No. 717,513. Patented Dec. 30, 1902.

J. S. STONE.

METHOD OF RELAYING SPACE TELEGRAPH SIGNALS.

(Application filed Jan. 23, 1901.)

(No Model.)

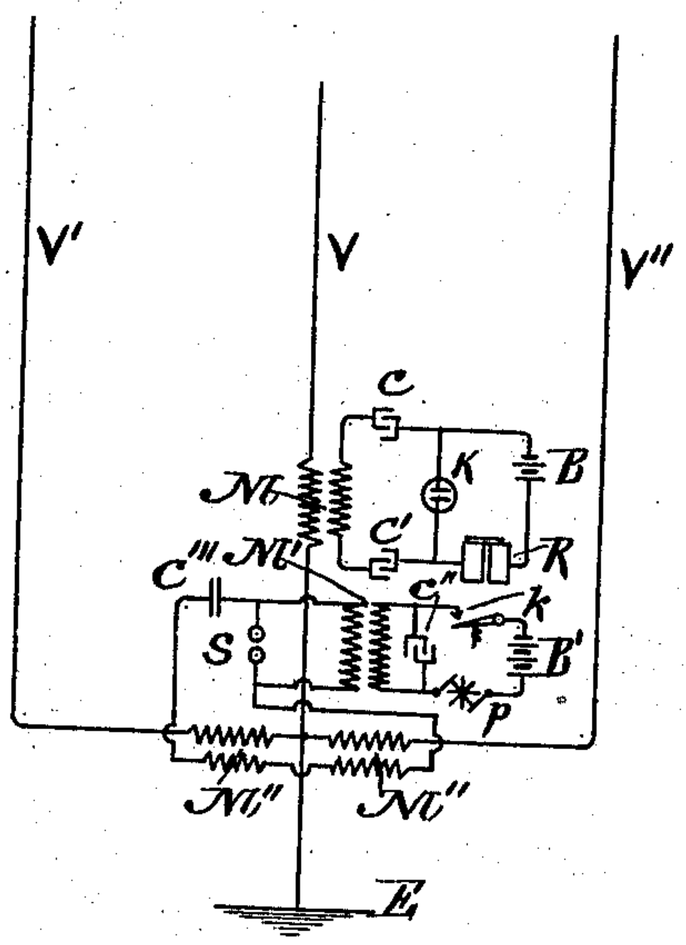

Fig. 1.

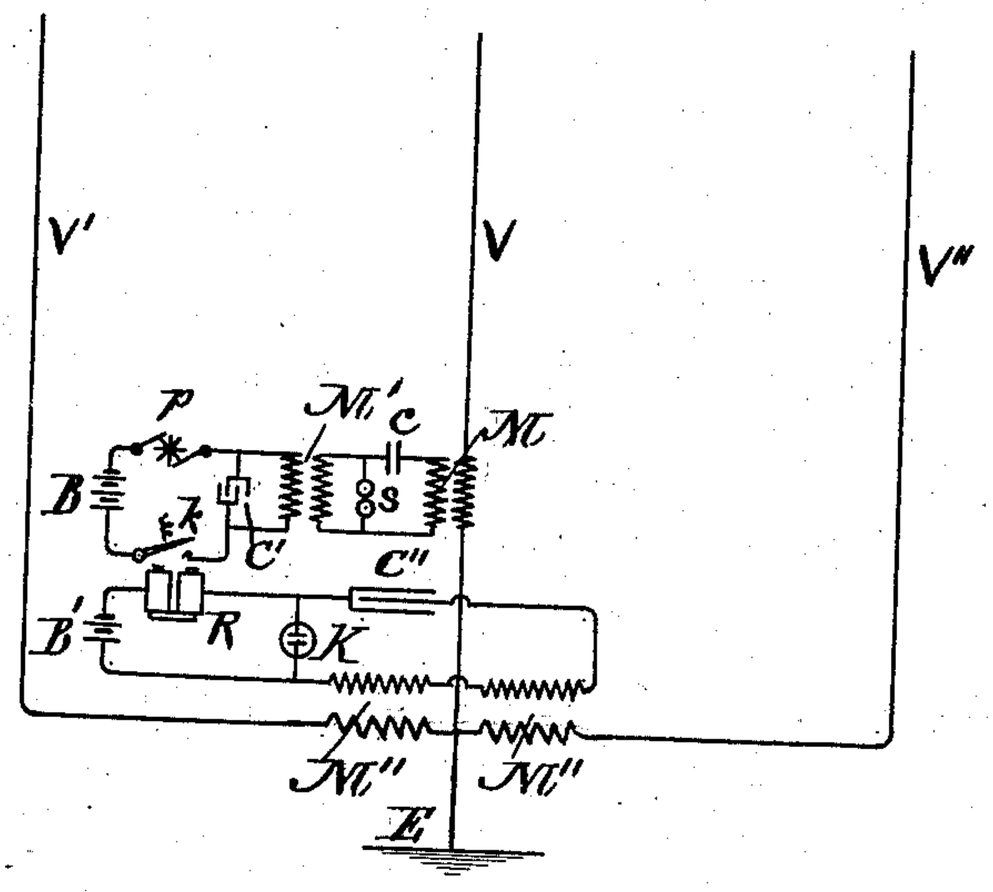

Fig. 2.

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METHOD OF RELAYING SPACE-TELEGRAPH SIGNALS.

SPECIFICATION forming part of Letters Patent No. 717,513, dated December 30, 1902.

Application filed January 23, 1901. Serial No. 44,396. (No model.)

To all whom it may concern:

Be it known that I, JOHN STONE STONE, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Methods of Relaying Space-Telegraph Signals, of which the following is a specification.

The invention relates to the art of signaling electrically between stations not connected by a conducting-wire, sometimes called "space telegraphy," and more particularly to the type of space telegraphy in which the signals are transmitted by unguided electromagnetic waves.

The distance to which it is at present practicable to signal by electromagnetic waves is limited to distances considerably less than those easily communicated over by the ordinary telegraph and telephone of to-day. It is of the greatest importance, therefore, that suitable methods and means for automatically relaying space-telegraph signals be discovered and devised. So far as I am aware no method or apparatus for automatically relaying space-telegraph signals has heretofore been disclosed except such as depend for such efficiency as they may possess upon the use of a metallic screen as a material shield or barrier against the passage of the electromagnetic waves. Without considering in this connection the practical efficiency of such means, it seems sufficient to point out that the present invention does not involve the idea of any material shield or barrier, but rather an electrical organization of the apparatus whereby the desired result may be obtained.

The object of the present invention is to provide a method whereby space-telegraph messages may be automatically relayed. This object I attain by providing two space-telegraph systems of the elevated-conductor type, each comprising a transmitter and receiver, with a relay adapted to be set in motion by the receiver of one system, and thereby to operate the transmitter of the other system, and by so disposing the elevated conductor or conductors of the receiver of the first system and of the transmitter of the second, respectively, that the former will not be operated by the latter. Several different forms of apparatus may within my invention be employed to accomplish this result. Two of these various forms shall hereinafter be fully described. In one of the arrangements the elevated conductors of the transmitter of the second system are so placed that the waves emanating from them produce planes or lines of interference, and the elevated conductor or conductors of the receiver of the first system are placed in these lines or planes of interference and are thereby rendered incapable of being affected by the waves which emanate from the elevated conductors of the transmitter of the second system. The disposition of the elevated conductors in planes or lines of interference is described and claimed in an application filed by me contemporaneously herewith, Serial No. 44,393, renewed February 24, 1902, Serial No. 95,198. In another arrangement the elevated conductors of the receiver of the first system are so disposed relatively to those of the transmitter of the second that the electromagnetic waves emanating from the latter produce equal electric vibrations in the several elevated conductors of the former; but the relay, which is set in motion by the receiver of the first system and which by its motion operates the transmitter of the second, is so associated with the elevated conductors of the receiver of the first system that the effects of the several equal electric vibrations conveyed to it from that transmitter are opposed to each other, and their resultant effect upon the relay is *nil*. The disposition of the elevated conductors last referred to is described and claimed in an application filed by me contemporaneously herewith, Serial No. 44,398.

The nature of the invention and the manner in which it operates may best be understood by having reference to the drawings which accompany and form a part of this specification.

Figure 1 is a diagram illustrative of a disposition of apparatus in which the elevated conductor V of the receiver of one system is placed in the plane of interference of the waves from two elevated conductors V′ V″ of

the transmitter of another system. Fig. 2 is a diagram illustrative of the disposition of apparatus in which the two elevated conductors V′ V″ of the receiver of one system are so disposed as to have equal electric vibrations developed in them by the electromagnectic waves emanating from the vertical wire V of the transmitter of another system and in which the effects of these vibrations are opposed to each other at a relay associated with said receiver of the first system.

In the figures, V V′ V″ are vertically-elevated conductors, M M′ M″ are induction coils or transformers, C C′ C″, &c., are condensers, B B′ are batteries, K is a coherer, R is a relay, *p* is an automatic circuit-interrupter, *s* is a spark-gap, *k* is a contact which is normally open, but which is closed when the relay R is set in motion, and E is an earth connection.

The operation of the coil M′, Figs. 1 and 2, produces a spark at the spark-gap *s*, and electrical oscillations result in the primary of the coil M″, Fig. 1, and M, Fig. 2, by virtue of the condensers C^3, Fig. 1, and C, Fig. 2. The primary coils of M″ are equal in every respect and are symmetrically disposed relative to the two secondary coils of M″. The electrical oscillations in the primary coils of M″ therefore induce equal and opposite electrical vibrations in the two conductors V′ and V″ of Fig. 1, owing to the fact that the two secondary coils of M″ are wound in the same direction and form virtually a continuous coil grounded at its neutral point.

The vertical wire V is connected to the ground at this neutral point, so that it is unaffected by the flow of current through the coil. In Fig. 2 the electrical oscillations in the primary coil M develop electric vibrations in the conductor V. Being symmetrically disposed with reference to the two vertical conductors V′ and V″, the electrical vibrations in it induce equal electrical vibrations in V′ and V″, and these vibrations traversing the primary coils of M″ in opposite directions their effect upon the secondary coil M″ is *nil*.

In the operation of the organization shown in Fig. 1 the electromagnetic signal-waves to be relayed are received from a distant transmitting-station upon the elevated conductor V and develop therein electric vibrations. These vibrations are conveyed to the coherer K through the intermediary of the induction-coil M and cause it to set in motion the relay R in a well-understood manner. The relay R thus set in motion closes the circuit of the battery B at *k* through the interrupter *p* and the primary of the induction or spark coil M′. A high potential is thereby developed in the secondary of the spark-coil M′, and a series of sparks occur at the spark-gap *s*. Oscillations are thereby developed in the circuit containing the condenser C‴ and the primary of the induction-coil M″, which in turn develop equal and opposite electric vibrations in the vertical conductors V′ and V″. These electric vibrations are equal and opposite, because the two halves of the secondary of M″ are equal, and the primary of M″ is symmetrically disposed with respect to these two halves of the secondary. When a given electromagnetic signal-wave has passed the receiver, a decoherer (not shown in the drawings) restores the coherer to its normal state. The electromagnetic waves emanating from the two vertical conductors V′ V″ of the transmitter of the second system do not affect the vertical conductor V of the receiver of the first system, because the two conductors V′ V″ are similar. The two oscillations developed in them are equal in amplitude and opposite in phase, and the vertical conductor V is symmetrically disposed with respect to V′ and V″—*i. e.*, it is in the plane of interference of the waves which emanate from V′ and V″.

In the operation of the organization shown in Fig. 2 the electromagnetic signal-waves to be relayed are received from a distant transmitting-station upon the elevated conductors V′ and V″, which are in a plane approximately that including the distant transmitting-station and are preferably at a distance apart equal to one-half a complete wave length of the electromagnetic waves to be received. Under these circumstances the electric vibrations developed in the two conductors V′ and V″ will be equal in amplitude and opposite in phase. These vibrations are conveyed to the coherer K through the intermediary of the induction-coil or transformer M″ and cause it to operate or set in motion the relay R in the usual manner. The relay R operates to close the circuit of the battery B at *k* through the interrupter *p* and the primary of the induction or spark coil M′. A high potential is thereby induced in the secondary of M′, and a rapid succession of sparks pass at the spark-gap at *s*, causing a high-frequency oscillation in the primary of the induction-coil M, and thereby developing high-frequency electric vibrations in the vertical wire V. When the electromagnetic waves of a given signal have passed the receiver, a decoherer (not shown in the drawings) restores the coherer to its normal condition. The electromagnetic waves emanating from the vertical wire V produce equal electric vibrations in V′ and V″; but owing to the fact that the two halves of the primary of the coil M″ are equal and symmetrically disposed with respect to the secondary these vibrations passing through the two halves of the primary in opposite directions have no resultant effect upon the coherer K, and therefore upon the relay R.

As has been above shown, the elevated conductor of either the transmitter or receiver, or both, may be multiple.

Having fully described my invention, I claim—

The method of relaying space-telegraph signals, which consists in receiving the sig-

nals to be relayed in the receiver of one space-telegraph system of the elevated-conductor type; causing this receiver to thereby operate the transmitter of a second system of the same type, and so respectively electrically organizing and disposing the said receiver and transmitter conductors that the receiver will not be operated by signals sent by the transmitter.

JOHN STONE STONE.

In presence of—
ALEX. P. BROWNE,
ELLEN B. TOMLINSON.