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AUTOMATIC PROPORTIONAL TRAFFIC CONTROL DEVICE

Filed May 25, 1956

2 Sheets-Sheet 1

FIG. 1

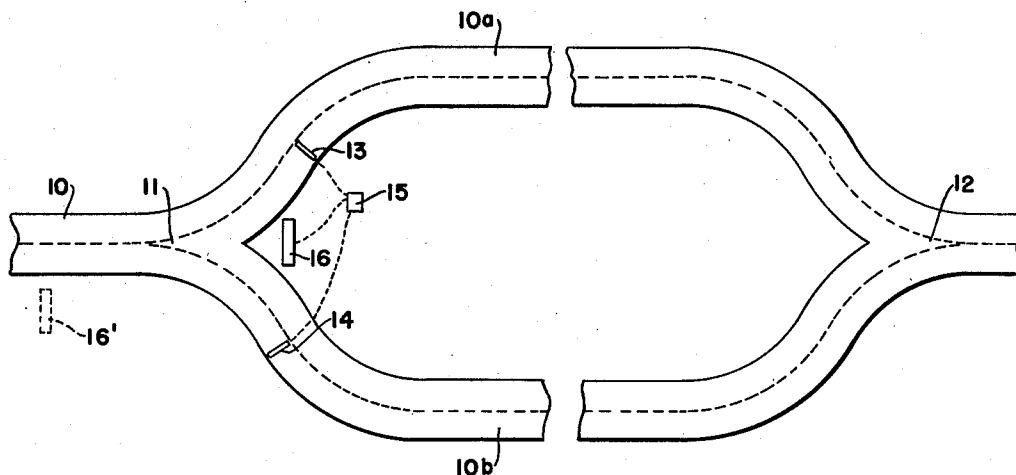
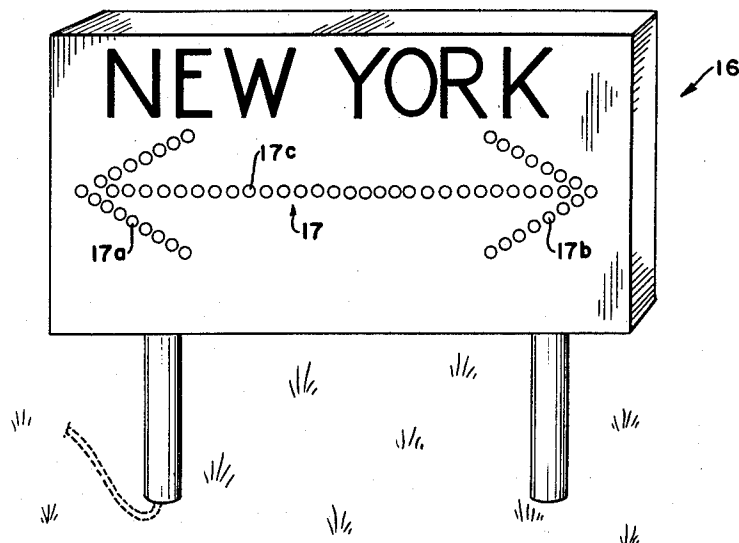


FIG. 2



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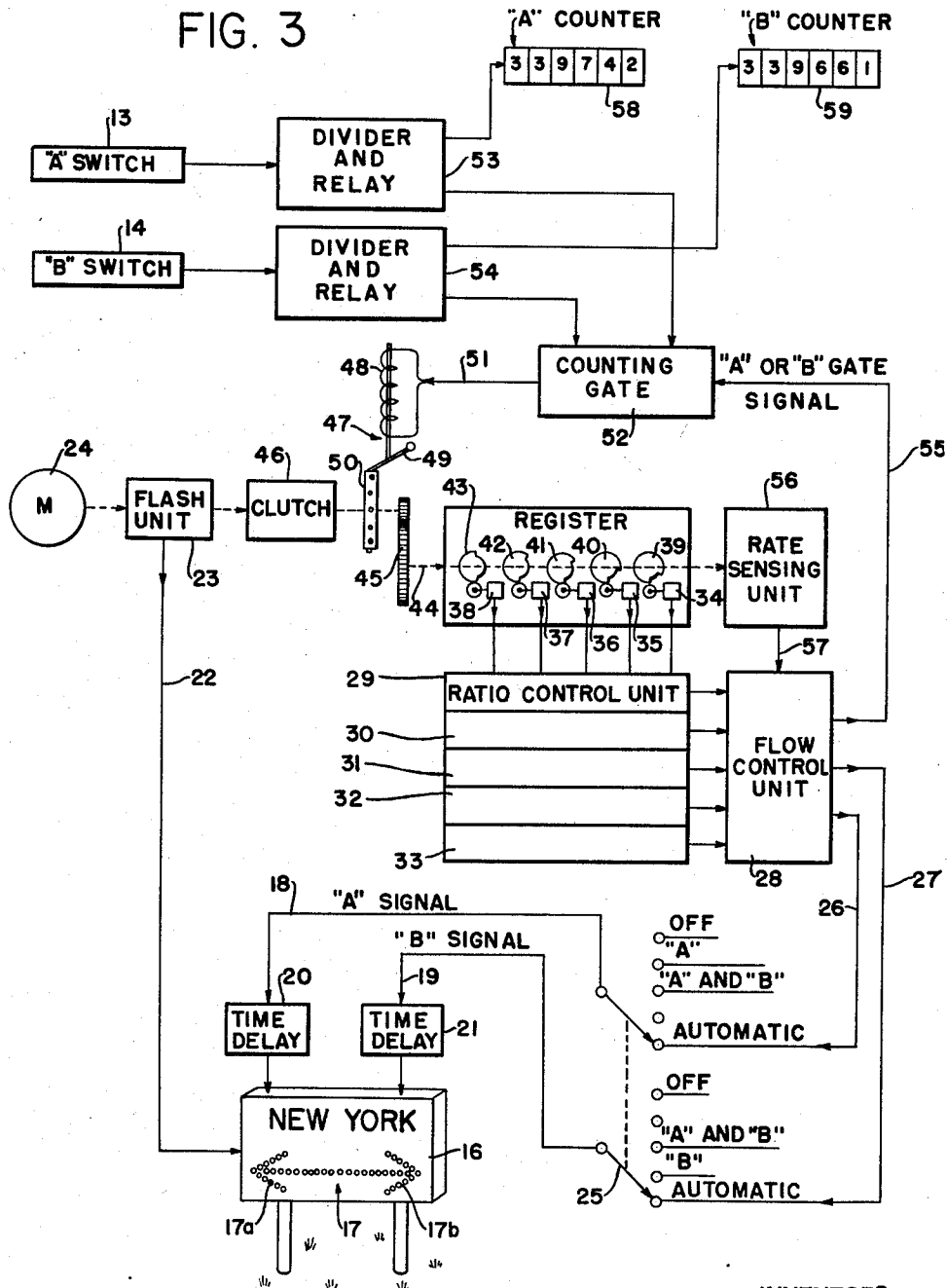
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FIG. 3



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AUTOMATIC PROPORTIONAL TRAFFIC CONTROL DEVICE

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2 Claims. (Cl. 340—31)

The present invention relates to traffic control equipment, and more particularly to a novel and improved control system which is operative automatically to direct motor vehicle traffic in a desired manner over a plurality of highways, routes or streets.

In many instances, modern road or street systems provide alternate routes which may be taken by motor vehicle traffic in order to reach a particular destination. In most cases, the selection of the route to be taken is left to the discretion of the vehicle operator, or in some cases permanent signs are erected for the purpose of recommending or directing the use of certain routes at certain times. However, present arrangements are not entirely satisfactory since the vehicle operator has no means of determining, either upon or before reaching the junction of the alternate routes, the traffic conditions prevailing at the time. Accordingly, it is impossible for the vehicle operator to intelligently select the route which will most conveniently carry him to his desired destination under the prevailing conditions. As will be readily understood, traffic load and conditions will vary substantially from time to time, being affected greatly by such factors as business rush traffic, school hours, spectator events, road surface conditions, and weather.

Broadly speaking, the present invention provides a novel traffic control system which is operative automatically to provide traffic-directive information for routing the flow of vehicle traffic onto various highways of a plurality thereof in proportions adapted best to suit the traffic load or conditions prevailing at the time. As a corollary, the improved traffic control system renders driving conditions more safe by reducing the average traffic density on particular ones of the alternate highways or routes and thus increasing the average distance between vehicles. The improved system also results in the better equalization of wear on the various highways by insuring that certain ones thereof are not disproportionately burdened with traffic.

The new traffic control system incorporates a flashing illuminated sign generally located at or slightly ahead of the intersection of the alternate highways, in combination with means for determining the volume and time rate of traffic flow over the various routes. Such flashing illuminated sign may, of course, be located at any distance from various routes, highways, or streets to conform with the necessity for adequate time and opportunity to make a selection of routes. The system includes means for processing the traffic information in such manner as to cause the illuminated sign to direct traffic onto the highways in accordance with a preferred schedule, taking into account the relative highway capacities and the rate of traffic movement thereon under various traffic conditions.

In one application of the new system, traffic may be routed over alternate routes or bypasses in accordance with a predetermined fixed proportion or ratio, or means may be provided for automatically altering the ratio as a function of the total volume of traffic. Thus, under

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certain traffic conditions it may be desirable to direct 90 percent of the traffic over one route and 10 percent over another route; under other conditions it may be desirable to direct 60 percent of the traffic over one route and 40 percent over another. The apparatus of the invention provides for the automatic selection of a ratio calculated to best utilize the road facilities for handling traffic at the then prevailing rate of flow. The invention also contemplates the provision of means for manually controlling the traffic-directing sign, if desired, so that all traffic may be directed over one route in the event of an accident or other traffic tie-up on the other route.

As a more specific feature, the apparatus of the present invention includes time-delay means operative, when the traffic-directing sign is actuated for changing the flow of traffic from one route to another, to prevent such a sudden change in directive signals as would tend to confuse oncoming traffic. Thus, the traffic-directing sign incorporated in the new system may include an illuminated arrow having points at opposite ends, or other symbols such as route or highway numbers or street names or numbers may be utilized instead of arrows depending on the particular traffic situation desired to be controlled. Where the arrow is employed, the shaft portion of the arrow is common to both points and remains illuminated at all times and traffic is directed in one direction or the other by illuminating one or the other of the arrowheads. The change of flow of traffic is accomplished by extinguishing one arrowhead and illuminating the other. However, since a sudden change might tend to confuse the immediately oncoming traffic when the illuminating sign is located at or slightly ahead of an intersection, means are provided for delaying the extinguishing of one arrowhead after illumination of the other. Accordingly, when the traffic-directing sign changes from one direction to another, there is a brief interval when both arrowheads are lighted. This assures a smooth transition in the flow of traffic. Similar provisions are made where the directive signals employed are other than arrows, as will be readily understood.

The invention also provides means for obtaining a numerical count of the traffic flowing over the separate highways, as may be desirable for the purpose of conducting traffic flow studies, for example. Such studies may be desirable from time to time for the purpose of adjusting or correcting the traffic flow ratios in accordance with current road and traffic conditions.

For a better understanding of the invention, reference should be made to the following detailed description and accompanying drawing, in which:

Fig. 1 is a simplified schematic representation of a highway system having alternate routes and incorporating the new traffic control system of the invention;

Fig. 2 is an enlarged perspective view of the traffic flow directing sign incorporated in the new system; and

Fig. 3 is a simplified schematic representation of an electrical control circuit incorporated in the new system.

In Fig. 1, the numeral 10 designates a highway which divides, at a point designated by the numeral 11, into separate routes 10a, 10b. At some later point, the highways 10a, 10b rejoin, at a junction 12, which may sometimes be designated herein as a common destination point.

In accordance with the invention, each of the highways 10a, 10b is provided with a vehicle counting device 13 or 14 which is adapted to sense the number of vehicles traveling over the highways in the direction from left to right. The sensing devices or traffic detectors 13, 14 may, in themselves, be conventional. They may take the form of suitable trip plates, for example, set flush with the pavement, photo-electric units, hydraulic or pneumatic pressure-responsive devices actuated through suitable

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hoses stretched across the pavement, induction pickup coils buried in the roadway, or other similar devices. The traffic flow information derived by the traffic detectors 13, 14 is channeled to a computer device 15, to be described in more detail, which processes the information and in response thereto appropriately energizes a traffic flow directing sign 16 located in a prominent position near the junction 11 of the highways 10a, 10b so as to be in the full view of the immediately oncoming traffic approaching the intersection. In the exemplary arrangement of Fig. 1, the flow directing sign 16 is positioned immediately at the junction in the highways 10a, 10b. Alternatively, the sign may be positioned somewhat ahead of the junction point, as indicated at 16'.

As shown in Fig. 2, the sign 16 is provided with a large arrow-like indicator 17, having points or heads 17a, 17b at its opposite ends. The indicator 17 is comprised of a plurality of electric bulbs, for example, which may be selectively illuminated. In the illustrated form of the apparatus, the shaft portion 17c of the arrow-like indicator is normally lighted at all times, while the opposite head portions 17a, 17b are alternatively lighted so that the indicating arrow points in one direction or the other. Occasionally, both head portions 17a and 17b will be illuminated at the same time to direct traffic in both directions onto the alternate highways 10a, 10b or to provide smoothness in the transition of flow from one highway to the other.

Referring now to the schematic diagram of Fig. 3, the flow directing sign 16 is provided with an "A" signal and a "B" signal through lines 18, 19, respectively. Line 18, carrying the "A" signal, passes through a time-delay control 20 and then to the sign 16, and is adapted, when energized, to illuminate the head 17a of the arrow 17. Line 19, carrying the "B" signal, connects with the sign 16 through a similar time-delay device 21, and is adapted, when energized, to illuminate the head portion 17b of the arrow. A third control line 22 connects the sign 16 with a flashing switch 23 driven by a suitable electric motor 24. The motor 24 is adapted for continuous actuation, so that the source of power for illuminating the arrow 17 is continuously interrupted to effect a flashing of the arrow, regardless of which head portion thereof is energized. The flashing of the arrow 17 renders it more effective in attracting the attention of the vehicle drivers in advance of the dividing point 11 of the highway, so that there is ample time afforded the driver in following the instructions of the sign.

In the illustrated form of the invention, control lines 18, 19 carrying the "A" and "B" signals, respectively, are connected to a ganged selector switch 25 having a plurality of operative positions. In the position shown, the switch 25 adapts the apparatus for automatic operation in a manner to be described. In other positions of the switch 25, the continuous application of the "A" or "B" signals, or both, may be provided, or the sign may be completely shut off. The specific arrangement of circuit connections for effecting other than automatic operation of the sign 16 are considered to be within the knowledge of persons skilled in the art and will therefore not be described in detail.

When the switch 25 is set for the automatic control of the sign 16, lines 18 and 19 are connected through control lines 26, 27, respectively, to a flow control unit 28. The flow control unit 28 is in turn connected with a plurality of ratio control units 29-33. Each of the several ratio control units 29-33 is connected with all of a plurality of double-throw switches 34-38 adapted for independent operation by means of a plurality of cams 39-43. The ratio control units 29-33 include selector switch means (not shown) having eleven positions, and these switches may be individually set to be in circuit with any one of the switches 34-38 in one or the other of its operative positions.

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In accordance with the invention, each of the cams 39-43 is proportioned differently, and although only five such cams are illustrated, it will be understood that any number may be employed. As an example, the cam 39 may be so formed that the double-throw switch 34 is in one of its operative positions for 36 degrees of rotation of the cam and in its other operative position during the remaining 324 degrees of rotation. In a similar manner, the cam 40 may be contoured to hold the switch 35 in one position during 20 percent of each revolution, and in another position during the remaining 80 percent; cam 41 may be arranged to hold switch 36 in one position during 30 percent of each revolution, and in the other position during the remaining 70 percent; cam 42 may be arranged to hold switch 37 in one position during 40 percent of each revolution and in its other position during the remaining 60 percent; the fifth cam, 43, may be arranged to hold the switch 38 in either of its operative positions for equal percentage periods of each revolution of the cam.

By properly setting the selector switch means for each of the ratio control units 29-33, any one of the units may be connected in circuit with any one of the switches 34-38, in either of the operating positions of the switches. The arrangement is such that when the circuit is completed to a ratio control unit, an "A" signal is provided by the unit, while a "B" signal is provided at other times. For example, if it is assumed that the ratio control unit 29 is connected in circuit with the switch 35, when the latter is in a depressed position, an "A" signal will be provided during an 80 percent portion of each cam revolution. If the selector switch is changed to connect the switch 35 in circuit in its released position, an "A" signal will be provided during a 20 percent portion of each cam revolution. It will thus be apparent that by appropriately setting the selector switch means of the ratio control unit 29, the "A" and "B" signals may be provided in any ratio, ranging from zero to 100 percent of each cam revolution, in increments of 10 percent.

Each of the ratio control units 29-33 is provided with its own selector switch means so that the individual units may be arranged to proportion the "A" and "B" signals in a different manner. The flow control unit 28 then functions to select one of the ratio control units and render it operative. The flow control unit acts in response to the rate of traffic flow, and is operative to select different ratio control units for different rates of traffic flow. In this manner, the division or proportioning of the traffic flow over the separate highways may at all times be best suited to the prevailing traffic conditions.

As illustrated in Fig. 3, the several cams 39-43 are rotated in unison by a single shaft 44. The shaft 44 is driven through a set of reduction gears 45, connected to the continuously driven motor 24 through a suitable slip clutch 46 and escapement mechanism 47. The escapement mechanism 47 is actuated by a solenoid device 48 which, when energized, lifts a lever 49 and permits rotation of an escapement wheel 50 through one unit of movement.

To actuate the escapement solenoid 48, the operating coil thereof is connected through a line 51 to a counting gate 52. The counting gate 52 is in turn connected to the traffic sensing devices 13, 14 through relays 53, 54, respectively, so that each vehicle passing over the detecting devices 13, 14 causes an appropriate signal to be directed to the counting gate 52.

In the illustrated arrangement, during periods when traffic is directed over highway 10a, it is desired to count only those vehicles moving over the highway 10a. This is accomplished by appropriately connecting the counting gate 52, through line 55, to the flow control unit 28. During times when "A" signals, for example, are directed out of the flow control unit 28, an appropriate signal is directed through line 55 to the counting gate

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52 so that the escapement mechanism 47 is actuated each time a vehicle traveling over highway 10a passes over the sensing device 13. Such occasional vehicles as may pass over the sensing device 14, on highway 10b, will not affect the count.

Assuming that the head portion 17a of arrow 17 is illuminated, and traffic is being directed over highway 10a, each time a vehicle passes over the sensing device 13 the counting gate 52 will pass a signal to the escapement device 47, actuating the latter and permitting one unit of movement of the escapement wheel 50. This causes a partial rotation of the shaft 44, carrying the several switch-actuating cams 39-43. Depending on which one of the several ratio control units 29-32 is at that time rendered effective by the flow control unit 28, "A" and "B" signals will alternately be directed to the sign 16, to alternately energize or illuminate the arrowhead portions 17a, 17b. Assuming further, by way of example, that the ratio control unit 31 is effective, an "A" signal will be directed to the sign 16 until such time as a predetermined number of vehicles have passed over the detecting device 13 and the cam 41 has rotated to a sufficient extent to change the position of switch 36. At this time, the ratio control unit 31 causes a "B" signal to be directed to the sign 16 along with a simultaneous discontinuance of the "A" signal. The head portion 17b of the arrow 17 is immediately illuminated. However, in accordance with the teachings of the invention, the time delay device 20 operates to sustain the illumination of the arrow-head portion 17a for a short period of time, even though the "A" signal has been discontinued. Thus, for a brief interval, both head portions 17a and 17b of the arrow are illuminated, assuring the smooth transition in traffic flow from highway 10a to highway 10b.

Simultaneously with the application of the "B" signal to the sign 16, an appropriate signal is sent through line 55 to the counting gate 52 so that impulses of the traffic sensing device 14 and relay 54 are directed to the escapement mechanism 47, while impulses from the sensing device 13 and relay 53 are excluded therefrom. During the following period, each vehicle moving over the alternate route 10b will effect the actuation of the escapement mechanism 47 and will cause rotation of the cam shaft 44. After a predetermined rotation of the shaft 44, the cam 41 comes to a position in which the switch 36 is returned to its first position and the ratio control unit 31 is conditioned to provide "A" signals to return the flow of traffic to highway 10a. When the "A" signals are resumed, "B" signals are simultaneously terminated. However, the time delay device 21 maintains the head portion 17b of the traffic directing arrow 17 illuminated for a brief interval to avoid an abrupt transition of traffic from one highway to the other.

As will be apparent, the rotation of the cam shaft 44 is dependent solely upon the movement of vehicles over the alternate routes to which the traffic is directed. Accordingly, the proportioned contours of the cams 39-43 are representative of the proportions in which the vehicles will be directed to the alternate routes.

In accordance with the invention, means are provided for automatically selecting the proper ratio control unit to be rendered effective for best handling the prevailing flow of traffic. Accordingly, a rate-sensing unit 56 is provided which is operative in response to variations in the traffic load to render different ones of the ratio control units effective in the control system. Thus, in the illustrated arrangement, the cam shaft 44 is connected to the rate-sensing unit 56 in such manner that the rate of rotation of the shaft 44, which is indicative of the rate of traffic flow, produces a control signal in the sensing unit 56 which is directed through line 57 to the flow control unit 28. Thus, under conditions of relatively light traffic, it may be desirable to route 90 percent of the traffic over one of the highways and 10 percent of the traffic over the other highway. To accomplish this, the

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rate-sensing unit 56 is effective, in response to the relatively low rate of rotation of the cam shaft 44, to so condition the flow control unit 28 that a particular one of the ratio control units is rendered effective in the control system. When the flow of traffic becomes heavier, the shaft 44 will rotate at higher speeds and the rate sensing unit 56 will condition the flow control unit 28 for rendering others of the ratio control units effective in the circuit. As will be readily apparent, the proportional flow of traffic over the alternate routes may readily be made to conform with optimum conditions as determined by scientific studies, for example.

To facilitate the making of traffic flow studies, and for other purposes, suitable counter devices 58, 59 may be provided in connection with the relays 53, 54 and traffic sensing devices 13, 14. For this purpose, suitable dividing means are incorporated in the relay devices 53, 54 so that each signal directed to the relay devices is sent to the counters 58, 59 as well as to the counting gate 52. As will be readily understood, the counting devices 58, 59 may be adjusted or reset without in any way affecting the control system.

The advantages of the invention should now be apparent. The new traffic control device provides for the automatic routing of vehicular traffic over selected highways, routes or streets in such manner that most advantageous use is made of the road facilities. The new system operates in a continuous cycle to alternately direct the vehicles over selected routes in proportions designed to maintain a desired optimum traffic density on the various routes, in accordance with the traffic conditions prevailing at the time. Moreover, the new system provides means for altering the ratio of traffic flow in accordance with variations in traffic conditions so that the practical aspects of such varying conditions are automatically taken into consideration in the handling of the traffic. Thus, under light traffic conditions, it may be desirable to route the traffic substantially exclusively over one highway. On the other hand, under heavy traffic conditions it may be desirable to route the traffic equally over the several routes. The particular flow ratios will, of course, be a matter of empirical determination at each location. However, the system of the invention is adapted to readily accommodate various patterns of traffic handling. Moreover, while in the illustrated apparatus, means are provided for altering the traffic flow ratio in accordance with the total rate of flow of traffic, the system may as well be adapted for controlling the traffic flow pattern in accordance with time and other factors. The flow control unit 28, which is operative to selectively render the several ratio control units 29-33 effective may be provided with such additional control instrumentalities as may be deemed necessary or desirable for the particular traffic conditions encountered, and such variations are deemed to be in the spirit and scope of this invention.

One of the specific advantageous features of the invention resides in the traffic flow control sign 16 having a flashing arrow-like directive indicator 17 thereon. The arrangement is such that head portions of the arrow-like indicator may be alternately illuminated, providing a clearer and readily visible signal directing oncoming traffic onto a selected one of the alternate highways. The same arrangement can of course be provided with other symbols. The sign is also provided with control means operative during periods of transition to sustain illumination of one of the head portions of the arrow-like indicator after the other head portion has been energized. This avoids possible confusion of the immediately oncoming traffic and provides for a smooth transition in the flow of traffic from one alternate highway to the other.

It should be understood that the specific apparatus herein illustrated and described is intended to be representative only, as certain changes may be made therein

without departing from the clear teachings of the invention. For example, the new system may be readily adapted for use as a continuous automatic traffic monitor, in which case the sign 16 may provide informative, rather than directive, indicia, for the purpose of advising oncoming traffic of the conditions to be encountered ahead.

It is also contemplated that the various control instrumentalities incorporated in the new system may be located remotely, at a central control station, where the traffic conditions may be continuously supervised, and controlled. The apparatus may also be arranged in portable form, where desired, enabling it to be transported from place to place to handle unusual traffic conditions. Reference should therefore be made to the following appended claims in determining the full scope of the invention.

We claim:

1. In a control system for use in monitoring the flow of moving traffic on traffic lanes of a highway system and of the type comprising an indicator positioned in noticeable relation to traffic approaching the highway system and having means for presenting changeable information, and control means for operating the indicator to direct approaching vehicles onto selected highway lanes, the improvement in said control means comprising detecting means in the lanes positioned downstream, in the direction of traffic flow, from the indicator, means for rendering one of said detecting means at a time effective, means for registering the number of vehicles counted by the effective one of said detecting means, cycling means

responsive to the registry of a predetermined number of vehicles by the effective detecting means to actuate said indicator to direct traffic into another of said lanes and to render effective the detecting means for the other lane, said cycling means comprising a plurality of cams of varying surface contour, said cams being movable through a portion of a revolution in response to the registry of each vehicle, switch means operated by the cams for actuating said indicator and rendering effective selected ones of said detecting means, and means for rendering selected ones of the cams effective in response to variations in the number of vehicles registered per unit of time.

2. The control system of claim 1, in which said cycling means includes a solenoid operated escapement actuated by the effective detecting means, said cams being connected to said escapement for step-by-step rotation thereby.

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