

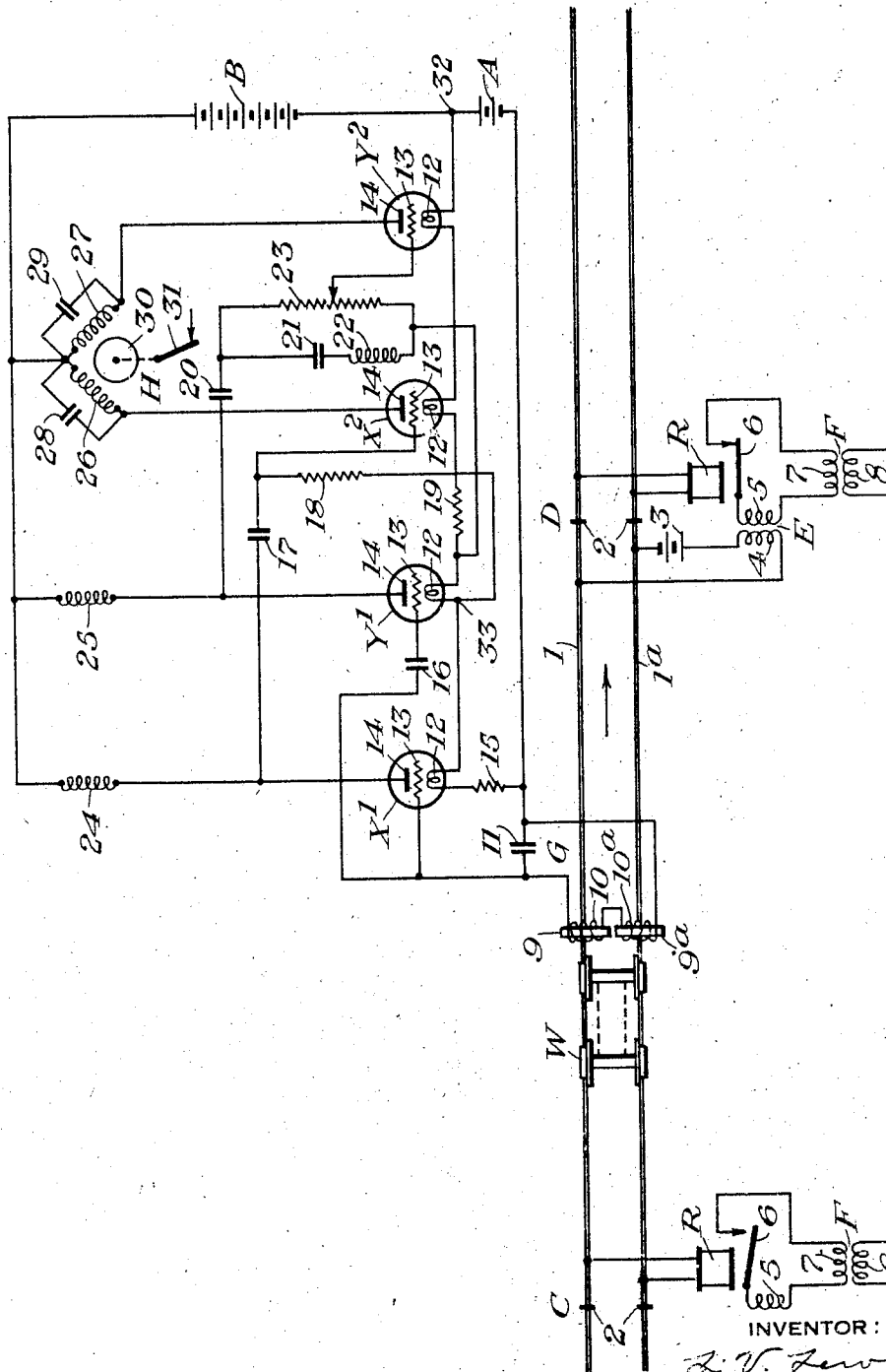
Dec. 22, 1925.

1,566,331

L. V. LEWIS

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed April 11, 1925



INVENTOR:
J. V. Lewis,
BY A. Z. Tennill
His ATTORNEY

UNITED STATES PATENT OFFICE.

LLOYD V. LEWIS, OF EDGEWOOD BOROUGH, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed April 11, 1925. Serial No. 22,295.

To all whom it may concern:

Be it known that I, LLOYD V. LEWIS, a citizen of the United States, residing at Edgewood Borough, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Railway-Traffic-Controlling Apparatus, of which the following is a specification.

My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type comprising governing means carried on a train and controlled by alternating current received from the trackway.

One feature of my invention is the provision in apparatus of this nature of means for controlling an induction motor relay by a single phase source of current received from the track.

I will describe one form of apparatus embodying my invention, and will then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of apparatus embodying my invention.

Referring to the drawing, the reference characters 1 and 1^a designate the track rails of a railway along which traffic normally moves in the direction indicated by the arrow. These rails are divided by insulated joints 2 into a plurality of track sections, of which only one complete section C—D is shown in the drawing. Each section is provided with a track circuit comprising a track battery 3 and a track relay R. The rails of each section are also supplied with alternating train controlling current under the control of traffic conditions in advance of the section. As here shown, this latter current is furnished by interposing between the track battery 3 and one rail 1, the secondary 4 of a transformer E, the primary 5 of which is at times supplied with alternating train controlling current from the secondary 7 of a transformer F. The primary 8 of each transformer F is constantly connected with a source of alternating current which is not shown in the drawing. The circuit for the primary 5 of each transformer E includes a front contact 6 of the track relay R for the track section next in advance, so that alternating train controlling current

is supplied to the rails of a section when the section next in advance is unoccupied but not when such section next in advance is occupied.

As shown in the drawing, section C—D is occupied by a train W. Located in advance of the forward wheels and axle of this train are a pair of cores 9 and 9^a disposed above the two rails 1 and 1^a respectively, which cores carry windings 10 and 10^a respectively. The windings 10 and 10^a are connected in a pick-up circuit G in such manner that the alternating currents induced in these windings by train controlling current in the track rails are additive. The pick-up circuit G includes a condenser 11, and this condenser, together with the two windings 10 and 10^a, are preferably tuned to resonance at the frequency of the train controlling current.

The train governing apparatus includes a relay H of the induction motor type, comprising two stator windings 26 and 27, and a rotor 30 which operates a contact 31. The supply of current to the stator winding 26 of relay H is controlled by the voltage across condenser 11, through the medium of a two-stage amplifier comprising tubes X' and X². The supply of current to the other stator winding 27 of relay H is similarly controlled by the voltage across condenser 11, through the medium of a two-stage amplifier comprising amplifier tubes Y' and Y².

In a train control system of the type to which the present invention relates, an induction motor relay is preferable to a direct current relay, because of the fact that the induction motor relay is immune to shock and vibration, and has desirable selective frequency characteristics. The induction motor relay operates efficiently only when it is supplied with two-phase energy. It is, of course, possible to energize an induction motor relay from a single phase source by incorporating phase splitting devices within the relay, but such devices are necessarily inefficient and increase the total power consumed by the relay to a point beyond the output available from an ordinary vacuum tube amplifier. It is also possible to operate an induction motor relay efficiently by providing a separate two-stage amplifier for each phase, but when an effort

is made to split the phases in the input circuits to said amplifiers difficulty is encountered due to loss of efficiency because of the extremely minute energy available in the pick-up circuit G. In my invention I eliminate these difficulties by providing a two-stage amplifier for each winding of the induction motor relay and incorporating a phase-splitting device between the first and second stages of one amplifier.

As illustrated in the drawing, the filaments 12 of the four amplifier tubes are connected in series, together with limiting resistances 15 and 19, across a filament battery A. The voltage across condenser 11 in the pick-up circuit G is impressed across the grid and filament of the amplifier tube X'. The grid 13 of this tube is maintained at a fixed negative direct current potential with respect to the filament 12 of the same tube by an amount equal to the drop in potential due to the filament current flowing in resistance 15. That is to say, grid 13 of tube X' is connected directly with one terminal of condenser 11, and filament 12 of this tube is connected with the other terminal of condenser 11 through the resistance 15. With the grid 13 thus made negative with respect to the filament, oscillations can be maintained in the input circuit of tube X' without loss of energy by conduction from grid 13.

Amplifier tube X' is provided with a plate circuit which includes a plate battery B having one terminal connected with the plate 14 of tube X' through a reactance 24, and the other terminal connected with the filament circuit at point 32. The amplified voltage variations in this plate circuit appear as a variation in potential between the plate 14 and the filament 12 of tube X', which potential is impressed through a condenser 17 across the grid and filament of tube X². The function of condenser 17 is to block the positive battery potential from the grid of tube X². The grid of tube X² is provided with a negative bias by being connected through a grid leak resistance 18 to the filament circuit at points 33 which is negative with respect to the negative end of the filament 12 of tube X², the amount of negative bias in this instance being represented by the drop across the resistance 19 and the filament 12 of tube Y'.

The tube X² is provided with a plate circuit which includes the plate battery B and the stator winding 26 of relay H.

The amplifier circuits associated with the other winding 27 of relay H differ from those associated with winding 26 in two particulars. The grid of tube Y' would have an excessive negative bias if it were connected directly to condenser 11, and, consequently, a blocking condenser 16 is interposed. The other difference between the

amplifier circuits is that the output circuit for tube Y' contains the phase shifting means.

The plate circuit for tube Y' includes the plate battery B and a reactance 25. The output circuit for tube Y' passes from plate 14 of this tube, through a condenser 20, a second condenser 21, and a reactance 22 to the filament 12 of tube Y'. I will first assume for purposes of discussion that condenser 21 is omitted. The output circuit comprising condenser 20 and reactance 22 are tuned to resonance at the frequency of the alternating train controlling current, and so a voltage will be built up across reactance 22 which is greater in amplitude than the voltage across the plate and filament of tube Y' and is approximately in quadrature relation to the latter voltage. This voltage across reactance 22 is impressed across the grid and filament of tube Y². To accomplish this, a high resistance 23 is connected across the terminals of reactance 22 (the actual circuit including condenser 21). The grid 13 of tube Y² is connected adjustably with any desired point on resistance 23, and the filament 12 of tube Y² is connected with reactance 22, through filament 12 of tube X² and resistance 19. This arrangement provides a ready means for adjusting the voltage impressed upon the grid and filament of tube Y² by properly choosing the point at which the grid 13 is connected with resistance 23, and this adjustment will not disturb the phase of the voltage impressed across the grid and filament of tube Y². As pointed out hereinbefore, the voltage will be approximately in quadrature relation to the corresponding voltage impressed upon the grid and filament of tube X². The negative bias of the grid of tube Y² is obtained by a blocking condenser 21, but it is necessary that the grid circuit for tube Y² include a high resistance as it is in multiple with the input circuit of this tube. Inasmuch as resistance 23 and reactance 22 may be of low resistance to direct current, I interpose the blocking condenser 21 between the condenser 20 and the reactance 22. The capacity of the blocking condenser 21 should be about ten times as great as that of condenser 20, so that it will have but slight effect upon the resonance between condenser 20 and reactance 22 and may in effect be compensated for by the proper adjustment of reactance 22.

The plate circuit of tube Y² includes winding 27 of relay H. It will be evident, therefore, that the currents supplied to the two relay windings 26 and 27 will be approximately in quadrature, so that the operation of this relay is efficient.

Each winding 26 and 27 of relay H is preferably tuned to resonance at the frequency of the train controlling current by condensers 28 and 29 respectively.

Although I have herein shown and described only one form of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Train carried apparatus comprising a pick-up circuit receiving alternating current from the trackway, an induction motor relay, a two-stage amplifier interposed between said circuit and one winding of said relay, a two-stage amplifier interposed between said circuit and the other winding of said relay, and means located between the two stages of one of said amplifiers for displacing the phase of the current supplied to the associated relay winding with respect to the phase of the current supplied to the other relay winding.

2. Train carried apparatus comprising a pick-up circuit receiving alternating current from the trackway, an induction motor relay, a two-stage amplifier interposed between said circuit and one winding of said relay, a two-stage amplifier interposed between said circuit and the other winding of said relay, and means associated with the input circuit the second stage of one of said amplifiers for displacing the phase of the current supplied to the associated relay winding with respect to the phase of the current supplied to the other relay winding.

3. Train carried apparatus comprising a pick-up circuit receiving alternating current from the trackway, an induction motor relay, a two-stage amplifier interposed between said circuit and one winding of said relay, a two-stage amplifier interposed between said circuit and the other winding of said relay, and means for tuning the output circuit of the first stage of one of said ampli-

fiers to resonance at the frequency of said alternating current for displacing the phase of the current supplied to the associated relay winding with respect to the phase of the current supplied to the other relay winding.

4. Train carried apparatus comprising a pick-up circuit receiving alternating current from the trackway, an induction motor relay, a two-stage amplifier interposed between said circuit and one winding of said relay, a two-stage amplifier interposed between said circuit and the other winding of said relay, the output circuit of the first stage of one of said amplifiers containing a condenser and a reactance tuned to resonance at the frequency of said alternating current, a resistance connected across said reactance, and the input circuit for the second stage of the same amplifier being connected across one terminal of said reactance and a point on said resistance.

5. Train carried apparatus comprising a pick-up circuit receiving alternating current from the trackway, an induction motor relay, a two-stage amplifier interposed between said circuit and one winding of said relay, a two-stage amplifier interposed between said circuit and the other winding of said relay, the output circuit of the first stage of one of said amplifiers containing two condensers and a reactance connected in series and tuned substantially to resonance at the frequency of said alternating current, a resistance connected across that part of the resonant circuit which includes condenser and reactance, the grid of the second stage of the same amplifier being connected with a point on said resistance and the filament of the said second stage of the same amplifier being connected with said reactance through the filament of the second stage of the other amplifier and a resistance.

In testimony whereof I affix my signature.

LLOYD V. LEWIS.