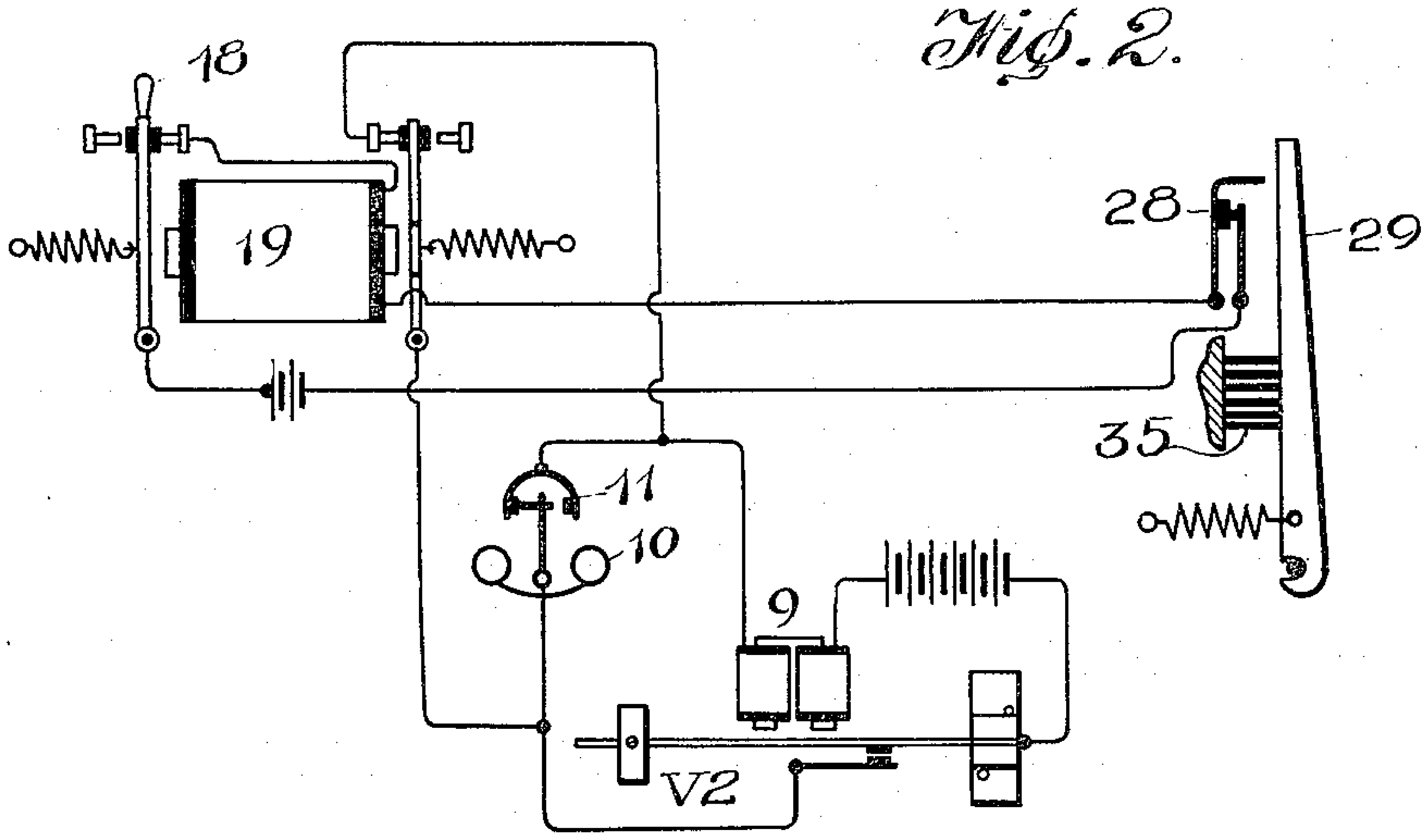
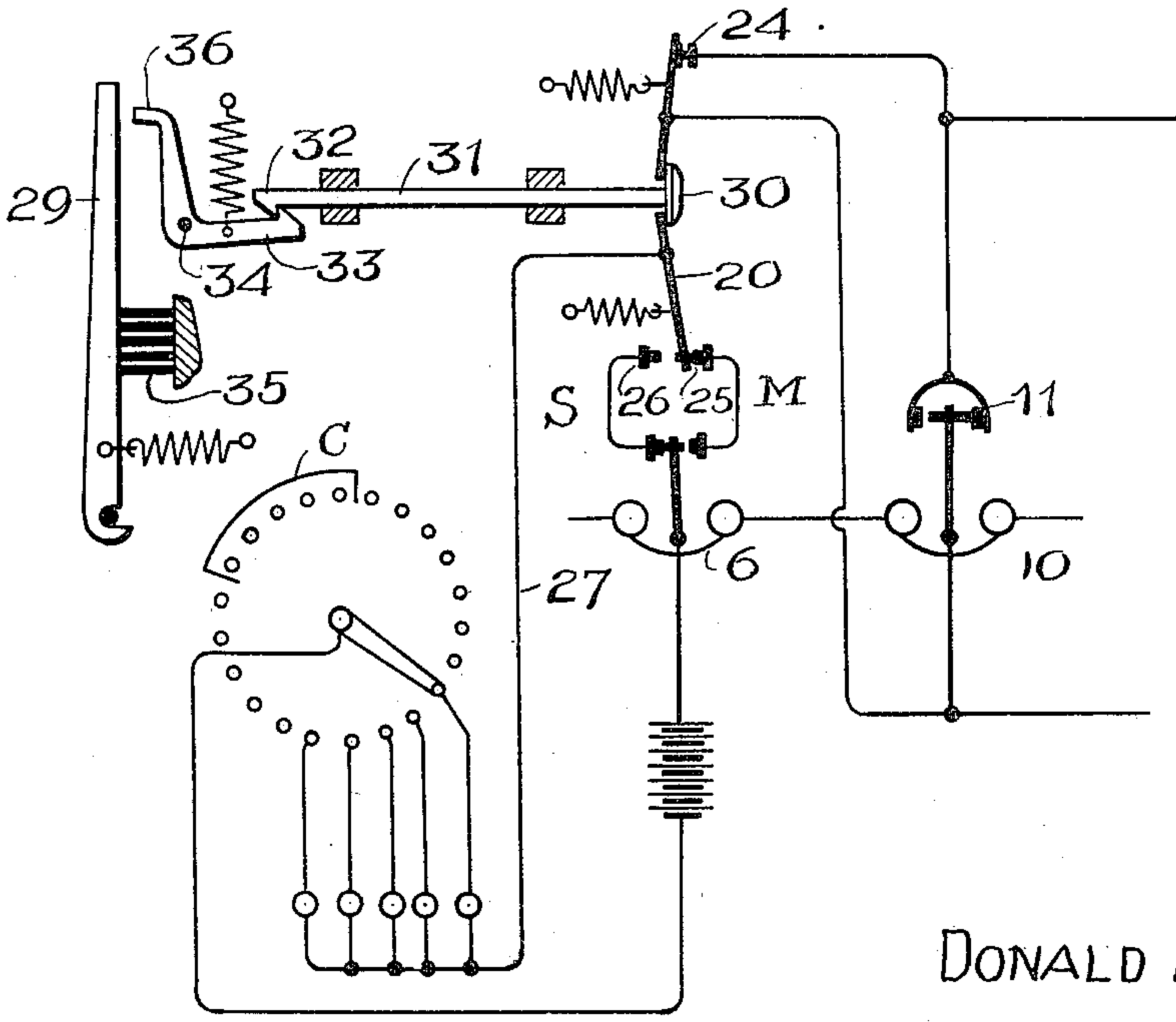


Fig. 3.



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UNITED STATES PATENT OFFICE.

DONALD MURRAY, OF LONDON, ENGLAND, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEGRAPH SYNCHRONIZING SYSTEM.

Application filed February 15, 1924. Serial No. 693,112.

To all whom it may concern:

Be it known that I, DONALD MURRAY, a subject of the King of Great Britain, residing at 55 Goswell Road, London, E. C. 1, in the county of London, England, have invented certain new and useful Improvements in Telegraph Synchronizing Systems (for which an application for patent has been filed in Great Britain, Dec. 6, 1922), of which the following is a specification.

This invention relates to multiplex printing telegraph systems, in which the correction of synchronism is secured from the message signals instead of from a special correcting signal.

Correction from the message signals is old, but it has hitherto been achieved in multiplex systems in a rather complicated way, requiring considerable alteration in the ordinary pattern of multiplex apparatus.

The object of the present invention is to apply the method of correction from the message signals in a multiplex system in a very simple way without involving any material departure from standard multiplex apparatus such as the Baudot.

The invention is illustrated in the accompanying drawings.

Fig. 1 is a general diagram of the connections of a multiplex printing telegraph system, including station A and station B arranged in accordance with the present invention.

Fig. 2 illustrates an electrical method of securing synchronism automatically between the two stations A and B.

Fig. 3 illustrates a mechanical method of securing synchronism automatically between the two stations A and B.

Correction of synchronism from the message signals appeared first in the Hughes printing telegraph, and I applied this method in the Murray automatic printing telegraph in the year 1899 and I proposed its application to the multiplex in 1903. Picard afterwards applied it to the Baudot multiplex across the Mediterranean. The Western Union Telegraph Company in America subsequently adopted the Picard plan with modifications.

The main feature of the present invention is the combination of the plan used in the Murray automatic system with part of the Picard plan. In the Murray automatic system, the speed of the vibrator V2, Fig. 1, is made sensitive to current variations in the magnet 9 driving the reed of the vibrator. This is achieved by the use of buffer springs 7 and 8 on each side of the reed. The arriving message signals operate a local correcting relay 10, the contacts of which are in the circuit of the vibrator magnet 9. The vibrator magnet contact 13 on the reed and the local correcting relay contact 11 consequently interfere with each other and vary the strength of the current impulses in the vibrator magnet in proportion to any increase in speed of the reed over the speed of the arriving signals. I use this plan also in the invention now being described.

In the Picard system, alternations of current in the line are used while no signals are being sent, each channel of the multiplex sending — + + + —. The message signals are correspondingly inverted, and at the receiving end of the line the back as well as the front contacts of the line relay are used to rectify this inversion of the signals.

In the Picard system, a variety of other more or less complicated arrangements are employed, and correct phase is secured manually by sending an agreed-upon letter signal, the synchronizing mechanism being interrupted by hand until the letter is correctly registered, and the synchronizing mechanism is then allowed to operate again.

In the Western Union multiplex system, the Picard plan of reversals and rectifying by use of the back as well as the front contact of the line relay is followed with this difference, that the channels themselves are alternately positive and negative. Each channel therefore operates with one polarity of current, thus: + + + + +, or — — — — — instead of — + + + — as in Picard's plan. In other respects, the Picard plan is more or less closely followed, with the exception that the correcting magnet revolves, thus getting more than one correction per revolution if necessary. In the Western Union system, like the Picard, manual operation of the switches is required to secure correct phase.

After these explanations, the novel features of my invention will be more readily understood. I arrange the distributors 1 and 2, Fig. 1, so that only one channel of the multiplex, that shown in Fig. 1, has reversed polarity and operates on the back contact of the line relay. It will be seen that in the case of channel A at A, Fig. 1, station A, the five contact levers l, in their position of rest, press against the marking contact bar M instead of against the spacing contact bar S. For the other three channels at station A this arrangement is reversed. At station B printer A on channel A operates normally on the back contact 5 of the recording relay 6. In the quadruple installation therefore the sequence of polarity in the four channels when no signals are being transmitted, is as follows:—

D ------ A ++++++ B ------ C ------.

There is therefore at the beginning and end of the channel A, a change in the condition of the line when no signals are being transmitted, and this change in the condition of the line from negative to positive and from positive to negative effects correction of synchronism, and as it takes place on one particular channel only, it also secures correct phase automatically.

Hence, when the circuit is in synchronism and in phase, the four printers A, B, C, D, are silent and operate only when message signals are transmitted. For synchronizing at station B (the corrected station), various plans may be followed. Picard's method may be employed, or the Western Union method. Both of these involve extra contact rings on the distributors and extra brushes. This entails considerable alteration of the commutators on the distributors and also requires various relays and switches.

These methods may be adopted without departing from the scope of this invention; but a far simpler plan is to employ the synchronizing method used in the Murray automatic system already referred to, in which the speed of the vibrator V2, Fig. 1, is controlled by interference from the line signals. For this purpose buffer springs 7 and 8, Fig. 1, may be employed on each side of the reed of the vibrator V2 as in the Murray automatic system, or the Delany method of a magnet or magnets at the end of the reed may be employed; or I may utilize the variation in speed of the reed due to the reaction of the reed on the driving magnet 9. In this case I may employ a soft iron armature attached to the reed with the magnet very close to the armature to secure maximum electromagnetic interference and therefore maximum variation of the speed of the reed with variation of current. With any of these devices I employ the Murray automatic system arrangement of a local correcting relay 10, Fig. 1, operated by the line relay, the back and front contacts of the correcting relay being joined together electrically as shown at 11, and the armature of the relay being allowed a fair amount of play, adjustment of play being made to suit the amount of correction required. In Fig. 1 the recording relay 6 and the correcting relay 10 are shown operating direct in main telegraph line 15. but they can of course be arranged to operate locally from the main line relay. The armature 12 of this correcting relay 10 crosses over between its contacts at the beginning and end of every change of polarity in the line. As the contacts of this local correcting relay are in the same local circuit as the contact 13 on the reed that sends vibratory impulses into the reed magnet 9, there is interference between the two contacts if they do not open and close at the same instants. When they open and close exactly at the same time, maximum current impulses flow through the vibrator magnet 9 and the reed 14 vibrates with maximum energy and speed, owing to the buffer springs 7 and 8. (In the case of utilizing the reaction of the reed 14 on the vibrator magnet 9 above mentioned, the speed and energy of the reed are reduced with increased current.) If the relay and vibrator contacts get out of step with each other, there is interference, and smaller current impulses flow through the vibrator magnet, resulting in the speed of the reed being brought into harmony again with the speed of the line signals.

When no signals are being transmitted over the line, there are two points, one at the beginning and the other at the end of the channel A as already described at which correction of the speed of the vibrator takes place. Experience shows that this is sufficient. When signals are being transmitted, the corrections of the vibrator speed become numerous and irregular, corresponding to the position of the brush arms all round the distributor commutator, but the correcting action is the same, and correct speed and phase are preserved.

It is possible to operate without connecting the back and front contacts of the correcting relay 10, but in this case the correcting action is more violent and irregular and electric connection of the back and front contacts as shown in Fig. 1 is preferable.

The usual multiplex method is employed of running the distributor at station B at a speed of about .2 per cent faster than the speed at station A. That is to say, the vibrator at station B runs about .2 per cent faster than the arriving line signals. Interference between the contacts 11 of the correcting relays 10 and 13 of the vibrator magnet 9 then occurs, and the speed of the vibrator is then modified by the alteration in the amount of current until it is in harmony with the line signals.

The distributors 1 and 2 at stations A and B are driven by phonic or other motors 16 and 17 controlled by the speed of the vibrators V1 and V2.

Finally, provision must be made for auto matic phase-finding. If all the transmitters are stopped, transmitter A at station A, will send out the five-unit marking signal and the other transmitters B, C, D, (not shown) will send out spacing current, and if the action of the correcting relay 10, at the receiving station is cut out by moving over a trigger catch by hand so as to short circuit the contacts of the relay or short circuit the relay itself, the trigger catch also reversing the connections of printer A so that it temporarily operates on the front contact of the line relay like printers B, C, D, then the five-marking-unit signal will gradually travel round the distributor commutator at the receiving station. Consequently it will affect each printer A, B, C, D, in succession; but no operative action will take place on any of the printers except printer A immediately after printer D. This trigger short-circuiting arrangement is shown at station B, Fig. 1, and also in Figs. 2 and 3. Referring to Fig. 1 station B, pressing over contact lever 18 by hand closes a circuit through the relay magnet 19, which then holds itself closed and attracts armature 20, which throws the common return wire 27 of printer A over from the back contact 26 on to the front contact 25 of the recording relay 6. It also closes the circuit through the relay magnet 21 energized by the battery 22, which therefore attracts its armature 23 and closes contact 24, which it will be seen short-circuits the correcting relay contact 11, and thus renders the correcting relay inoperative. This condition remains until the contact at 28 is opened. This de-energizes the relay magnets 19 and 21, and the arrangement is restored to the normal correcting condition with printer A once more operating on the back contact 5 of the recording relay 6. Printer A is provided with a mechanical device so that when the five-unit marking signal reaches the point at which it is correctly recorded as five marking units on printer A, a lever 29, Fig. 2, is selected by the usual selector plates 35 in the printer which momentarily trips open the contact 28 and this unlocks the magnet 19 and opens the contact 18 and thus opens the short circuit of the correcting relay 10 so that the correcting relay 10 starts acting at the right phase point. At the same time the trip action as just described reverses the action of printer A so that it again operates on the back contact of the line relay. Hence printer A performs automatically the action now performed manually on the Picard and the Western Union multiplex. As long as no messages are running, corrections will be recorded at the beginning and end of channel A during each revolution. While messages are passing corrections will take place at the beginning and end of each change in the condition of the line.

An appreciable interval of time elapses before this tripping action can take place. Suppose for instance that the trip does not operate in printer A till the distributor brushes have reached channel C, then no harm is done because the brushes only advance the usual three quarters of a degree per revolution, and that is an amount very easily corrected in the next revolution. There would be no difficulty in correcting even two degrees of advance of the brushes and this is considerably beyond any practical requirement.

If at any time synchronism fails, all that is necessary is to stop the transmitters, (as at present) and then push over the catch lever 18, Fig. 1 at the receiving station B that short circuits the correcting relay 10 and reverses the action of printer A. Synchronism will then re-establish itself automatically, and this will be indicated by the opening of the short circuit and the silencing of the printers.

In Fig. 2 only magnet 19 is shown, magnet 21 being omitted, but the operation is the same, Fig. 2 illustrating specially the printer mechanism 28, 29, and 35 for opening the circuit.

In Fig. 3 a mechanical arrangement for the short-circuiting and switching arrangement is shown, which avoids the use of the two magnets 19 and 21 and of the contact 28. Depressing the button 30 by hand closes the contact 24 which short-circuits the contacts 11 of the correcting relay 10. Depressing the button 30 also throws the contact lever 20 over from the back contact 26 to the front contact 25, thus putting the common return wire 27 of printer A on the front or marking contact 25 instead of the back or spacing contact 26. The button 30 is connected to a rod 31 having a hook 32 at its end which engages with the pawl 33 pivoted at 34. At the right moment, as already described, printer A selects lever 29, Fig. 3, by means of the movement of the selector plates 35. The lever 29 then moves inward and strikes the tail piece 36, thereby tripping the pawl 33 and restoring all the contacts to the normal operating positions.

The advantage of my method of synchronism is its extreme simplicity. In the modern multiplex it is customary to use the Gulstad relay and a local operating relay is therefore necessary. All that is required additional for the present method of synchronism is a local correcting relay in the same circuit as the local operating relay. No correcting magnet is required in the distributor and no epicyclic correcting gear, a very material simplification. In fact, the distributor reduces to a phonic wheel and a commutator. No extra receiving rings or brushes are required on the commutator and no extra switches or condensers or relays, as in the Picard system and Western Union method. It can be applied to the ordinary Baudot distributors without changing anything except the number of segments on the commutator. Also the front commutator alone is sufficient for sending and receiving, leaving the back commutator available for retransmission.

Having now particularly described my said invention and in what manner the same is to be performed, I claim:—

1. In a synchronous multiplex printing telegraph system, a telegraph line, means for transmitting impulses of different polarities on said line, a multi-channel receiving distributor, printer relays connected to each channel, circuit connections whereby the printer relays in one channel are unresponsive to impulses of one polarity and means for changing said circuit connections, whereby said relays are made responsive to impulses of said polarity.

2. In a synchronous multiplex printing telegraph system, a telegraph line, a vibrator at the receiving station having a natural period of vibration, a correcting relay controlled by received signals, circuit connections controlled by said correcting relay, whereby the vibrator position is corrected to correspond to the received impulses, and means for short-circuiting the circuit connections, whereby the main line correcting relay is rendered inoperative.

3. In a telegraph system as set forth in claim 1, a recording relay, the printer relays of said one channel being operated from the back contact of said recording relay and the relays of the other printers from the front contact, and means for temporarily changing the connection of said back-contact connected printer relays to the front contact of the recording relay to secure correct phase relation when synchronism is being established.

4. In a synchronous telegraph system as set forth in claim 1, a special selecting lever which when operated sets the normal synchronizing mechanism into operation when the correct phase point is reached.

In testimony whereof I affix my signature.

DONALD MURRAY.