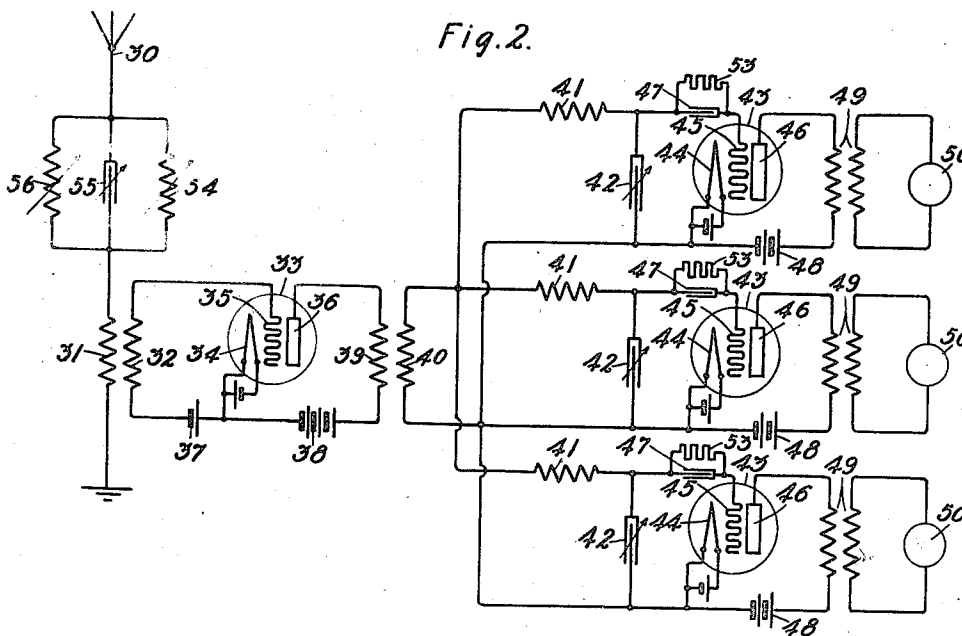
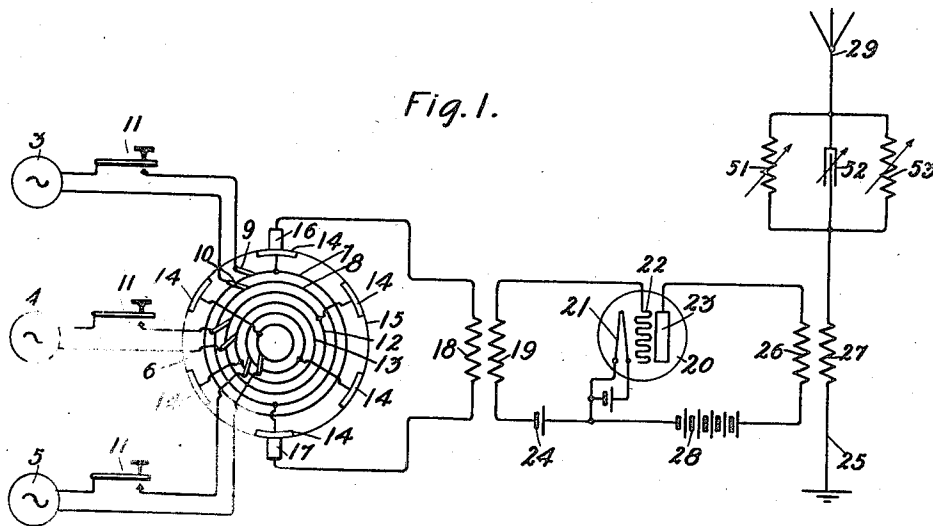


E. H. COLPITTS.
MULTIPLEX RADIOTELEGRAPH SYSTEM.
APPLICATION FILED SEPT. 11, 1915.

1,194,820.

Patented Aug. 15, 1916.



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UNITED STATES PATENT OFFICE.

EDWIN H. COLPITTS, OF EAST ORANGE, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

MULTIPLEX RADIOTELEGRAPH SYSTEM.

1,194,820.

Specification of Letters Patent.

Patented Aug. 15, 1916.

Application filed September 11, 1915. Serial No. 50,173.

To all whom it may concern:

Be it known that I, EDWIN H. COLPITTS, a subject of the King of Great Britain, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Multiplex Radiotelegraph Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to the transmission and reception of radio or wireless signals, and more particularly to multiplex telegraphy, whereby a plurality of messages may be transmitted simultaneously from one station and may be received simultaneously on one antenna or on a plurality of antennae located at the same place or at various places. It has been suggested previously that this may be accomplished by impressing upon the antenna a number of oscillations of different frequencies in succession, and in arranging at the receiving station circuits responsive to these various frequencies, the time elapsing between successive repetitions of the same frequency being so small that a number of such repetitions occur during the time required to make the shortest signal which may occur. It has been further suggested that the impression of the different frequencies upon the radiating antenna may be accomplished by using a rotating commutator at the sending station. In practice, however, much difficulty is encountered by virtue of the fact that the commutator cannot successfully commutate the large amount of power required for radio signaling.

The object of this invention is to overcome commutation difficulties, and this object is attained by passing a small amount of power only through the commutator. Having done this, the low-power high-frequency oscillations are amplified to any desired extent, and impressed upon a suitable antenna for radiation. In order to obtain more efficient selective radiation and reception, it is desirable to give the antenna a number of degrees of freedom corresponding to the number of messages to be simultaneously transmitted or received, and to tune the antenna to the various frequencies to be used.

Referring to the drawing, Figure 1 shows a transmitting station and Fig. 2 shows a receiving station to be used in connection therewith.

In Fig. 1, 3, 4 and 5 represent a plurality of high frequency generators of low power. These generators may be of any suitable or desirable type, such as high frequency dynamos, mercury arc oscillators or thermionic oscillation generators. 6 represents a commutator which is adapted to be rotated at a high speed. 7 and 8 represent two slip rings mounted on said commutator. In contact with said slip rings are two brushes 9 and 10 which connect directly with the generator 3, in the circuit of which is placed a key 11 for interrupting the flow of power from said generator, in accordance with signals to be transmitted. 12 and 13 represent another pair of slip rings, which, by means of suitable brushes, are connected with the generator 4. A similar pair of slip rings is provided for each additional generator used. These generators are adjusted to supply high frequency oscillations of different frequencies. Connected to each slip ring is a segment of conducting material 14, and between each segment is placed insulating material 15. By means of contact brushes 16, 17, a pair of segments is brought into connection with the primary 18 of a transformer the secondary 19 of said transformer being connected to the input circuit of an amplifier. Any suitable type of amplifier may be used, but it has been found that a thermionic amplifier of the audion type is particularly well adapted for the purpose, and 20 shows such an amplifier in which 21 represents the usual heated element, 22 the grid and 23 the plate. The usual battery 24 is shown to determine the potential of the grid 22. The battery 28 is also placed in the output circuit of said amplifier in the usual manner and for the usual purpose of supplying the power required for said output circuit. Usually a plurality of such amplifiers will be connected in parallel to give higher output power. The output circuit of the amplifier is connected to a radiating system 25, by means of the inductive coupling supplied by 26 and 27. The radiating system consists of the elevated conductor 29 or of any other suitable radiating system. This elevated antenna is connected to earth in the usual manner.

Fig. 2 represents the receiving station in which 30 shows the elevated conductor connected to earth, said conductor being constructed similarly to the antenna system at

the sending station. The receiving antenna is inductively connected by means of the inductances 31 and 32 to the input circuit of an amplifier 33. This amplifier may be of any suitable type, but it has been found that a thermionic amplifier of the audion type is well adapted for the purpose. This amplifier is of the same type as that shown in Fig. 1, but obviously will be modified in view of and in accordance with the fact that the amount of power received is very limited. The amplifier has the usual heated element 34, grid 35 and plate 36 with the polarizing battery 37 in the input circuit and the battery 38 for supplying power to the output circuit. Inductively connected to the output circuit of this amplifier, by means of the coils 39 and 40, are a plurality of receiving circuits, each one containing an inductance 41 and a condenser 42. Any one circuit is tuned to the frequency of a corresponding generator at the sending station. Connected to these two receiver circuits are translating circuits of any suitable type. In this case there is shown connected around the condenser 42 a detector 43 of the audion type, with the usual heated element 44, grid 45 and plate 46. The condenser 47, shunted by the high resistance 53, is placed in the input circuit and a power battery 48 in the output circuit. Inductively connected to the output circuit, by means of the transformer 49, is the translating device 50, which may be a telephone head-piece, a sounder or any other suitable translating device.

The operation of the system is as follows: The commutator 6 is set into rapid rotation whereby the generators are brought into connection with the transformer coil 18 in cyclic succession. The speed of the commutator is sufficiently high so that each generator is brought into connection with the coil 18 a number of times in the period required for the shortest signal to occur. The low power oscillations from any generator may then be modified in accordance with signals to be transmitted, and these low power oscillations will then be amplified to any desired extent by means of the amplifier 20. Having been so amplified, high power oscillations are impressed upon the antenna 29 and radiated. For the purpose of more effective radiation, it is desirable to tune the radiating system to each and all of the frequencies to be radiated. This is accomplished by giving the antenna system a number of degrees of freedom corresponding to the number of generators, that is, by making the radiating system more complex. In Fig. 1, one manner of accomplishing this is shown in which the antenna system is given three branches, 51, 52 and 53, each of these branches being of a reactive character. By a suitable adjustment of these reactances 51, 52 and 53, the

radiating system may be tuned to the various frequencies to be radiated. Similarly, at the receiving station the antenna system is given a corresponding number of degrees of freedom and is tuned by means of the reactances 54, 55 and 56, thus rendering the receiving system selectively responsive to the waves to be received.

In general, the power received on the antenna will be so small that it is desirable to amplify it, and provision for this is made by means of the amplifier 33. It is obvious, however, that this amplifying circuit may be omitted without departing from the spirit of this invention. In view of the tuning of the circuits 40, 41 and 42, it is apparent that each circuit will select the oscillations of that frequency coming from the corresponding generator at the sending station, and will not receive the oscillations coming from any other generator.

From the above description it is clear that the difficulties due to commutating large amounts of current in the commutator and breaking such large currents by means of the key 11 are obviated, this being accomplished by generating and modifying low power oscillations and then amplifying this low power.

While in the specification and claims the term "amplifier" has been used, and in the drawing one such amplifier has been shown, it is to be understood that in general a plurality of these amplifiers will be necessary in order to obtain a sufficient amount of power for radiation. These amplifiers may be connected in series or in parallel or both in the manner indicated in such patents as that to Arnold Nos. 1,129,942 and 1,129,943, March 2, 1915.

It is also to be understood that this invention may be used either for wireless communication, as described in the specification, or may be adapted for telegraphy over wires by suitably connecting the present antenna system to any wire telephone system.

What is claimed is:

1. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; means for controlling the circuits of the generators in accordance with signals to be transmitted; means for rendering said generators effective in cyclic and rapid succession; means for amplifying the low power oscillations and an antenna for radiating the high power oscillations.

2. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means for modifying said low power oscillations in accordance with signals; an amplifier; means for impressing said modified low power oscillations from

the generators in cyclic and rapid succession on the input circuit of said amplifier; a radiating antenna associated with the output circuit of said amplifier and means for receiving said signals simultaneously.

3. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means for modifying said low power oscillations in accordance with signals; an amplifier; means for impressing said modified low power oscillations from the generators in cyclic and rapid succession on the input circuit of said amplifier; a radiating antenna associated with the output circuit of said amplifier; a receiving antenna and a plurality of circuits associated therewith, each adapted to receive and translate the signals sent from the corresponding generator.

4. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means associated with each generator; a thermionic amplifier of the audion type; means for connecting said generators in cyclic and rapid succession to the input circuit of said amplifier; a radiating antenna associated with the output circuit of said amplifier; a receiving antenna; a thermionic amplifier of the audion type associated therewith and a plurality of circuits each adapted to receive and translate the signals sent from a corresponding generator.

5. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means associated with each generator; a commutator; a thermionic amplifier of the audion type; connections from said generator to the commutator and connections from the commutator to the input circuit of said amplifier; a radiating antenna associated with the output circuit of said amplifier; a receiving antenna; an amplifier associated therewith and a plurality of circuits each adapted to receive and translate the signals sent from a corresponding generator.

6. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means associated with each generator; a commutator; a thermionic amplifier of the audion type; connections from each generator to the commutator and connections from the commutator to the input circuit of said amplifier; a radiating antenna associated with the output circuit of said amplifier; a receiving antenna; a thermionic amplifier of the audion type having its input circuit connected to said receiving an-

tenna; a plurality of receiving circuits each tuned to the frequency of the corresponding generator at the sending station and connected to the output circuit of the amplifier and a translating device connected to each receiver circuit.

7. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means connected to each generator; a rotating commutator; a transformer; connections from each generator to the commutator and connections from the commutator to the transformer whereby the transformer is supplied with low power, high frequency oscillations from the generators in succession; a thermionic amplifier of the audion type having its input circuit connected to the secondary of the transformer; a radiating antenna, adapted to radiate a plurality of frequencies, connected to the output circuit of the amplifier; a similar receiving antenna; a thermionic amplifier of the audion type having its input circuit connected to said antenna; a plurality of receiver circuits each tuned to the frequency of a corresponding generator at the sending station and connected to the output circuit of the amplifier and a translating device connected to each of said receiver circuits.

8. In a multiplex radio signaling system, a plurality of generators of low power oscillations of high but differing frequencies; signaling means connected to each generator; a rotating commutator; a transformer; connections from each generator to the commutator and connections from the commutator to the transformer, whereby the transformer is supplied with low power high frequency oscillations from the generators in succession; a thermionic amplifier of the audion type having its input circuit connected to the secondary of the transformer; a radiating antenna tuned to the frequencies of the plurality of generators and inductively connected to the output circuit of the amplifier, a similar receiving antenna, a thermionic amplifier of the audion type having its input circuit inductively connected to said antenna; a plurality of receiver circuits, each being tuned to the frequency of the corresponding generator at the sending station and inductively connected to the output circuit of the amplifier; a detector of the audion type connected to each of said tuned circuits and a translating device connected to each of said detectors, all as and for the purpose described.

In witness whereof, I hereunto subscribe my name this 7th day of September A. D., 1915.

EDWIN H. COLPITTS.