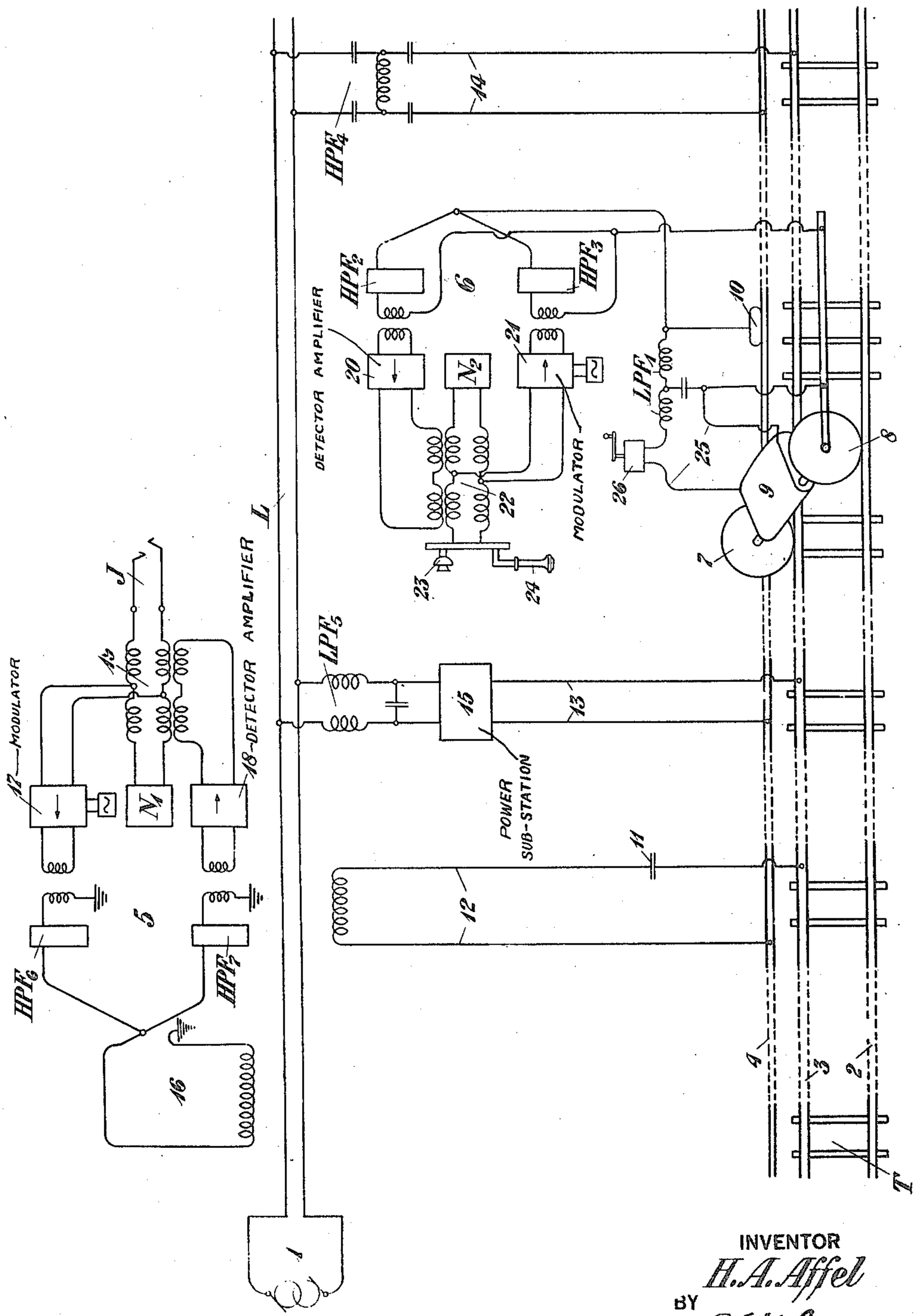
July 1, 1924. 1,499,438

H. A. AFFEL

SYSTEM OF COMMUNICATION WITH MOVING VEHICLES

Filed June 18, 1921



INVENTOR
H. A. Affel
BY
J. E. Yoke
ATTORNEY

Patented July 1, 1924. 1,499,438

UNITED STATES PATENT OFFICE.

HERMAN A. AFFEL, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SYSTEM OF COMMUNICATION WITH MOVING VEHICLES.

Application filed June 18, 1921. Serial No. 478,597.

To all whom it may concern:

Be it known that I, HERMAN A. AFFEL, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Systems of Communication with Moving Vehicles, of which the following is a specification.

This invention relates to systems of communication and more particularly to improved arrangements for communicating with moving vehicles, such as railway trains.

In the arrangements of the invention the same medium is utilized for conveying the telephone or signal currents to the moving vehicle as that used for supplying the motive power thereto, such for example as a third rail or an overhead high tension power wire. Furthermore in order to prevent the power current from causing disturbance in the message and so that a plurality of messages may be transmitted simultaneously, the message or telephone current is superimposed on a high frequency carrier current. In the invention arrangements are also provided for improving the transmission by transmitting the message currents primarily over the high tension power wire and applying them at frequent intervals through intermediate circuits to the third rail and vehicle, thereby avoiding large attenuation which would result if the message currents were applied directly to the third rail. Other features of the invention will appear more fully from the detailed description hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in which is illustrated a circuit diagram of a preferred embodiment thereof.

The drawing shows an electric railway system comprising the track T having the rails 2 and 3 and the third rail 4. Running in the vicinity of the track is the high tension power line L which is connected to a power supply 1 at a terminal station. Current is supplied to the third rail from the high tension power line at intervals along the route by auxiliary circuits and power sub-stations, such as the circuit 13 and the power sub-station 15. It is advantageous to have a primary distribution system, such as the high tension power line L, and frequent cross connections to the third rail, such as circuit 13, as considerable saving of energy may be thus effected which would otherwise be impossible due to the higher resistance of the third rail. The power sub-stations, such as 15, in these auxiliary circuits serve to translate the high tension power current into current suitable for operating the car motor. The car wheels 7 and 8 are shown supporting the motor 9. Current is supplied to the motor from the third rail by a brush 10 in contact with said rail and over circuit 25. In circuit 25 is a controller 26 and the low pass filter LPF_1. This filter and the other filters hereinafter referred to are of the band filter type, disclosed in the U. S. Patent No. 1,227,113 to G. A. Campbell, and will readily transmit frequencies within a certain range but will attenuate and extinguish frequencies outside of said range. The band filter LPF_1 will pass the power currents but will prevent the other currents, such as signaling currents, from being transmitted therethrough. In the circuit 13 is the filter LPF_5 which will allow the transmission of the high tension power currents but will attenuate and extinguish the signaling currents of carrier frequency utilized.

The telephone transmitting and receiving arrangements 6 are provided in the car. These arrangements are associated with the brush 10 and include the high pass filters HPF_2 and HPF_3 which will prevent the power currents from interfering with the telephone apparatus but which will readily allow the transmission of the telephone currents. There is provided in the receiving branch a detector and amplifier arrangement, shown schematically as 20 as any suitable detecting and amplifying arrangement may be used. In the transmitting branch is provided a modulating arrangement, such as 21, whereby the low frequency telephone currents may be superimposed upon a carrier channel of higher frequency. This modulating device may be of the duplex vacuum bulb type illustrated in the U. S. patent to John R. Carson, No. 1,343,307, although other well known types might be utilized. The transmitting and receiving branches are associated with a hybrid coil 22 with which is associated the usual type of balancing network N_2 and the telephone transmitter 23 and the receiver 24.

At some desirable point would be located the stationary telephone station 5. This

station would be inductively related to the high tension line L by means of circuit 16. Station 5 would include the high pass filters HPF_6 and HPF_7 similar to HPF_2 and HPF_3, a modulating device 17 similar to 21 and amplifying and detecting arrangements 18 similar to 20. There would also be provided the hybrid coil 19, a balancing network N_1 and a jack J to which might be connected telephone apparatus. The high frequency carrier currents which would be transmitted from station 5 would be transmitted inductively through circuit 16 to the line L. As is well known, whenever a coil or a length of wire through which a current is flowing is placed in the vicinity of a pair of conductors in a circuit, electromotive forces will be induced in said conductors. If conditions of prefect balance existed between the conductors in the circuit, these electromotive forces might neutralize each other. However, this would be the exception, and, in general, a series component would result which would give a current flow in the circuit in series over said pair of conductors. The high frequency carrier currents accordingly would flow over the wires L in series. These currents would be transmitted from line L to the third rail over a number of auxiliary circuits, such as 12 and 14. Circuit 12 is inductively related to line L while circuit 14 is bridged across said line. While alternative arrangements have thus been shown either or both types may be employed. In each of these circuits would be selective arrangements which would readily allow transmission of the telephone currents but which would attenuate and extinguish the power currents. These selective arrangements are shown in circuit 14 as the high pass filter HPF_4 and in circuit 12 as the condenser 11 and an inductance. It is pointed out that auxiliary circuits of the type of 12 or 14 would be provided at frequent intervals along the route of the car so that there would be frequent cross connections between the primary distribution system L and the third rail. As the line L is of copper and is relatively large it furnishes an excellent transmission path for the telephone currents and produces relatively small attenuation. If the telephone system was connected directly to the third rail the steel rail on the other hand would cause considerable attenuation in the telephone currents. Accordingly with the arrangements of this invention by providing a primary distribution line of low attenuation with frequent cross connection to the third rail, it is possible to save considerable energy and to give greatly improved transmission in a system of this character.

The power circuit for the arrangements disclosed may be traced as follows: from the power source 1, over the high tension primary distribution line L, and thence over one of the circuits, such as 13, and through the sub-power station 15 where the high tension power currents will be translated into low tension currents suitable for operating the car motor. These currents will be transmitted from circuit 13 to the third rail and the grounded car tracks. From the third rail these currents will be transmitted through the brush 10, through the low pass filter LPF_1, and over circuit 25 to the motor 9, thereby cperating the motor and driving the car. The telephone currents transmitted from station 5 to station 6 on the moving car will be transmitted over the following path: from telephone apparatus (not shown) associated with jack J, to the modulating apparatus 17, where the telephone currents will be superimposed upon a high frequency carrier current and thence through the high pass filter HPF_6 to the circuit 16. From the circuit 16 these currents will be transmitted by induction to the line L and thence over one of the auxiliary circuits, such as 14, to the third rail and one of the grounded rails. From the third rail these telephone currents will be transmitted to the shoe 10, through the high pass filter HPF_2 to the detecting and amplifying apparatus 20 and thence through the hybrid coil 22 to the telephone receiver 24. Currents transmitted from the moving telephone station 6 would be transmitted over the following path: from the transmitter 23 to the modulating apparatus 21 where these currents would be superimposed upon a high frequency carrier current and thence through the high pass filter HPF_3, through the shoe 10, to the third rail; from the third rail over one of the circuits, such as 14 or 12, to the high tension line L; from the high tension line L these currents would be transmitted by induction to the circuit 16 and thence through the high pass filter HPF_7 to the detecting and amplifying apparatus 18, and through the hybrid coil 19 to the telephone receiving apparatus which might be connected to the jack J.

While the invention has been disclosed in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a system for communicating with moving vehicles, a high tension electric power line, a secondary distribution line associated with said high tension line, a moving vehicle having a connection from said secondary line to telephone apparatus in said vehicle, a plurality of auxiliary circuits suitable for the transmission of telephone currents interconnecting said high tension line

and said secondary line at frequent intervals along the route of said lines, and means for applying telephone current to said high tension line.

2. In a system for communicating with moving vehicles, a high tension electric power line, a telephone station associated with said line whereby high frequency carrier current molulated by message currents may be impressed on said power line, a secondary distribution line, a plurality of auxiliary circuits suitable for the exclusive transmission of said telephone currents interconnecting said high tension line and said secondary line at frequent intervals along the route of said lines, a plurality of auxiliary circuits suitable for the exclusive transmission of power currents interconnecting said high tension line and said secondary line at frequent intervals along the route of said lines, a moving vehicle having connecting means with said secondary line, and carrier current telephone apparatus in said vehicle connected to said connecting means.

In testimony whereof, I have signed my name to this specification this 16th day of June, 1921.

HERMAN A. AFFEL.