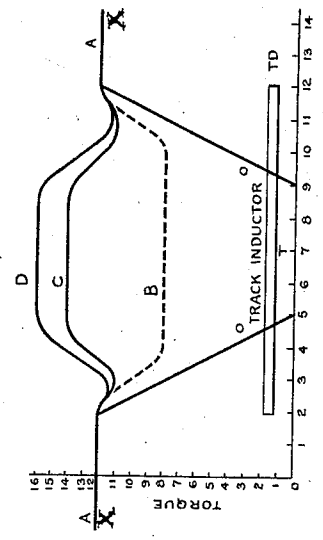
Jan. 7, 1930. A. G. SHAVER ET AL 1,742,617

TRAIN CONTROL SYSTEM

Filed Feb. 17, 1927

Fig. 2.



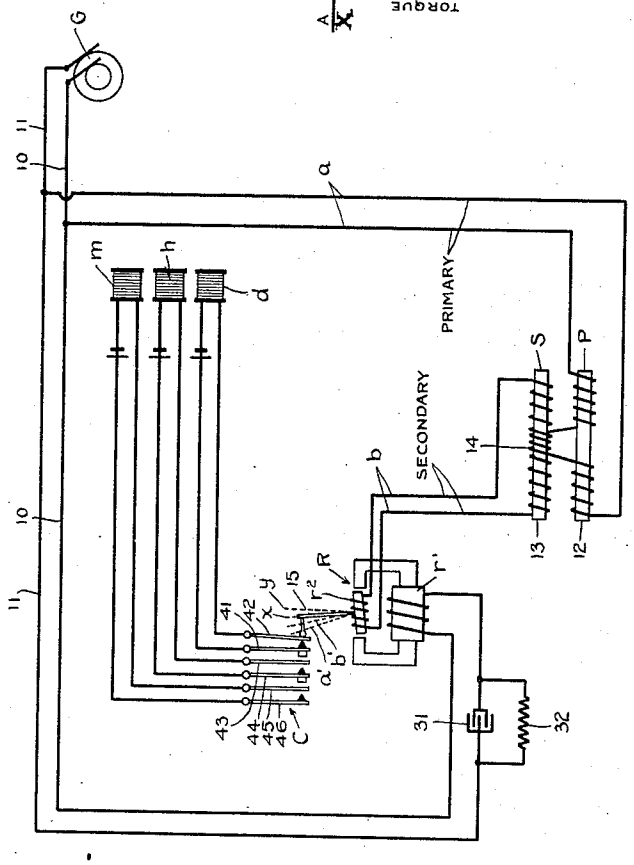
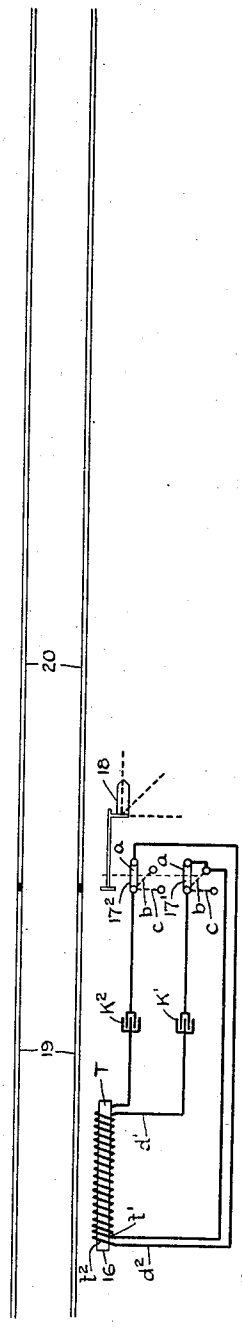


Fig. 1.



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UNITED STATES PATENT OFFICE

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TRAIN-CONTROL SYSTEM

Application filed February 17, 1927. Serial No. 168,903.

This invention relates to train control systems, and has special reference to the provision of an improved train control system of the induction type.

More specifically, the present invention relates to the type of system described in the application for Letters Patent filed by Theodore Bodde on October 30, 1926 under Serial No. 145,192.

The application referred to above discloses a train control system of the induction type which embodies cooperating vehicle carried and roadside inductors in which an activating condition is produced in the vehicle carried inductor to effect some active operation of the train control apparatus by the movement or positioning of said vehicle carried inductor relative to a roadside inductor which embodies circuit control means devoid of an energy source.

In prior induction train control systems of which we are aware, an activating operation of the vehicle carried circuits was produced by the transmission of some energizing influence from the roadside inductor to the vehicle carried inductor obtained by energizing the roadside inductor either directly by means of a source of energy located on the roadside or indirectly by locating the source of energy on the moving vehicle and reflexing or retransferring said energy through cooperating vehicle carried and roadside inductors from the vehicle to and through the roadside inductors and back to the vehicle apparatus.

In the system described in the co-pending application referred to above, the principal objections to the type of system described in the paragraph immediately preceding are eliminated. The objections to the older type of system have their origin either in the necessity of using roadside energy for the roadside inductors, or in the necessity of using a multiplicity of inductors for reflexing energy where the energy source is located on the vehicle.

One of the primary features of the system described in the above mentioned Bodde application, and also in the invention disclosed and described hereinafter resides in the provision of an improved induction train control system in which a single roadside inductor may be employed and selectively operated to produce in a vehicle carried inductor means a number of operations corresponding to the conditions of the roadside, which operations comprise the production of a condition in the vehicle carried inductor means to produce a tripping or train control stopping operation in the train control apparatus or/and a condition in the vehicle carried inductor means to permit a passive state in the vehicle carried apparatus, that is, to permit the vehicle to pass a roadside controlling station without any modifying operation being produced in the vehicle carried apparatus. In the Bodde application referred to above, these operations are combined with a third condition producible in the vehicle carried inductor means for effecting some other operation therein in response, for example, to a "clear", or "caution" roadside condition.

In the system which constitutes the subject matter of the present invention the system disclosed by Bodde is modified in such a manner that the selective operation of the roadside inductor and its cooperation with the vehicle carried inductor means may produce in the vehicle carried inductor means or in other vehicle carried apparatus which are responsive to the condition of the vehicle carried inductor means at least three positive operations corresponding to the conditions of the roadside. The results attained are capable of being produced with the use of a single inductor controlled by circuit means without using or employing a roadside source of energy for the inductors.

Another object of the present invention is to modify the vehicle carried apparatus so that it becomes more sensitive to the type of roadside apparatus described herein.

Other principal objects of our invention will become evident as the description proceeds, and to the accomplishment of the foregoing and such other objects as will hereinafter appear, our invention consists in the elements and their relation one to the other in circuit combinations as hereinafter more particularly described and sought to be defined

in the claims; reference being had to the accompanying drawings which show the preferred embodiment of our invention, and in which:

Fig. 1 is a wiring diagrammatic view of cooperating vehicle carried and roadside inductive apparatus embodying the principles of our invention, and

Fig. 2 is a view of a graph showing the operating characteristics and exemplifying the underlying principles of the system of our invention.

Referring now more in detail to the drawings and having reference first to Fig. 1 thereof, we show our invention applied to a train control system having a vehicle carried inductor means of the type disclosed in the copending application of A. G. Shaver, Serial No. 506,595, filed Oct. 10, 1921, which comprises inductively coupled coils consisting of a primary coil P and a secondary coil S inductively coupled thereto for the transmission of flux from the primary to the secondary coil, the said primary coil being arranged in a primary circuit *a* designated by the legend "Primary" in Fig 1, which circuit is connected to the mains 10 and 11 of an alternating current source of energy such as the generator G, and the said secondary coil being arranged in a secondary circuit *b* also designated in the drawings by the legend "Secondary". Both primary and secondary coils P and S are preferably wound on cores 12 and 13 which are preferably laminated and the primary P is preferably provided with a section 14 coiled over the secondary coil S in opposite sense thereto so as to act in bucking or opposing relation thereto for the purpose of neutralizing the flux under certain conditions, as described and claimed in the patent to A. G. Shaver, No. 1,521,332 of December 30, 1924.

The vehicle carried coupled coil combination P—S is employed for normally energizing a vehicle carried translating device such as a relay R which, as shown in Fig. 1 of the drawings, preferably is of the form of a two-element relay having a field coil r' and an armature coil r^2, the said field coil r' being connected to the generator G by means of the conductors 10 and 11 and the said armature coil r^2 being connected directly in the secondary circuit *b*. The armature r^2 is provided with a movable circuit controlling member 15 for selectively operating a contact mechanism generally designated as C for in turn selectively controlling the train control circuits to be described hereinafter.

As disclosed in the aforementioned copending application of A. G. Shaver, Serial No. 506,595 of 1921, the vehicle carried transformer combination P—S operates to normally energize the relay R by the transmission of sufficient flux from the primary P to the secondary S to effectively energize the relay coil r^2 of the relay R; when, however, the coupled coil combination P—S moves over in proximity to an inert roadside element, the flux from the primary P is diverted to and through the roadside inert element and shunted from the secondary coil S in a degree sufficient to effectively deenergize the relay R. When the relay R is energized under the first or normal condition of the inductively coupled coils P and S, the circuit controlling member 15 thereof assumes a normal position, such as shown in full lines in Fig. 1 of the drawings, which position is indicated as *x*, and when the relay is effectively deenergized by the shunting of the secondary, the circuit controlling member 15 of the relay moves to a neutral position such as indicated by the dotted line position *y*. In the operation of this system it is also known that when the roadside inert element is provided with an energyless circuit, the said circuit may be closed to permit the vehicle carried inductor means to pass the roadside inductor (on closed circuit) without any substantial diversion or shunting of the flux from the secondary S and hence without modifying the operation of the relay R, the circuit controlling member 15 thereof being maintained in the normal or full-line position *x*. By this means it is possible to control the roadside inductor either to produce an effective deenergization of the vehicle carried translating device or relay to trip the vehicle carried apparatus, or to permit the vehicle carried apparatus to pass the roadside station unaffected so as to prevent or inhibit the tripping operation from taking place.

The application of Bodde above referred to discloses a system of this character in which another activating influence can be produced in the vehicle carried inductors and apparatus by the employment of a roadside circuit devoid of any energy source. More particularly, it has been found empirically that by employing an inert or energyless roadside circuit of given characteristics, a torque may be produced in the relay R which is substantially greater than the normal torque thereof due to the normal transmission of flux from the primary coil P to the secondary coil S. This increase of torque in the relay R may be employed for producing a third condition or positioning thereof, which third condition may be utilized either for effecting the production of another indication in the vehicle carried apparatus, such as an indication in response to a "caution" roadside condition, or for effecting a resetting operation of the tripped vehicle carried apparatus.

These results have been found capable of being accomplished by the use of a tuned or resonant inert roadside circuit controlling the roadside inductor. For this purpose Bodde

utilized a track or roadside inductor means which comprise an inductor track coil wound on preferably a laminated core, the coil being disposed in a circuit devoid of an energy source, the circuit having a condenser connected in series with the track coil, the condenser being so chosen that it tunes the circuit into resonance with the frequency of the generator G. The roadside circuit is also provided with a switch member which is movable into the "clear", "caution" and "danger" positions by the operation of a semaphore or equivalent means. When the vehicle inductor combination P—S is positioned or moves over the track inductor when the tuned or resonant circuit is closed, an increase over the normal torque of the relay R is produced which is utilized to move the circuit controlling member 15 of the relay to a position indicating "all clear" or to give any other desired indication. It will be seen, therefore, that the Bodde system provides means whereby the circuit controlling member 15 may occupy one of three positions, one of these positions being its normal position; and under given conditions the member 15 is positively actuated and moved from its normal position to one of two other positions. It is moved to one of these other positions when the roadside circuit is open and is moved to the third position when the roadside circuit is closed through the tuning condenser.

We have discovered that the system disclosed and described by Bodde may be modified so that a still further positive indication may be transmitted by the roadside circuits to the vehicle carried apparatus. In our system, therefore, the circuit member 15 may occupy any one of four positions, depending upon the conditions of the roadside circuits. One of these positions is the normal position shown by the position x in Fig. 1 of the drawings. The circuit controlling member 15 is maintained in this position by the normal torque of the relay R due to the current induced in the secondary circuit b under normal conditions, namely, under such conditions when the vehicle carried inductor does not overlie any roadside inductor; in other words, when the train is disposed at a point intermediate the ends of a signalling block. The position y of the circuit controlling member 15 is assumed by said member 15 when the torque of the relay R is diminished due to the cooperation of the vehicle carried inductors with an open circuited roadside inductor. Positions a' and b' of the circuit member 15 are obtained by a variable increase in the torque of the relay R. These positions a' and b' of the circuit member 15 or the variation of the torque of the relay R are obtained by the roadside circuit shown in Fig. 1 and its cooperation with the vehicle carried apparatus.

In the place of one coil utilized by Bodde on the roadside inductor, we provide a roadside inductor T which comprises a laminated core 16 and two coils t' and t^2 wound thereon in the same direction and connected in independent circuits d' and d^2 respectively, these circuits comprising condensers K′ and K² respectively and also comprising movable switch arms 17′ and 17² which are operated by the semaphore signal 18 or equivalent means associated with the insulated track section or block 20 of a block signalling system. The switch arms 17′ and 17² are each movable to the three positions a, b or c corresponding to the "clear", "caution" and "stop" positions of the semaphore signal 18. The circuits are so arranged that when the semaphore signal 18 is in the "clear" position, both circuits d' and d^2 are closed by means of the switch arms 17′ and 17² in their a positions through the condensers K′ and K² respectively. When the semaphore is moved to its "caution" position, switch arms 17′ and 17² are moved to their b positions, thereby causing a break in the circuit d^2 while the circuit d' is still maintained in its closed condition through the condenser K′. When the semaphore 18 is in its "danger" position, both circuits d' and d^2 are open.

Normally, or when the train is disposed in a block intermediate the ends thereof so that the vehicle carried inductor combination P—S does not overlie the track inductor T, the movable armature r^2 of the relay R occupies the position shown, and the circuit controlling member 15 which is mounted on r^2 and is operated thereby, occupies the position x, thereby closing the circuit of the danger indicating means d, and maintaining said circuit closed under normal conditions by maintaining the contacts 41, 42 in contact with each other.

When the vehicle carried inductor means P—S is positioned or moves over the track inductor T when the switch arms 17′ and 17² are in their a positions and the circuits d' and d^2 are each closed through the tuning condensers K′ and K², an increase over the normal torque of the relay R is produced which is utilized to move the circuit controlling member 15 of the relay to the position a' indicated in dotted lines in Fig. 1 of the drawings. When the vehicle carried inductor P—S is positioned or moves over the track inductor T when the switch arms 17′ and 17² are in their b positions respectively, and circuit d' is closed through its condenser K′ while circuit d^2 is open, the increase over the normal torque of the relay R produced is not as great as in the case when both circuits d' and d^2 are closed, and the circuit controlling member 15, therefore, of the relay is then moved from its normal position to the position b' indicated in dotted lines in Fig. 1 of the drawings.

It will be seen that the movement of the

member 15 to the y position permits the contacts 41 and 42 to break contact, thereby deenergizing the "danger" indicating means d and giving a "danger" or "tripping" indication. When the circuit controlling member 15 is moved from the normal to its b' position, the contacts 43 and 44 are closed, thereby energizing the "caution" responsive device h and giving a "caution" indication. When the circuit control member 15 is moved from the normal to its a' position, the contacts 45, 46 will be closed and thereby energize the device m, giving a "clear" indication.

While as shown in the drawings the movement of the circuit control member 15 from its normal to its a' position causes the closing of all the contacts, it will be apparent to those skilled in the art that this manner of operation may be modified as desired, and if desired, its operation may be such as to cause a successive make and break of such contacts.

In order that the system should operate in the manner described above, the coils t' and t^2 and the condensers K′ and K² must be so selected that when both circuits d' and d^2 are closed, the interaction between the roadside inductor and the vehicle carried inductor means must be such as to bring about a maximum increase in the torque of the relay R. In the present system it is preferred to accomplish this end by so selecting the coils t' and t^2 and the condensers K′ and K² that when the circuits d' and d^2 are closed, the two together constitute a system which is tuned in resonance with the generated frequency of the current generator G. It will be seen that when these circuits are so designed that together they constitute a system in resonance with the generated frequency, a break in one of the circuits will disturb the resonant condition, with the result that when the switch arms 17′ and 17² are in their b positions, the increase in the torque of the relay R will be reduced and the circuit control member 15 will not be moved to the a' position, but will instead be moved to the b' position. We do not, however, wish to be limited to the conditions specified immediately above. It will be apparent to those skilled in the art that substantially the same variation in the torque of the relay R may be obtained by empirically adjusting the condensers K′ and K² to give the desired results, and that such adjustment may under some conditions not necessarily bring about a resonant condition.

If desired, the coils t' and t^2 and the condenseres K′ and K² may be so selected that the circuits d' and d^2 will be substantial duplicates of each other. This, however, is not an essential feature of the present invention.

The increase of the torque in the relay R is believed to be due to an increase in the driving EMF in the secondary coil S, such increase in the driving EMF being in turn due to a strong counter-magneto-motive force set up by the tuned or nearly tuned track inductor which opposes the poles of the primary inductor P and hence forces a part of the flux of the primary P away from the roadside inductor and consequently confines the magnetic field of the vehicle carried inductor more closely to its own vicinity and tends to increase the flux through the secondary winding. In view of the fact that the tuning of the roadside inductor is varied when the condenser K² is taken out of the circuit, the effect of the roadside inductor and its cooperation with the vehicle carried apparatus will be different under different roadside conditions and the driving EMF of the relay R will be greater when both condensers K′ and K² are connected in the respective circuits than when only one of these condensers is connected. When both of the roadside circuits d' and d^2 are opened, as under "danger" track conditions, the inert core 16 of the track inductor T diverts or shunts the flux from the secondary S as heretofore described.

It will be seen, therefore, that the roadside circuits disclosed herein are selectively operable to diminish or to increase variably the flux transmission from the primary coil P to the secondary coil S of the vehicle carried inductor means. The opening of both track circuits d' and d^2 causes a shunting or diversion of the flux from the secondary and therefore a diminution of the flux transmitted from the primary to the secondary, thereby causing a positive actuation of the relay to its y position. Closing of the circuit d' causes a concentration or increase of flux through the secondary S, thereby increasing the torque in the relay R and causing a positive actuation of the circuit controlling member 15 from its normal position to the b' position. When both track circuits d' and d^2 are closed, the increase of flux through the secondary S is still greater, thereby still further increasing the relay torque and causing a positive actuation of the circuit controlling member 15 from its normal position to the a' position.

It is now apparent that by the use of a single track inductor which is provided with means for variably tuning its circuit, the circuit being devoid of an energy source, in combination with vehicle carried inductor means and other responsive apparatus, we may obtain four positions on the vehicle carried apparatus, one of said positions being normal and the other three positions being the result of positive actuation of said inductor and being due to the cooperation between the vehicle carried inductor means and the track inductor controlled in response to road-

side conditions. The positions y, a' and b' of the circuit member 15 may be momentary and may exist only during the passage of the vehicle over the roadside inductor, the member 15 in each case returning to its normal position after the vehicle has passed over the track inductor. The three positive actuations of the member 15 may be used to indicate "clear", "caution" and "danger" conditions of the roadside, or they may be used for any other indications.

In Fig. 2 of the drawings is shown a graph which depicts these characteristic operations of the vehicle carried and roadside inductors. In this graph the ordinates represent the torque effective on the relay R, while the abscissæ represent the movement of the vehicle inductor means over the track inductor, the latter being shown on the graph. Normally a torque is produced in the relay R represented by the curve XX corresponding to the position x of the relay armature r^2. Under "danger" roadside conditions when the circuits d' and d^2 are opened to produce the deenergization of the relay R, the torque drops and is represented by the curve XOTOX. When, however, the vehicle inductor cooperates with the track inductor under the conditions when the circuits d' and d^2 are closed, the torque of the relay increases, as shown by the curve XDX. The cooperation of the vehicle carried apparatus with the roadside apparatus under the conditions when only the circuit d' is closed, the circuit d^2 being opened, the torque of the relay increases as shown by the curve XCX. These phenomena may be contrasted with that produced by an untuned closed track circuit, for with the use of such a circuit, the torque of the relay slightly decreases when the untuned track circuit is closed as represented by the dotted line curve B on the graph.

For producing an increased efficiency in the relay R to make effective the increased torque thereof, we have found that the phases between the currents in the elements of the relay R should be predetermined, and we have discovered that the desired phase relationship may be obtained by the provision of a condenser 31 shunted by a resistance 32 both arranged in series with the field coil r' of the relay R. For a given relay R we have found that where the frequency employed is 60 cycles, the resistor 32 should have a resistance of about 80 ohms, while the condenser 30 should have a capacitance of about 62 microfarads. With these constants we have found that the tuned circuit d may be employed to produce a substantially maximum increase in the torque of the relay R.

The use and operation of the system embodying our invention and the numerous advantages thereof will in the main be apparent from the above detailed description thereof. It will be further apparent that while we have shown and described our invention in the preferred forms, many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

We claim:

1. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a circuit means devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, said circuit means comprising a plurality of inductively coupled circuits having a single inductor flux path.

2. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a circuit means devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, said circuit means comprising two inductively coupled circuits having a single inductor flux path.

3. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a circuit means devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, said roadside inductor comprising a plurality of inductively coupled coils having a single inductor flux path.

4. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a circuit means devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, said roadside inductor having two mutually inductive coils having a single inductor flux path.

5. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating condi-

tions in said apparatus; a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a plurality of inductively coupled circuits devoid of an energy source, and means for opening and variably closing said circuits for influencing the vehicle carried inductor means to produce said operating conditions.

6. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits devoid of an energy source, and means for opening and variably closing said circuits for influencing the vehicle carried inductor means to produce said operating conditions.

7. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a plurality of inductively coupled coils, and means for opening and variably closing said coils for influencing the vehicle carried inductor means to produce said operating conditions.

8. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two mutually inductive coils, and means for opening and variably closing said coils for influencing the vehicle carried inductor means to produce said operating conditions.

9. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying a circuit means devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, said roadside inductor having two mutually inductive coils and a capacitance electrically associated with each of said coils.

10. In combination, vehicle carried apparatus including an A. C. source of energy, vehicle carried inductor means energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means and embodying a plurality of inductively coupled circuits devoid of an energy source, each of said circuits comprising a capacitance, means for opening and variably closing said circuits for influencing the vehicle carried inductor means to produce any one of said operating conditions, said capacitances being such that when said circuits are both closed the roadside circuit is in resonance with the source of A. C. energy.

11. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means including inductively coupled coils energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means in a single inductor flux path, said roadside inductor embodying two circuits devoid of an energy source and operative when selectively opened and variably closed for influencing the vehicle carried inductor means to produce respectively one of said operating conditions in the vehicle carried apparatus.

12. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means including inductively coupled coils energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle inductor means, said roadside inductor embodying a resonant or tuned circuit means devoid of an energy source and operative when selectively opened and closed for influencing the vehicle carried inductor means to produce respectively one of said operating conditions in the vehicle carried apparatus, said circuit means comprising a plurality of inductively coupled circuits.

13. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means including inductively coupled coils energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle inductor means, said roadside inductor embodying a resonant or tuned circuit means devoid of an energy source and operative when selectively opened and closed for influencing the vehicle carried inductor means to produce respectively one of said operating conditions in the vehicle carried apparatus, said circuit means comprising two inductively coupled circuits.

14. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means including inductively coupled coils energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle inductor means, said roadside inductor embodying a resonant or tuned cir-

cuit means devoid of an energy source and operative when selectively opened and closed for influencing the vehicle carried inductor means to produce respectively one of said operating conditions in the vehicle carried apparatus, said roadside inductor comprising a plurality of inductively coupled coils.

15. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means including inductively coupled coils energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle inductor means, said roadside inductor embodying a resonant or tuned circuit means devoid of an energy source and operative when selectively opened and closed for influencing the vehicle carried inductor means to produce respectively one of said operating conditions in the vehicle carried apparatus, said roadside inductor having two mutually inductive coils.

16. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means including inductively coupled coils energized from said energy source and operable for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle inductor means, said roadside inductor embodying a resonant or tuned circuit means devoid of an energy source and operative when selectively opened and closed for influencing the vehicle carried inductor means to produce respectively one of said operating conditions in the vehicle carried apparatus, said roadside inductor having two mutually inductive coils and a capacitance electrically associated with each of said coils.

17. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus.

18. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits devoid of an energy source and operative when both are closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus.

19. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits devoid of an energy source and operative when both are closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, and when only one is closed to produce another of said operating conditions.

20. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits comprising mutually inductive coils and capacitances associated with each devoid of an energy source and operative when closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus.

21. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits comprising mutually inductive coils and capacitances associated with each devoid of an energy source and operative when both are closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus.

22. In combination, vehicle carried apparatus, a vehicle carried inductor means operable for producing one of three operating conditions in said apparatus; and a single roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two inductively coupled circuits comprising mutually inductive coils and capacitances associated with each devoid of an energy source and operative when both are closed for influencing the vehicle carried inductor means to produce one of said operating conditions in the vehicle carried apparatus, and when only one is closed to produce another of said operating conditions.

23. In combination, vehicle carried apparatus including a source of energy, a vehicle carried inductor means operable through said source of energy for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two mutually coupled circuits and resonant to said source of energy and operative when both circuits are

closed for influencing the vehicle carried inductor means to produce one of said operating conditions and when only one circuit is closed to produce another of said operating conditions.

24. In combination, vehicle carried apparatus including a source of energy, a vehicle carried inductor means operable through said source of energy for producing one of three operating conditions in said apparatus; and a roadside inductor cooperating with said vehicle carried inductor means, said roadside inductor embodying two mutually coupled circuits devoid of an energy source and resonant to said source of energy and operative when both circuits are closed for influencing the vehicle carried inductor means to produce one of said operating conditions and when only one circuit is closed to product another of said operating conditions.

25. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means comprising inductively coupled coils, the primary coil of which is connected to said A. C. source and the secondary coil of which is connected to said apparatus, and roadside inductor means cooperating with said vehicle carried inductor means, said roadside inductor means embodying a plurality of coils and circuit means devoid of an energy source, said roadside circuit being operative to selectively diminish or increase the flux transmission from the primary coil to the secondary coil of the vehicle carried inductor means to effect one of three operations in said vehicle carried apparatus.

26. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means comprising inductively coupled coils, the primary coil of which is connected to said A. C. source and the secondary coil of which is connected to said apparatus, and roadside inductor means comprising inductively coupled circuits and cooperating with said vehicle carried inductor means, and selectively operative to diminish or to variably increase the flux transmission from the primary coil to the secondary coil of the vehicle carried inductor means.

27. In combination, vehicle carried apparatus including an A. C. source of energy, a vehicle carried inductor means comprising inductively coupled coils, the primary coil of which is connected to said A. C. source and the secondary coil of which is connected to said apparatus, and roadside inductor means comprising two mutually inductive coils and circuit means devoid of an energy source associated with each coil and cooperating with said vehicle carried inductor means, and selectively operative to diminish or to variably increase the flux transmission from the primary coil to the secondary coil of the vehicle carried inductor means.

28. In combination, vehicle carried apparatus including a relay, a vehicle carried inductor means for operating said relay; and a roadside inductor cooperating with the vehicle carried inductor means, said roadside inductor embodying a plurality of coils and circuit means devoid of an energy source and operative on selective closed circuit for variably affecting the vehicle carried inductor means to produce different degrees of increase of torque in said relay.

29. In combination, vehicle carried apparatus including a relay, a vehicle carried inductor means for operating said relay; and a roadside inductor cooperating with the vehicle carried inductor means, said roadside inductor embodying a plurality of coils and circuit means devoid of an energy source, said roadside inductor being operative on open and on closed circuit for affecting the vehicle carried inductor means to produce respectively a decrease and a variable increase of torque in said relay.

30. In combination, vehicle carried apparatus including an A. C. source of energy and a relay, vehicle carried inductively coupled coils, the primary coil of which is connected to the A. C. energy source and the secondary coil of which is connected to said relay; a roadside inductor cooperating with said vehicle carried coils, said roadside inductor comprising two coils and circuit means for establishing a resonant or non-resonant circuit for said roadside inductor for affecting the vehicle carried inductor to produce a variable increase of torque in said relay.

Signed by said ARCHIBALD G. SHAVER at Chicago, in the county of Cook and State of Illinois, this 7th day of January, A. D. 1927.

ARCHIBALD G. SHAVER.

Signed by said BENJAMIN W. MEISEL at New York city, in the county of New York and State of New York, this 24th day of December, 1926.

BENJAMIN W. MEISEL.