

Dec. 22, 1936.

H. B. BRAINERD

2,064,882

TRAFFIC SIGNAL CONTROL

Filed May 21, 1931

3 Sheets-Sheet 1

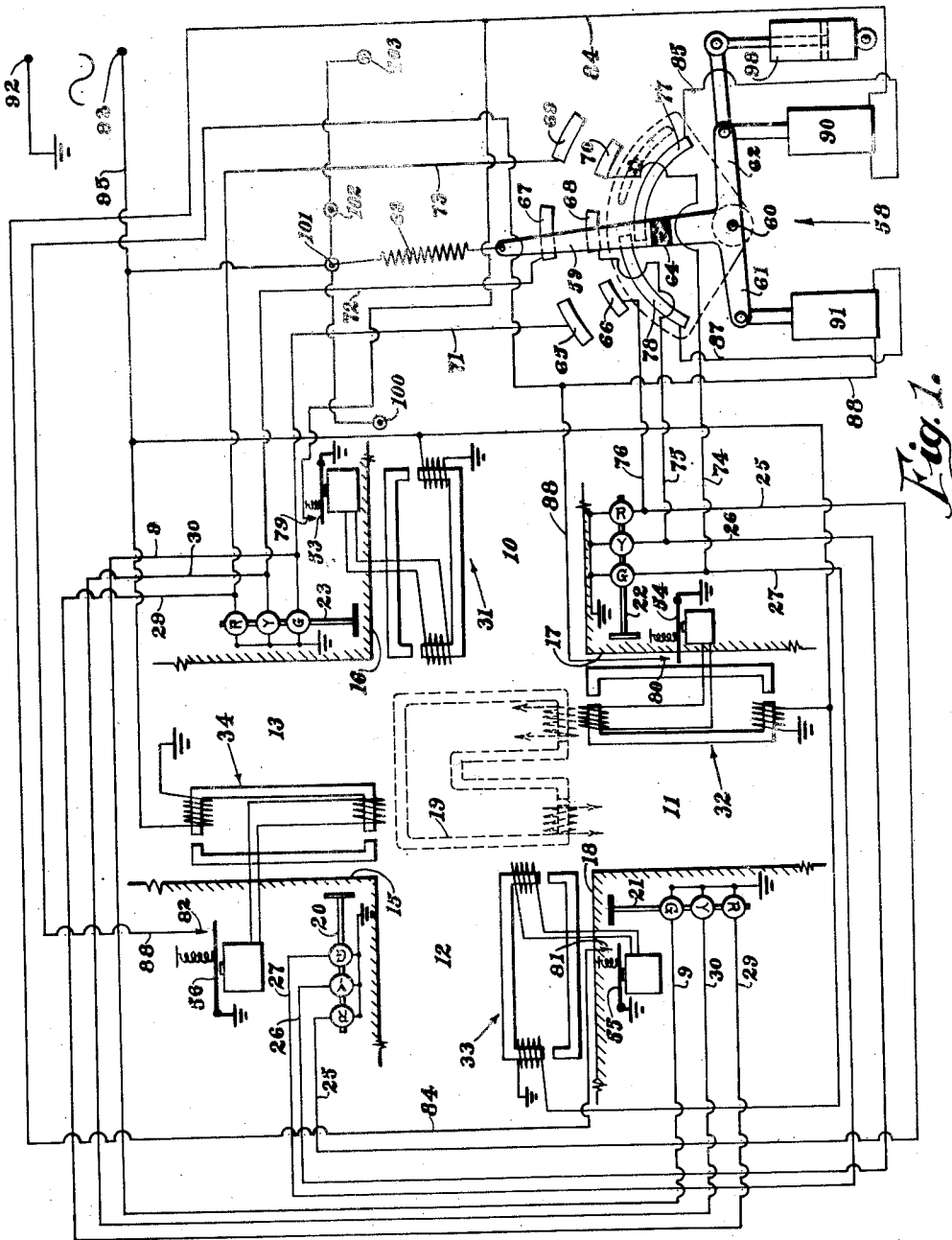


Fig. 1.

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3 Sheets-Sheet 2

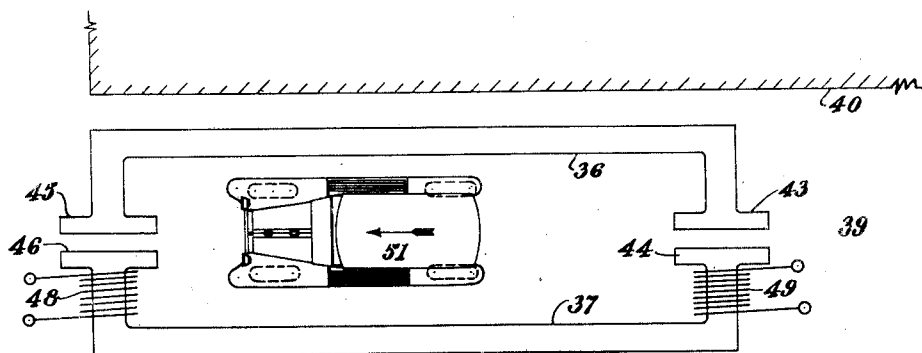


Fig. 2.

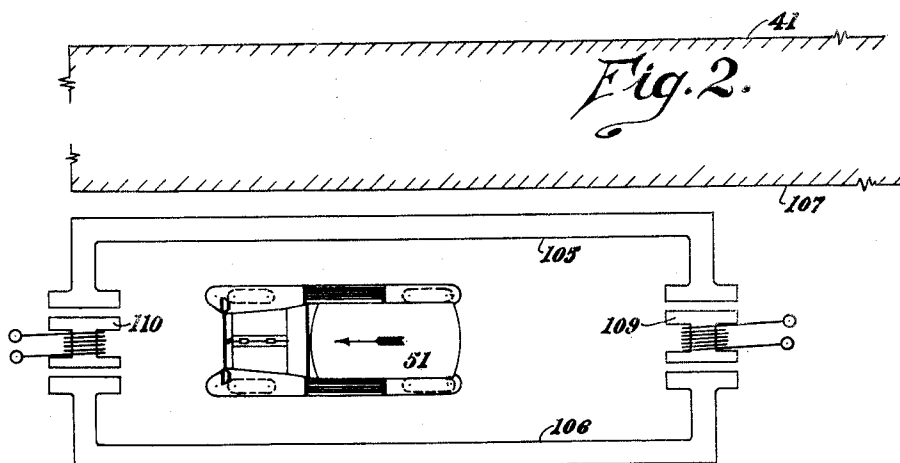


Fig. 3.

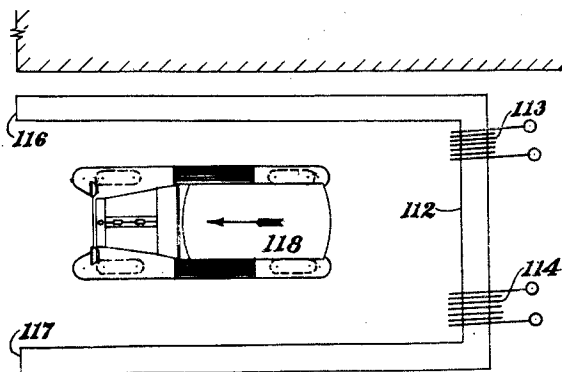


Fig. 4.

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3 Sheets-Sheet 3

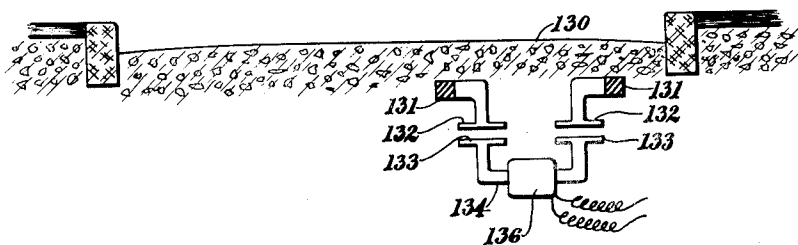


Fig. 6.

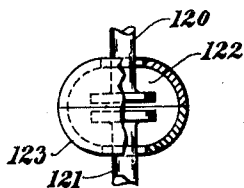


Fig. 5.

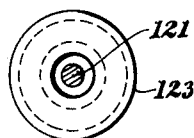


Fig. 7.

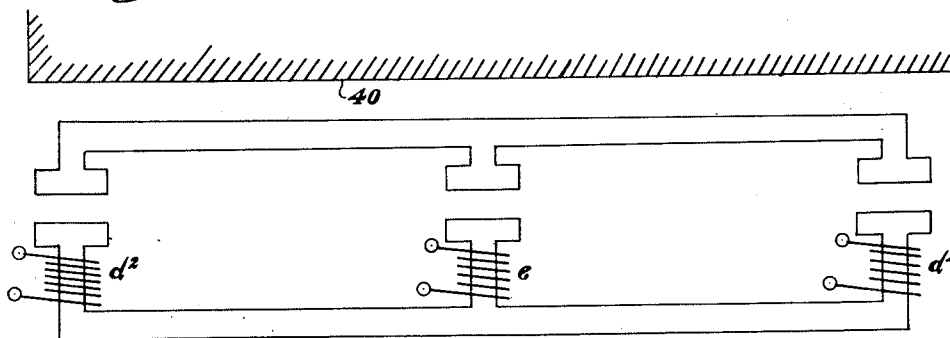


Fig. 8.

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2,064,882

TRAFFIC SIGNAL CONTROL

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Application May 21, 1931, Serial No. 539,011

8 Claims. (Cl. 177-339)

The present invention relates to a system for automatically detecting the presence and controlling the operation of free vehicles, by which is intended land vehicles operated on a highway, and characterized by their normal independence from any track or similar close limitation of their path of travel and by capacity for being steered, such vehicles comprising the usual automotive highway traffic.

Systems for automatically controlling the flow of traffic across intersecting lanes of travel have heretofore so far as I am aware employed a timed delay principle, the time interval being predetermined and largely inflexible, so that the traffic has to wait on the signal and accommodate itself thereto, instead of the signal being responsive to the traffic. In recognition of this fundamental drawback, attempts have been made to cause the signals to be worked with some regard to the actual instead of the presumptive conditions of traffic, and to this end resort has commonly been had to a vehicle detector located at a point considerably removed from an intersection. The detector is effective to operate a signal or other traffic control device whenever a vehicle passes the point where it is located. A timed delay device serves to hold the signal in operated position for a length of time assumed to be required for the vehicle to pass from the point of location of the detector to the margin of the intersection and for sufficient additional time for the vehicle to have presumably passed the intersection. The time periods must necessarily be liberal to accommodate slow moving vehicles and obviously result in many unnecessary delays to crossing traffic.

The limitation of such systems is that they detect the presence of vehicles only at a point, or at best at two points in the neighborhood of the approach to the intersection, and because they have no way of detecting the subsequent action of the vehicle after passing the single detector, or the first detector of a pair at opposite ends of the approach, they must rely on a timed delay during which the vehicle or vehicles actuating the detector are presumed to have effected a crossing. This presumption may just as easily be wrong as right, as is an unavoidable consequence. The attempt to avoid the timed delay through the use of two detectors acting each at a point introduces further problems, such as that of the vehicle which actuates the first detector and then through changing its course fails to actuate the second, which in turn require the provision of delicate and complicated compensat-

ing devices which are expensive and which also introduce the timed delay to correct the signaling. Furthermore the operation of such systems as are mentioned above may be disarranged by a vehicle which leaves the intersection over a lane normally used by approaching vehicles, such disarrangement continuing after its cause has departed.

The general object of the invention is to provide a novel and improved automatic traffic signal controlling system which shall be solely and completely responsive to the actual conditions and needs of traffic at all times even while these needs are frequently changed by the changes in volume, route, and direction of such traffic, and which shall avoid the obvious defects of existing systems known to me.

A particular object of the present invention is to provide an improved system using novel means for automatically controlling traffic, which shall obviate the use of the timed delay principle of operation, which is the basis of the common alternating timed signals and of the present detector controlled timed signals, also. Another object of the invention is the provision of novel vehicle-actuated detector means for controlling the signals which shall not be subject to injury by the vehicles themselves or be subject to damage or interference with its operation through the action of water, ice, mud and gravel, or through intentional tampering. A further object of the invention is to provide a system and detector means therefor which will be directly and accurately responsive to the relative volumes of traffic on the intersecting highways and will give precedence to conflicting traffic in proper accordance with the fundamental principles of priority of approach to the intersection. A further object of the invention is the avoidance in such organization of complicated and expensive and easily disarranged wiring systems and timing and releasing devices. Further objects of the invention are as will appear in the following description.

To avoid these objections to prior devices, this invention provides a system wherein the timed delay in operation of the traffic control devices is abolished. The vehicles themselves in their relative movements determine the signaling and effect their own control without timing. This control is determined by detecting the presence of a vehicle over an extended area instead of substantially at a point, such extended area having at least a sufficient sensitivity to the presence of a vehicle at all points throughout its extent,

and being inherently capable of being extended both in length and in width so as to exceed the horizontal area occupied by any vehicle. Such a detector may be arranged to detect the presence of a vehicle within a given area whose width is the lane or lanes used by traffic approaching the intersection and whose length extends away from the intersection to a point sufficiently removed therefrom for a vehicle traveling past said point at the greatest speed probable on the highway in question to bring itself to a stop before entering the intersection, this length being in all events greater than a typical single vehicle. This arrangement insures that a vehicle approaching the intersection will either operate the system to display a "go" or favorable signal, or will receive a "stop" or unfavorable signal at full stopping distance from the crossing; this stopping distance normally averages 30 feet at 20 miles per hour, 67 feet at 30 miles per hour, and 120 feet at 40 miles per hour. This is in contrast to those vehicle-actuated systems, in which the single-point detectors are frequently placed close to the intersection to minimize difficulties with timed delays, and hence a vehicle has no effect on the signal until it is much nearer than normal stopping distance. This extended detecting area may terminate at the margin of the intersection so that a vehicle will not leave its field of influence until it has moved well into the intersection, in plain view from the crossing lane of travel. Beyond this point in the movement of the vehicle there is no necessity of retaining the traffic signals or other control devices in cleared condition, provided of course there is no other vehicle approaching in either direction on the same route. At once it becomes possible for vehicles on the interfering or crossing way to affect their respective detectors and obtain a clear signal, without having to wait for a predetermined period of time to elapse, and regardless of the length of time consumed by the first vehicle in passing through the above area.

According to another aspect of my invention a novel form of vehicle detector is contemplated, employing longitudinal members, conducting magnetic flux over a considerable area adjacent to an intersection of traffic lanes, so that the presence of a vehicle within its field will affect the distribution of flux between the longitudinal members in such a manner as to cause an associated electrical circuit to undergo a change. A pulsating or alternating flow of flux may be employed, facilitating the detection of magnetic vehicles or other bodies at rest or moving very slowly, as well as the continuous detection of a body or vehicle moving within the aforesaid field. Suitable reluctance devices may be utilized to produce the desired flux distribution, by separating the longitudinal members from the transverse members and arranging the gaps perpendicularly to the lane of travel or with a covering of magnetic material so that the value of reluctance will not be undesirably decreased by magnetic bodies improperly or maliciously introduced.

The invention provides a detector having no delicate or moving parts, and which can be completely buried in the roadway, having no exposed or visible portions.

These and other features of the invention as set forth in the appended claims will appear more particularly in the following detailed specification and annexed drawings, in which,—

Fig. 1 is a schematic wiring diagram of the electrical system of connections used, and an il-

lustrative embodiment of one arrangement of detectors in relation to the roadways and to the intersection.

Fig. 2 is a top plan view of a single detector arrangement showing its relation with a vehicle approaching an intersection of traffic lanes.

Fig. 3 is a similar view of a modified form of detector.

Fig. 4 is a similar view of another modified form of detector.

Fig. 5 is a similar view of a reluctance device, which may be used to distribute more effectively the magnetic flux in the detector.

Fig. 6 is a view in vertical section taken at right angles to a highway showing a still further form of reluctance device.

Fig. 7 is an end view of the reluctance device shown in Fig. 5.

Fig. 8 is a plan view of a double or "duplex" detector.

A right angle intersection of two highways is illustrated in the drawings, each highway consisting of two lanes of traffic, although any number of lanes or any number of highways meeting at an intersection in any angular relation could be provided with devices embodying my improved system of control. There are thus shown four intersecting traffic lanes 10, 11, 12, and 13, each entering into the intersection which is determined by the projection of the lateral edges of the streets. The corners 15, 16, 17, and 18 are formed by the edges of these streets. The rectangular area defined by connecting the several corners each with its two adjoining corners determines the area of the intersection.

Conventional traffic signals or other right of way indicating devices 20, 21, 22, and 23, each consisting in the present instance, of red, yellow and green lights, are mounted upon suitable standards for affording control of traffic lanes 12, 13, 10 and 11, respectively. A standard interpretation of the colors is assumed to be, "stop" for red; "caution" or "warning" for yellow; and "go" for green. Electrical return connections for operating the lights are made by grounding one terminal on each of the fixtures. Diagonally opposite standards which control non-interfering lanes following similar routes in opposite directions have their lights connected in parallel: The red, yellow and green lights of signal 20 are connected by wires 25, 26 and 27 to the corresponding lights of signal 22; signal 21 is similarly connected to signal 23 by wires 29, 30 and 31.

Free vehicle detectors 31, 32, 33 and 34 are located under or adjacent to each of the lanes 10, 11, 12 and 13, respectively. These free vehicle detectors are sensitive to free vehicles, especially as distinguished from a detector which is designed to be sensitive only to vehicles running on a track or similar fixed route or path. Each detector is similarly constructed and operates in the present instance through the magnetic properties of a passing vehicle. Fig. 2 shows more clearly how two elongated members 36 and 37 may be located at either side of the lane of travel 39 which comprises one half the street area between the curbs 40 and 41. These members should be of high permeability magnetic metal with enlarged terminals 43, 44, 45, and 46 bent toward each other in proper spaced relation. An energizing coil 48 at one end may be connected to a source of alternating current supply and a detector coil 49 at another location may be connected to a suitable relay. Under normal conditions there will be some flux passing through coil

49 under the action of the energizing coil 48, but upon the entrance of a vehicle 51 between the magnetic members a large part of this mutual flux will be shunted through the vehicle. The resulting reduction, change, or surge in the current flow through the coil 48 will permit the armature of the relay to escape from its magnet to cause the operation of the signals.

Relays 53, 54, 55 and 56 may be associated with detectors 31, 32, 33 and 34, respectively. The presence of a vehicle anywhere within the area of the magnetic fields adjoining these detectors will uniformly affect these relays to close their contacts and establish a circuit to the main operating switch 58. A moving contact arm 59 is pivoted at 60 and may be insulated as indicated at 64 from crank arms 61 and 62, extending in opposite directions from the pivot point. A resilient spring 63 maintains the arm 59 in a position slightly to one side of the center of movement, and also serves to connect arm 59 to one side of the source of power, herein side 93. Stationary contacts 65 to 70, inclusive, are connected by wires 71 to 76, inclusive, to the various signal lights.

The armatures of relays 53, 54, 55 and 56 are all grounded and adjustably biased by tension springs of insufficient strength to overcome the force of the magnets when energized by the normal current induced in the detector coils 49 when no magnetic body is within the detector's field. A vehicle entering within the field of any detector causes the respective relay to release its armature, closing contact with its respective associated stationary contact point 79, 80, 81 or 82. Contact points of oppositely disposed relays are connected by wires 84 and 85. The circuit is completed from the contacts by wires 87 or 88 to solenoids 90 or 91, respectively. Movable armatures attracted by these solenoids are pivoted to crank arm 61 or 62 and serve to operate the switch arm 59 to move it over the contacts 65 to 70, inclusive.

Power is supplied through the terminals 92 and 93, the terminal 92 being grounded. The source of power for the whole system preferably is of the same character, and for best operation of the detectors should be from an alternating current system of supply. More reliable operation of the detectors will result if the frequency furnished differs widely from any common commercial frequency which is used nearby, so that no interference through unintended inductive effects will result. If the frequency selected is not too high, it may be used to energize the signal devices as well as the detectors. If this is done, a common connection 95 to all of the apparatus may be employed.

The operation of the system is as follows:—

Assume a vehicle enters the lane 13. As it approaches the intersection it comes within the influence of the magnetic field of detector 34, shunting the flux between the parallel members and causing the armature of relay 56 to be released. The contact 82 is grounded, and a circuit is completed from the power supply terminal 93, wire 95, spring 63, arm 59, contact 78, wire 87, contact magnet 91, wire 88, contact 82 and back through the armature and its ground connection to the other power supply terminal 92. This causes the switch arm 59 to be thrown to the left, and establishes a circuit from terminal 93, through wire 95, spring 63, switch arm 59, contact 65, wire 71 to green lights 21 and 23. Also, red lights of signals 20 and 22 are illumi-

nated through the contact 66 and arm 59. A clear road is thus prepared ahead of the vehicle, and stop signals are displayed on both the crossing lanes 10 and 12.

Switch arm 59 will be retained over contacts 65 and 66 until the vehicle passes entirely out of the field of influence of detector 34 at which time it at once is movable to the caution or opposed position. The detectors may be of such length that their field of force extends from the border of the intersection to a point on each lane sufficiently removed from the intersection to permit the stopping of any vehicle. This length may be made great enough to accommodate all vehicles traveling at a reasonable speed and should be sufficient to permit the operator to apply his brakes and stop his car before entering the intersection, even though traveling at the highest speed permissible along that part of the highway. The switch arm 59 will not be returned by spring 63 until the rear end of the vehicle has passed from the field of influence of the detector. The vehicle will by that time have passed well into the intersection in plain view from the crossing lanes. If desired, a simple dash-pot 98 may be connected to the switch arm to render the operation of the arm more even against the action of the spring 63. The dash-pot should not offer sufficient resistance to prevent substantially instantaneous operation of the switch arm when either magnet 91 or 92 is energized.

When the vehicle has passed through, the spring will return the arm 59 to any desired position according to its adjustment. For this purpose different pins 100, 101, 102 and 103, all connected to wire 95 are provided, to which the end of the spring may be attached. This permits the use of the system where it is desired to arrange one street as a through-way and the other as an intersecting way. The through-way will normally display a go-signal and the intersecting way a stop-signal, so that those crossing will approach with greater caution. With this arrangement, the two detectors in the through-way may be dispensed with and still achieve largely satisfactory traffic control. When both highways carry commensurate amounts of traffic the switch arm 59 will be adjusted normally to be returned to a middle position, closing circuit with contacts 67 and 68. These contacts complete the circuit with all of the yellow or caution lights through wires 72 and 75. While the lever remains in this position a caution signal will be displayed for all lanes of traffic.

Magnets 90 and 91 are so designed that when the armature of one is slightly withdrawn from its solenoid the tractile force is weakened. This is for two purposes; first to prevent changing of the signals while a vehicle is within the field of a detector and second to prevent the switch arm from locking in a dead center position through the simultaneous approach of two vehicles on intersecting lanes. This last effect is further accentuated by arranging the fixed end of spring 63 in a slightly off-center position, and by arranging contacts 77 and 78 to open the circuit to the undesired magnet as soon as the lever is moved by whichever magnet is to act, thus giving a preference to vehicles approaching the intersection on one street over those on the other. The spring and contacts 77 and 78 may be adjusted to give either street the preference by connecting the spring to either pins 101 or 102 and adjusting the contacts correspondingly, through proper movement of the sector on which they are

mounted (shown in dotted lines, Fig. 1), and securing it in adjusted position by its clamping screw.

When two vehicles are approaching on intersecting lanes at approximately the same time, one will be given the preference according to the setting of the spring 63. The other will be retained by the signals at the intersection until the first has passed well within the intersection area. The other vehicle will necessarily have had to slow down or stop. As soon as the first vehicle has passed beyond the field of its detector the effect of the second vehicle on its detector and associated apparatus will cause the signals immediately to shift, allowing it to continue on its way without delay. Since it must accelerate from a reduced speed to reach the crossing there is but slight likelihood of interference with the first vehicle even though the first has not passed beyond the intersection. No waste time is therefore required to permit the safe conduct of any number of vehicles over the crossing lanes. Traffic is seldom so heavy on any highway but what there are sufficient intervals through which a crossing vehicle may pass. A "duplex" detector, as shown in Fig. 8, having detecting coils d^1 , d^2 , at opposite ends and a common energizing coil e in the middle, can be used to lengthen the approach area, to give plenty of time to stop, to provide against the case where extending the side members to get a long detecting area would produce so much normal flux leakage that additional leakage or shunting by a vehicle would be inappreciable. The coils d^1 , d^2 , are jointly able to pass sufficient current to a mutual relay to hold the latter's armature in open-circuit relation, but while either is affected by a vehicle, the armature closes the circuit as already described.

Another use is that when a vehicle is standing in the "stopped" or opposing traffic lane (as around the corner in Fig. 8), and a second vehicle is in range of d^2 but d^1 is empty, this break in the traffic along the lane of d^1 — d^2 may be seized upon to permit such standing car in the said opposing lane to control the signals and cross over immediately after the other vehicle leaves d^2 , the signal facing the vehicle in the field of d^2 turning yellow followed by red immediately upon the vacating of d^2 , or shortly after as determined by a timer of any known form. The principle governing this phase of the invention is that on a high speed highway, the detector must be long to stop traffic fairly; but under certain circumstances, a break in traffic of the length of this long detector may rarely occur. Hence the single detector is in effect converted into two, so as to take advantage of a short break to transfer the right of way to the opposing traffic. Manual control may be incorporated into the system with slight obvious and well-known additions to permit use with such extremely heavy traffic, or any other unusual condition as by swinging lever 59 by hand.

Iron or other metal alloy having a high permeability should be used for the elongated magnetic members of the detectors. They may be divided into wires or laminations to reduce eddy current losses. They may also be used to reinforce the concrete employed in the roadway.

The flux may be distributed in any manner that will obtain the desired results. This distribution should be such as to produce a leakage through a vehicle adjacent the members, substantially proportionate to the flux remaining in the members. Such distribution may be effected by air-gaps having a reluctance of the same order of magnitude

as the reluctance encountered by the magnetic flux through the vehicle. An air-gap between terminals 45 and 46, Fig. 2, may control the total magnetic flux in the circuit. A second gap between terminals 43 and 44 should be adjusted to provide a reluctance commensurate with or if possible equal to that offered by the flow of flux through a vehicle or equivalent body between the elongated members. If desired, these gaps may be divided, one-half on each side of the coil, to balance the system more evenly, as in Fig. 3, where two similar elongated members 105 and 106 are shown arranged in proper relation to a curbing 107. Short magnetic cores 109 and 110 having coils thereon may be introduced between the terminals of these members.

Another form of detector device 112 is shown in Fig. 4, where both coils 113 and 114 are positioned at one end with the ends 116 and 117 separated. The flux will increase upon the presence of a vehicle 118 resulting in an increase of current in the relay coil 114 in this type of detector.

The use of a permanently magnetized core 44, 112, 134, in conjunction with an electromagnet energized by A. C. can be made to effect a greater sensitivity to the alternating magnetomotive force in the remainder of the device by raising the average flux density in the iron of the circuit to a point where an alternating magnetomotive force will cause a larger change in flux density than it would if the average flux density were not so raised, because through operating at a point where the slope of the hysteresis curve is steeper the resultant flux is greater.

The reluctance gaps should be shielded or otherwise properly arranged as shown in Figs. 5, 6, and 7, to prevent changing of their values by the presence of magnetic bodies and the consequent nullification of their action. Terminals 120 and 121 may correspond to any of those described in connection with Figs. 2 or 3. A magnetic shield 123 may surround the path of the leakage flux and prevent it passing through adjacent magnetically permeable bodies. Non-magnetic material 122 may be inserted to increase the structural strength. Various other forms might be devised.

It may be advisable to arrange the reluctance gaps of the magnetic circuit horizontally to direct the magnetic lines in a perpendicular direction, thereby preventing disabling the system through the presence of magnetic objects on the surface of a highway above. An end view of a magnetic system under a highway surface 130 is shown in Fig. 6. Longitudinal magnetic members 131 end in terminals 132 having their lower faces directed downwardly. Terminals 133 of another magnetic member 134 are disposed in suitable spaced relation opposing terminals 132. A coil 136 about member 134 serves either as an energizing coil or a relay coil corresponding to those shown in Figs. 2, 3, or 4, as the case may be. The arrangement with gaps below the longitudinal members 131 and perpendicular to the highway surface insures a constant value of reluctance without wilful interference from movable objects, since such objects, which could only be applied from above, would shunt flux between members 131 rather than from 131 to 133, shunting and operating rather than rendering the detector inoperative.

The detectors described are sensitive to the presence of both moving and stationary vehicles and extend over a considerable area. They may be buried under the roadway or disposed at the side, provided their field of force projects into the path taken by the vehicles. Their operation dif-

fers very considerably from that of detectors which are sensitive at but a single comparatively restricted spot, as distinguished from detection over an area of considerable extent. The advantages are obvious, since the present detectors may extend over any area desired and be of sufficient sensitivity to detect a vehicle over the entire area, or a number of abutting detectors may be employed if the area is too large for a single one, or if traffic conditions so require. Further, having no moving parts in or under the roadway, they are impervious to mud, ice, gravel, and other matter naturally present or improperly introduced. Even the relays may be located outside the detector where they are readily accessible for maintenance.

Detection over an extended area not only eliminates the necessity of timed delay devices which must be set at a maximum time period to take care of traffic moving at low speeds, producing inflexible time periods and initiating delays and interruptions to traffic moving at high speeds, but also permits extending the detector right up to the margin of the intersection so that control over the system by a vehicle is extended to include all movements that are capable of interfering with other traffic.

While the use of the timed delay principle is not necessary in the ordinary working of the system of the invention, yet its use is contemplated for special purposes, as to guard against tie-up of the signals due to breakdown of a vehicle within the field of influence of a detector, for which contingency two separate relays like 53 can be connected to the same detector in shunt or series, one responding to normal traffic conditions, while the other with a weaker armature spring is designed in effect to ignore the presence of one vehicle and respond only to more than one vehicle within the detector, with the timer, of usual or any known type, arranged to transfer control from the first or normal relay to the emergency one, so that the signals can continue to function in presence of a stalled car, control to revert to the normal relay after removal of the obstructing vehicle. Or the timer may be used where traffic is so heavy that the paired detectors on a single highway are rarely free of vehicles simultaneously. In these and other special cases, any known form of releasing device may be employed to terminate or revoke the effect of the detectors on this highway after a lapse of a given interval of time, to give the interfering traffic control of the signals. In this event, it would be desirable to provide some additional device to cause a warning signal to be shown when a signal was about to change from "go" to "stop" in the face of approaching traffic.

The great advantage of the present invention is that the vehicles themselves by their relative time of approach to and of passing through the field of the detector determine the nature and duration of the signal, in direct accord with the fundamental principles of priority of approach to the intersection and relative density of traffic on the two intersecting ways. Thus, the vehicle first reaching the approach to the intersection sets the signals on its highway to permit traffic thereon to cross, or turn, and sets the signals on the other highway to hold up traffic. If there are vehicles closely following the first, so that at least one remains within the active field of the detector which has set the signal, or the corresponding one across the intersection on the same highway, the signal remains unchanged until there

is a break in the traffic and the fields of these two detectors are momentarily unoccupied. Then, if a vehicle has entered either detector on the other highway, in the meantime, its influence causes the switch to shift and clear the crossing signals before it, only when there is a momentary pause in the transverse traffic. Since the signal stopping the traffic on either highway, is preferably initiated only when the detectors on that highway are free from vehicles, and the detecting area is of adequate extent back from the intersection to give an approaching vehicle sufficient time to stop, there is little incentive for a vehicle to crowd in close to its immediate predecessor or rush into the intersection following such vehicle at high speed in order to beat the change of signal, with resulting liability of accident, as commonly occurs with the timed delay systems.

It is apparent that my improved detector could be effectively utilized with a large number of traffic control systems. The system described being advantageous in certain instances, obviously other systems and circuits for control could be employed under special circumstances. For instance, manual control for pedestrian travel could be used, on the order of that already referred to. A hold-over detector could be used within the actual intersection area, as indicated in dotted lines at 19, Fig. 1, to prevent change of signals until a vehicle has left the intersection. It may also readily be seen that with the use of detectors abutting the intersection, a vehicle may make a complete U turn by simply entering into the field of each detector, actuating the signals in succession without stopping, in the absence of the approach of another vehicle. Also, a vehicle not having the right of way may make a right turn though confronted with a red signal, if desired, without having a continuing influence on the signals of the interfering lane. Further additional detectors may be installed for various purposes, as for route selection at irregular or multiple intersections, or a plurality of inter-controlled intersections may be linked together in a manner similar to previous practice.

One of the outstanding features of the invention is the use of means extending the detecting area lengthwise of the highway so as to effect detection over an area instead of at a point.

While the invention is set forth and described in connection with the employment of energy in the form of magnetic flux, or distributed in accordance with the principles of the magnetism throughout this detecting area, the use of other forms of energy, including radio frequency electric currents, together with appropriate guiding, conducting, or distributing means of any well-known character, is also contemplated, operating according to the general principle of a detectable variation or re-distribution effected through the presence or movement of a vehicle at or near any point along the length of such guiding, conducting, or distributing means.

Having thus described particular embodiments of my invention in their preferred forms I do not desire to be limited to the exact form and construction but submit the foregoing for illustrative purposes of the principles involved, rather than in a restricting sense.

What I desire to claim is:—

1. A vehicle detector adapted to control traffic signals, consisting of elongated parallel lengths of magnetically permeable material disposed in parallel relation to a lane of travel throughout a distance longer than the length of the longest

typical vehicle, means for producing an alternating magnetic field throughout said magnetic material, and an actuating device operable to work the signals upon the redistribution of the magnetic flux in the circuit by the positioning of a vehicle within the influence of said field.

2. A detector for free vehicles having in combination a magnetizing device, a detecting device, and magnetically permeable members extended in the direction of normal travel of such vehicles throughout a distance greater than the length of such vehicles, and so disposed that the magnetic flux therein is affected by the vehicle to be detected, so as to give a detecting impulse to said detecting device.

3. A vehicle detector adapted to control traffic signals consisting of a magnetic circuit adapted to be positioned underground adjacent a traffic lane for vehicles, longitudinal members included within said circuit of greater length than the vehicles to be detected, means for producing an alternating magnetic field through said circuit and an actuating device operable to work the signals upon the disturbance of the magnetic circuit by the positioning of a vehicle within the influence of said field.

4. A vehicle detector for traffic control consisting of a magnetic system adapted to be positioned adjacent a traffic lane for vehicles, magnetic members included within said system and arranged adjacent the traffic lane, means for producing a magnetic field through said members of suitable strength to produce a substantial leakage through a vehicle adjacent said members, a portion of increased reluctance to magnetic flux in said magnetic circuit, said reluctance being approximately equal to the reluctance through said vehicle, means shielding said portion of increased reluctance, and means for detecting the changed distribution of flux caused by such leakage so as to indicate at a remote point the presence of such vehicle.

5. A system for regulating traffic having in combination, a detecting device, magnetically permeable members extended in the direction of normal traffic of such vehicles throughout a distance greater than the length of such vehicles,

so disposed that the magnetic flux therein is affected by the vehicle to be detected, means for indicating right-of-way, and means to cause the detecting device to effect the operation of the indicating means upon said magnetic flux being affected by a vehicle.

6. Apparatus for directing the operation of vehicles having in combination, traffic signals, a magnetic circuit adapted to be positioned underground adjacent a traffic lane for vehicles, longitudinal members included within said circuit of greater length than the vehicles to be detected, means for producing an alternating magnetic field through said circuit, and devices controlling the action of the signals in response to disturbance of the magnetic circuit by the positioning of a vehicle within the influence of said field.

7. In a right-of-way indicating system, in combination, a signal, a magnetic circuit adapted to be positioned adjacent and apart from a traffic lane for vehicles, magnetic members included within said circuit of greater extent in the direction of travel in such lane than the vehicles to be detected, means for producing an alternating magnetic field through said circuit, and an actuating device operable to work the signal upon the disturbance of the magnetic circuit by the positioning of a vehicle within the influence of said field.

8. A system for regulating free vehicle traffic where a plurality of lanes of traffic interfere with one another, including a traffic control device, a detector having a field of sensitivity covering an area greater than that occupied by any one vehicle and positioned below at least one of the lanes located at the approach to the area of interference, said detector including a magnetizing device, a detecting device, and magnetically permeable members extended in the direction of normal travel of such vehicles throughout a distance greater than the length of such vehicles, and means controlling the traffic control device in accordance with the disturbance of the magnetic flux in the magnetically permeable members caused by the presence of a vehicle.

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