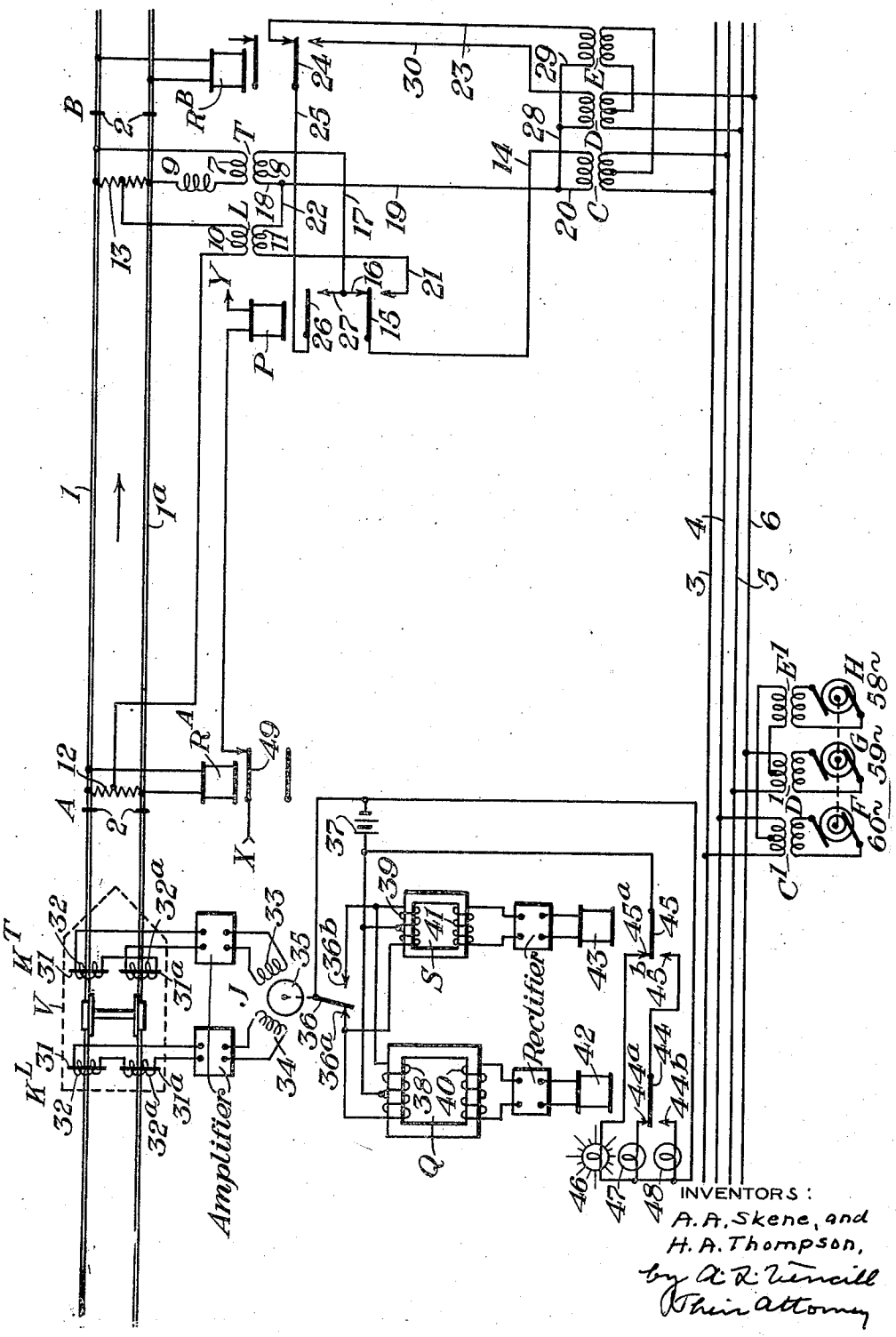
March 20, 1928.

1,663,222

A. A. SKENE ET AL

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 20 1926



Patented Mar. 20, 1928. 1,663,222

UNITED STATES PATENT OFFICE.

ANDREW A. SKENE, OF WILKINSBURG, AND HOWARD A. THOMPSON, OF EDGEWOOD BOROUGH, PENNSYLVANIA, ASSIGNORS TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed December 20, 1926. Serial No. 155,844.

Our invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type comprising train carried governing means controlled by energy received from the trackway.

We will describe one form of railway traffic controlling apparatus embodying our invention, and will then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view illustrating one form of railway traffic controlling apparatus embodying our invention.

Referring to the drawing, the reference characters 1 and 1^a designate the track rails of a stretch of railway track over which traffic normally moves in the direction indicated by the arrow. These rails are divided, by means of insulated joints 2, into a plurality of successive track sections, only one of which, A—B, is shown in the drawing. Each track section is provided with a track relay designated by the reference character R with an exponent corresponding to the location, and connected across the rails adjacent the entrance end of the section. Associated with relay R^A is a repeater relay P which is connected with terminals X and Y of a suitable source of energy, not shown in the drawing, over front contact 49 of relay R^A. Relay P is therefore energized only when relay R^A is energized.

A track transformer T has its secondary 7 constantly connected across the rails adjacent the exit end of section A—B through the usual impedance 9. Section A—B is therefore provided with a track circuit comprising the secondary 7 of transformer T, impedance 9, relay R^A and the rails of the section in series. The section is also provided with a loop circuit over which current is supplied to the rails of the section in parallel. For this purpose two impedances 12 and 13 are connected across the rails adjacent the entrance end and the exit end, respectively, of the section, and secondary 10 of a loop transformer L is connected with the mid-point of these impedances.

Alternating currents are supplied to the trackway through a plurality of transformers C, D and E. The primary of transformer C is supplied with alternating current of one frequency from an alternator F, through a transformer C^1, over line wires 3 and 4. Transformer D is supplied with alternating current through a transformer D^1 from an alternator G, over line wires 5 and 6. A third alternator H supplies alternating current to the primary of a transformer E^1, the secondary of which is connected with the mid-points of the secondaries of transformers C^1 and D^1. Transformer E has its primary connected from the mid-point of the primary of transformer C to the mid-point of the primary of transformer D. It will therefore be plain that the primary of transformer E is supplied with alternating current from transformer E^1, over a phantom circuit through wires 3, 4, 5 and 6. The alternators F, G and H are arranged to supply alternating currents of slightly different frequencies. These frequencies may have any suitable values, but for purposes of explanation we will assume that alternator F delivers current of 60-cycles per second, that alternator G delivers current of 59 cycles per second, and that alternator H delivers current of 58 cycles per second. In order to maintain constant the relative values of the frequencies of the currents delivered by the three alternators F, G and H, we preferably connect the alternators mechanically.

When section A—B is unoccupied, so that relay R^A and relay P are energized, current is supplied from transformer C to the primary 8 of transformer T over a circuit which passes from the secondary of transformer C, through wire 14, front contact 15 of relay P, wires 16 and 17, primary 8 of transformer T, and wires 18, 19 and 20, back to the secondary of transformer C. When section A—B is occupied, however, so that relay R^A is de-energized, thereby de-energizing relay P, the circuit just traced for transformer T is open, and current flows from the secondary of transformer C through wire 14, back contact 15 of relay P, wire 21, winding 11 of loop transformer L, and wires 22, 19 and 20, back to the secondary of transformer C. Furthermore, if relay R^B is energized when relay P is de-energized, current flows from the secondary of transformer E, through wire 23, front contact 24 of relay R^B, wire 25, back contact 26 of relay P, wires 27 and 17, primary 8 of transformer T and wires 18, 19, 28 and 29, back to the secondary of transformer E.

If, however, relay R^B is de-energized, as by the presence of a train in the section to the right of point B, and if relay P is de-energized, current flows from the secondary of transformer D, through wire 30, back contact 24 of relay R^B, wire 25, back contact 26 of relay P, wires 27 and 17, primary 8 of transformer T, and wires 18, 19 and 28, back to the secondary of transformer D.

It will be plain from the foregoing explanation that when section A—B is unoccupied, transformer T is supplied with current from transformer C so that the track circuit of this section is supplied with 60-cycle current. Under these conditions, the circuit for primary 11 of transformer L is open at back contact 15 of relay P, so that no current is supplied to the loop circuit for section A—B. When the section A—B is occupied, however, current is supplied to the primary of transformer L from transformer C so that under these conditions the loop circuit of section A—B is supplied with 60-cycle current. At the same time the primary of transformer T is connected with transformer D or with transformer E, depending upon the condition of relay R^B so that the track circuit for section A—B is supplied with alternating current of 59 cycles or 58 cycles depending upon traffic conditions in advance.

The reference character V designates a train which is provided with two receivers K^T and K^L, each comprising two magnetizable cores 31 and 31^a carried in inductive relation with the two track rails 1 and 1^a respectively. Each of the cores 31 is provided with a winding 32 and each of the cores 31^a is provided with a similar winding 32^a. The receiver K^T is located in advance of the forward axle of the train and the windings 32 and 32^a of this receiver are connected in series in such manner that the voltages induced therein by current which flows in opposite direction in the two track rails at an instant are additive. This receiver may therefore be called a track receiver because it is responsive to alternating current supplied to the track circuit of the section occupied by the train. The windings 32 and 32^a of the receiver K^L are connected in series in such manner that the voltages induced therein by alternating currents which flow in the same direction in the track rails at an instant are additive. This receiver may therefore be called the loop receiver because it is responsive to loop current in the track rails of the section occupied by the train. The track receiver K^T and the loop receiver K^L are connected, through amplifiers of any suitable type, with the windings 33 and 34, respectively, of an induction motor relay J. This relay is provided with an armature 35 which swings a contact 36 in one direction or the other depending upon the relative polarity of the alternating currents supplied to windings 33 and 34.

When the train V occupies a section which is supplied with loop current and with track circuit current, it will be plain that currents of corresponding frequencies will be supplied to windings 34 and 33 of relay J. As a result the contact 36 will be swung in one direction each time the currents in windings 33 and 34 are in phase and will be swung in the opposite direction each time the currents in these windings are 180° out of phase. It will be plain therefore that the frequency of oscillation of the contact 36 of relay J will correspond to the difference between the frequencies of the currents supplied to windings 33 and 34. In other words, the frequency of oscillation of contact 36 will be equal to the beat frequency of the currents in the two windings of the relay J. If the track circuit is being supplied with 58-cycle current and the loop circuit is being supplied with 60-cycle current the beat frequency will be two cycles per second and the frequency of oscillation of relay J will also be two cycles per second. If, however, the track circuit is being supplied with 59-cycle current and the loop circuit is being supplied with 60-cycle current, the beat frequency will be one cycle per second and relay J will oscillate once per second.

The train may be provided with decoding apparatus of any suitable type which is selectively responsive to the frequency of oscillation of the relay J. As shown in the drawing this decoding apparatus is similar to that shown and described in an application for Letters Patent of the United States, Serial No. 112,491, filed May 29, 1926, by Clarence S. Snavely, for railway traffic controlling apparatus. This apparatus comprises two transformers Q and S, the primaries 38 and 39 of which are supplied with periodically reversed direct current from a battery 37 under the control of contact 36 of relay J. As shown in the drawing, when contact 36 swings to the left to close contact 36—36^a current flows through the left-hand portions of primary 39 of transformer S and primary 38 of transformer Q in one direction, and when contact 36 swings to the right to close contact 36—36^b, current from battery 37 flows in the opposite direction through the right-hand portions of primaries 38 and 39. The secondary 41 of transformer S is connected through a rectifier with a relay 43, and the secondary 40 of the transformer Q is connected through a rectifier with a relay 42. It will therefore be plain that the flux in the transformers Q and S is periodically reversed at the frequency of oscillation of contact 36.

The parts are so proportioned that when relay J is operating at one cycle per second

to reverse the flux in transformer Q once per second, the core of the transformer is substantially saturated and relay 42 is supplied with sufficient energy to pick up the relay. It follows that relay 42 will also be energized when the flux is being reversed twice per second as when relay J is operating upon a beat frequency of two cycles per second. Transformer S is so proportioned that when the flux in the transformer is being reversed twice per second, its core is substantially saturated, and sufficient energy is supplied to relay 43 to pick up the relay. When the flux in transformer S is being reversed once per second, however, relay 43 is de-energized, because the reversals of flux are of the same amplitude as when this flux is being reversed twice per second, due to the saturation of the core, and since they are less rapid the energy supplied to relay 43 is not sufficient to energize the relay. The relays 42 and 43 control governing means of any suitable type. In the form here shown a proceed lamp 46 is supplied with energy from battery 37, over front contact 45—45^a of relay 43, a caution lamp 47 is supplied with energy from battery 37 over back contact 45—45^b of relay 43 and front contact 44—44^a of relay 42, and a stop lamp 48 is supplied with energy over back contact 45—45^b of relay 43 and back contact 44—44^b of relay 42.

We will now assume that train V enters section A—B and that track relay R^B is energized. Relay R^A becomes de-energized, thereby opening the circuit for relay P and causing that relay to become de-energized. 60-cycle current is therefore supplied to the loop circuit and 58-cycle current is supplied to the track circuit of section A—B. Windings 34 and 33 of relay J are therefore energized by currents of 60-cycles and 58-cycles respectively, so that the beat frequency at which the contact 36 oscillates is two cycles per second. Under these conditions, relays 42 and 43 are both energized so that the proceed lamp 46 is lighted. If, however, relay R^B is de-energized, the loop circuit of section A—B is supplied with 60-cycle current as before, but the track circuit of this section is supplied with 59-cycle current so that the beat frequency to which the relay J responds is equal to one cycle per second. With relay J operating at this frequency, relay 43 is de-energized but relay 42 is energized so that the caution lamp 47 is lighted. If the train enters an occupied section where it will be deprived of track circuit current or if it is deprived of loop current or if for any other reason the relay J ceases to oscillate, relays 42 and 43 will both be de-energized so that the lamp 48 will be lighted to indicate stop.

When the train leaves the section, the 59 cycle current supplied to the track circuit from transformer D, energizes relay R^A, thereby closing relay P and restoring the apparatus to its normal condition.

Although we have, in describing the apparatus embodying our invention, referred to a number of frequencies for the alternating currents supplied to the trackway and for the beat frequencies to which the relay J is responsive it should be particularly pointed out that these particular frequencies are not essential, and have been specified simply for purposes of explanation. Furthermore, it should be noted that although we have herein shown and described apparatus which supplies only two different frequencies to the track circuit we do not limit ourselves to this number but that additional frequencies may be supplied to the track circuit to operate relay J at an additional number of frequencies to obtain upon the train an increased number of indications.

Although we have herein shown and described only one form of railway traffic controlling apparatus embodying our 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 our invention.

Having thus described our invention, what we claim is:

1. Railway traffic controlling apparatus comprising means for supplying the trackway with two alternating currents of different frequencies, two train carried receivers separately responsive to such currents, a relay having two windings supplied with energy from the two receivers respectively, and governing means controlled by said relay in accordance with the relation between the frequencies of said currents.

2. In combination, a stretch of railway track, two trackway circuits for said stretch, means for supplying one circuit with alternating current of a first frequency, means for supplying the other circuit with alternating currents of different frequencies, two train carried receivers separately responsive to the currents in said circuits, and governing means controlled by said receivers in accordance with the difference between the frequencies of the currents supplied to said circuits.

3. Railway traffic controlling apparatus comprising means for supplying the trackway with two alternating currents of different frequencies, a train carried member arranged to oscillate at different frequencies depending upon the difference between the frequencies of said currents, and governing means on the train responsive to the frequency of oscillation of said member.

4. Railway traffic controlling apparatus comprising a train carried relay having two windings, means located in the trackway for

causing alternating currents of different frequencies to flow in said windings, said relay having a movable member which is subjected to the vibromotive forces due to the joint action of such currents, and governing means selectively responsive to the frequency of oscillation of said member.

5. In combination, a stretch of railway track, two trackway circuits for said stretch, means for supplying one circuit with alternating current of a first frequency, means for supplying the other circuit with alternating currents of different frequencies, and means on the train selectively responsive to the difference between the frequencies of the currents in such circuits but not responsive to the current in either such circuit alone.

6. In combination, a stretch of railway track provided with a loop circuit and a track circuit, means for at times supplying alternating current of one frequency to the loop circuit, means for supplying alternating currents of different frequencies to the track circuit, and governing means on a train selectively responsive to the difference between the frequencies of the currents in the loop and track circuits.

7. In combination, a stretch of railway track provided with a loop circuit and a track circuit, means for normally supplying the track circuit with alternating current of one frequency, means effective when a train occupies the stretch to supply alternating current of such one frequency to the loop circuit, and to supply the track circuit with alternating currents of different frequencies depending upon traffic conditions, and governing means on the train selectively responsive to the difference between the frequencies of the currents in such circuits.

8. In combination, a forward and a rear section of railway track, a track relay responsive to traffic conditions in the forward section, a track transformer having its secondary connected across the rails of the rear section, a first impedance and a second impedance connected across the rails adjacent the entrance end and the exit end, respectively of the rear section, a loop transformer having its secondary connected with such impedances, two sources of alternating current of different frequencies, means for at times connecting one said source with the primary of the track transformer, and means for at other times connecting such one source with the primary of the loop transformer and for connecting the remaining source with the primary of the track transformer.

9. Railway traffic controlling apparatus comprising an induction motor relay having two windings and a movable armature, means located in the trackway for supplying alternating currents of different of different frequencies to such two windings, and governing means controlled by the armature and responsive to the beat frequency of such currents.

10. Railway traffic controlling apparatus comprising means for supplying the trackway with two alternating currents of different frequencies, a member arranged to oscillate at the beat frequency of such currents, and governing means responsive to the frequency of oscillation of such member.

11. In combination, a section of railway track, a loop circuit for such section, a track circuit for such section, means for supplying the loop circuit with alternating current of a single frequency, means for supplying alternating currents of different frequencies to the track circuit, and governing means controlled jointly by the currents in the loop circuit and the track circuit.

12. In combination, a section of railway track, a loop circuit for such section, a track circuit for such section, means for supplying the loop circuit with alternating current of a single frequency, means for supplying alternating currents of different frequencies to the track circuit, and governing means responsive to the relation between the frequencies of the currents in such circuits.

13. In combination, a section of railway track, a loop circuit for such section, a track circuit for such section, means for supplying the loop circuit with alternating current of a single frequency, means for supplying the track circuit with alternating currents of different frequencies in accordance with traffic conditions in advance, and governing means responsive to the relation between the frequencies of the currents in such circuits.

14. In combination, a section of railway track, a loop circuit for such section, a track circuit for such section, means responsive to traffic conditions in such section for supplying the loop circuit with alternating current of a single frequency, means for supplying the track circuit with alternating currents of different frequencies in accordance with traffic conditions in advance of the section, and governing means responsive to the relation between the frequencies of the currents in the loop and track circuits.

In testimony whereof we affix our signatures.

ANDREW A. SKENE.
HOWARD A. THOMPSON.