Aug. 27, 1968 J. D. H. DONNAY 3,399,379

HIGHWAY INTERSECTION SYSTEM

Filed Sept. 17, 1964 3 Sheets-Sheet 1

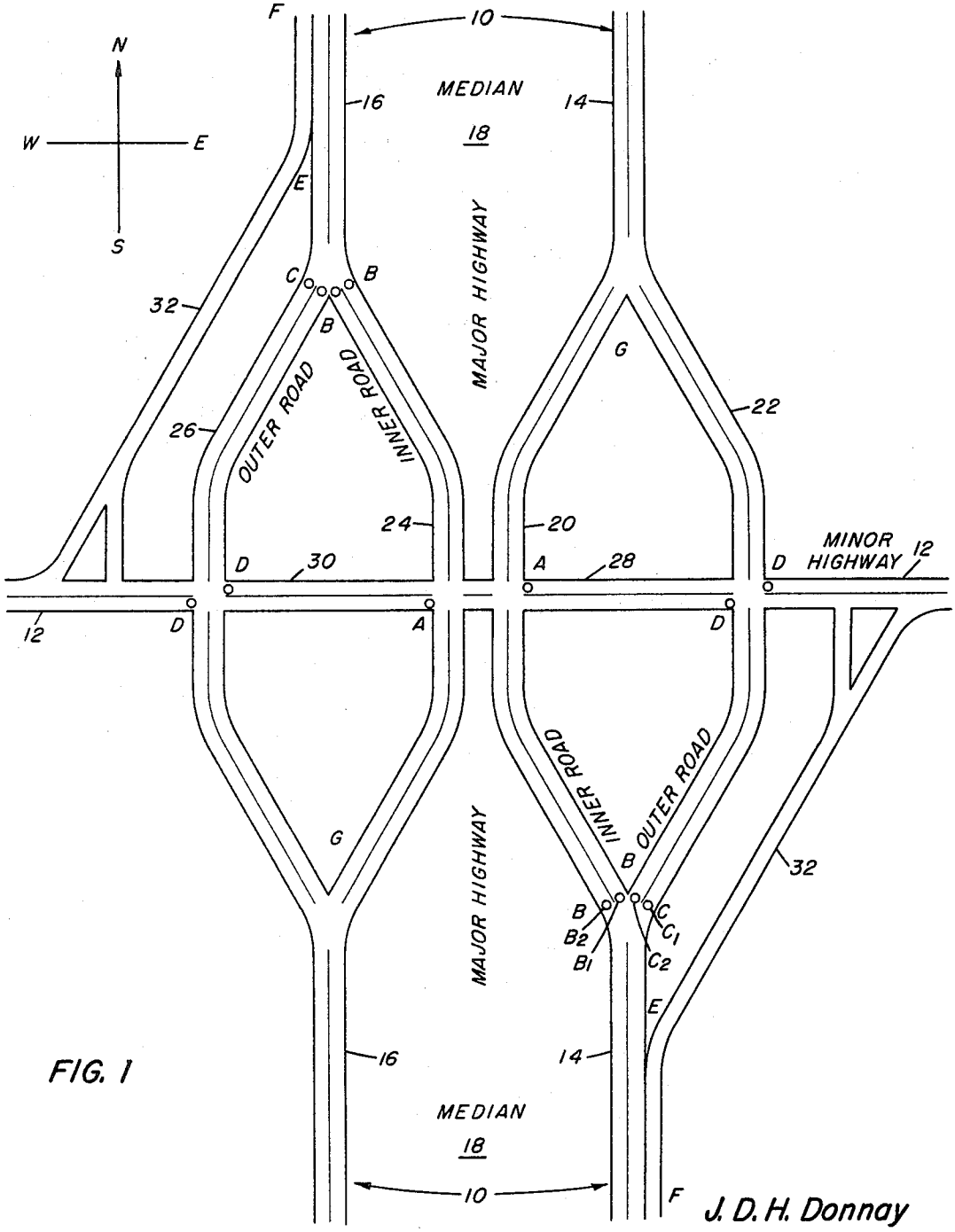


FIG. 1

J. D. H. Donnay
INVENTOR.

BY

Walter J. Finch
ATTORNEY

Aug. 27, 1968 J. D. H. DONNAY 3,399,379

HIGHWAY INTERSECTION SYSTEM

Filed Sept. 17, 1964 3 Sheets-Sheet 2

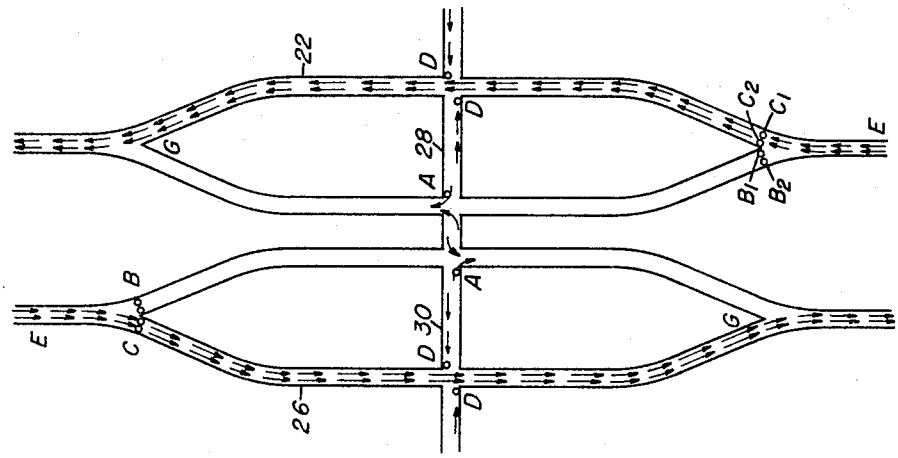


FIG. 4

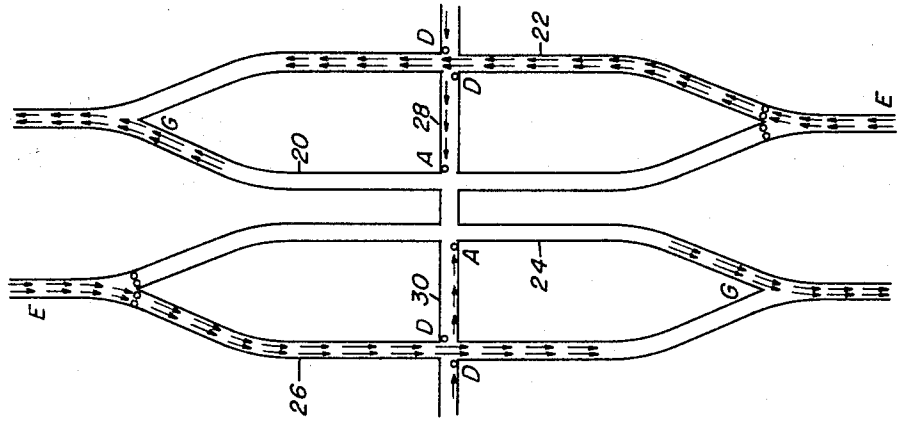


FIG. 3

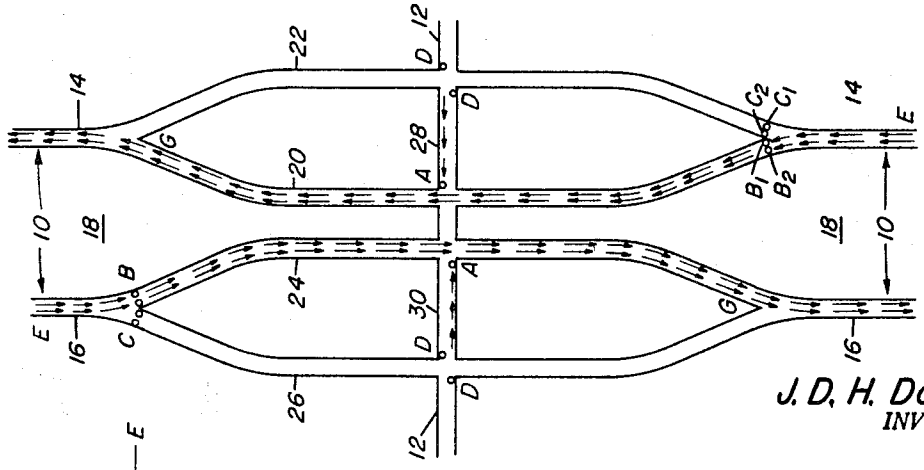


FIG. 2

J. D. H. Donnay
INVENTOR.

BY

Walter G. Finch

ATTORNEY

Aug. 27, 1968 J. D. H. DONNAY 3,399,379

HIGHWAY INTERSECTION SYSTEM

Filed Sept. 17, 1964 3 Sheets-Sheet 3

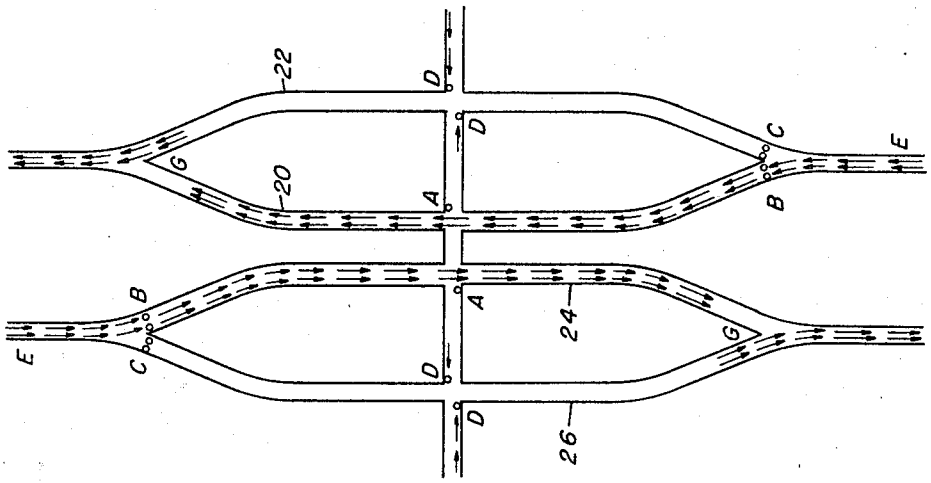


FIG. 6

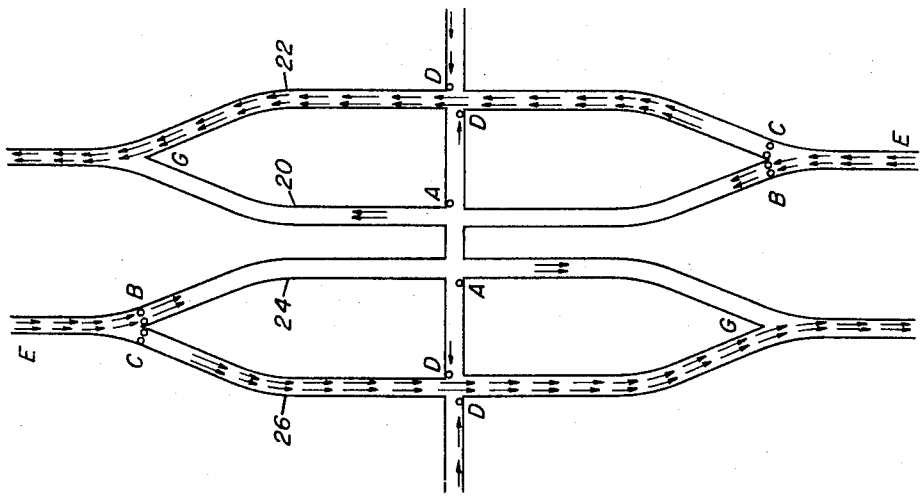
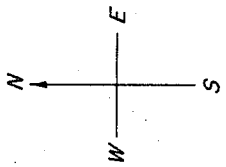


FIG. 5



J. D. H. Donnay
INVENTOR.

BY Walter J. Finch
ATTORNEY

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3,399,379

HIGHWAY INTERSECTION SYSTEM

Joseph D. H. Donnay, 7200 Charles St., Lutherville, Md. 21093

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2 Claims. (Cl. 340—40)

This invention relates generally to highway intersection systems, and more particularly it pertains to an improved major-minor highway crossing system at grade.

It is an object of this invention to provide a road intersection arrangement for continuous, uninterrupted flow of traffic on a major highway without recourse to grade separation.

Another object of this invention is to provide a minor road intersection system at grade with a major road in which minor road traffic is subjected to less waiting than occasioned with the usual traffic light arrangements of prior art.

Still another object of this invention is the provision of a system of highway intersection system at grade wherein all crossings are made across an empty road at right angles and all turns strictly directional all with perfect safety and no confusion.

By a new geometric design of road intersection system and appropriate system of time controlled traffic lights this invention requires no overpass construction but is well adapted to a later stage of such construction if desired should the minor highway become of major importance.

This invention further contemplates a diamond arrangement of highway intersection for least interruption of flow of traffic on a minor highway and no stoppage of traffic on the intersecting major highway and wherein the land acquisition is reduced to a minimum so that private use of the encompassed land can be continued.

An especially attractive feature of this invention lies in the fact that it is well adapted to urban as well as rural use.

Other objects and attendant advantages of the invention will become more readily apparent and understood from the following detailed specification and accompanying drawings in which:

FIG. 1 is a plan view of a major-minor highway intersection system incorporating features of the invention; and

FIGS. 2, 3, 4, 5 and 6 are traffic-flow patterns illustrating the working of the invention.

With reference now to the details of the drawings, particularly FIG. 1, the new type of intersection system of this invention is intended for any crossing of a major by a minor road. By a new geometric design of the intersection system and by an appropriate system of controlled traffic lights it achieves the result that the traffic on a major road **10** need not be interrupted to permit the crossing by the traffic of a minor road **12**.

A major highway **10**, as best shown in FIG. 1 is provided with a four-lane highway having a median strip **18**, because this situation is likely to be the more common. The "Diamond Switch" of this invention, however, is applicable to a two-lane highway just as well.

The north-bound traffic, in road half **14**, at alternate periods, is made to use either the inner road **20** or the outer road **22** to cross the minor highway. The south-bound traffic, in half **16**, is similarly made to use either the inner road **24** or the outer road **26**, thus permitting minor traffic to cross whichever is unused at the time.

The cycle of operations is shown on FIGS. 2, 3, 4, 5 and 6. The traffic lights or changeable signs are designated by letters.

At time I, as indicated in FIG. 2, the major traffic is using the inner roads **20**, **24** and lights A are closed to prevent minor traffic from crossing them. Lights B are open allowing access on the inner roads to the major traffic. Lights C close the outer roads **22** and **26** to major traffic. Lights D open the way to minor traffic, which may enter the reservoir roads **28** and **30** between outer and inner roads; lights D also close the outer roads, duplicating the function of lights C, as an added safety; and a permanent sign NO LEFT TURNS is placed at D, to prevent minor traffic from making a left turn.

Minor traffic that is approaching the intersection, stops at A, minor traffic that is leaving the intersection is free to cross the outer roads and is on its way. At E, some distance ahead of the fork, traffic on the major highway **10** is alerted by the changeable sign SWITCH SIGNALS AHEAD: BEAR LEFT.

When the reservoir roads **28** and **30** are full, or when enough time has elapsed, major traffic is about to be switched from inner roads to outer roads. The signal at E changes from BEAR LEFT to BEAR RIGHT, shortly before the lights at B and C change, B from green to red and C from red to green.

It is to be noted that both lights B and C have two lights each; one with subscript B_1 for the outer lane of traffic, the other with subscript B_2 for the inner lane, both driving in the same direction on the same highway half. The outer lights B_1 and C_1 are switched a couple of seconds before the inner ones, B_2, C_2. This insures that the traffic of the outer lane will switch to the outer road ahead of the traffic in the inner lane, so that the two lanes will remain separate. We now come to time II, as indicated in FIG. 3.

At time II lights D, which have changed at the same time as the B and C lights, prevent minor traffic from crossing outer roads **22** and **26** but let major traffic free to use outer road. Lights A remain red to minor traffic in reservoir, roads **28**, **30**, while the lengths of the inner roads **20** and **24** empty of traffic. FIG. 3 shows the last cars leaving the intersection through the inner roads **20** and **24**, while the following cars, that have been switched at BC, are progressing along the outer roads **22** and **26**, duly protected at D. When the inner roads are completely empty, the lights at A change; this is when time III begins.

At time III as indicated by FIG. 4, the lights at A open the intersection to minor traffic that has been waiting in the reservoir roads **28** and **30**. Some cars turn right, some turn left, as shown, onto the empty inner roads; some others go to D, where the red light prevents them from crossing the outer roads **22** and **26**. Some newly arrived minor traffic stops at D and waits for the next switch to enter the reservoir.

As soon as the intersection at A is cleared of cars, major traffic may be switched to the inner roads again. The first thing that happens is that the alerting signal at E changes from BEAR RIGHT to BEAR LEFT a couple of seconds before the lights at C and B are reversed. The inner-lane lights C_2 change first, then the outer-lane ones C_1, that is, the inner-lights C_2 turn from green to red as the inner-lights B_2 turn from red to green; then the outer-lights C_1 turn red as the outer-lights B_1 turn green. This precaution is similar to the one described at the end of time I (above). Simultaneously, with the change at the inner lights B_2 and C_2 lights A have changed to stop minor traffic from crossing inner roads. We now enter time IV(a).

At time IV(a) as indicated by FIG. 5, major traffic has just been switched from outer to inner roads. The lights at D remain red to minor traffic; more cars are waiting outside the reservoir at D. A few cars are progressing along the inner roads **20** and **24** after having turned from the minor highway at A. They are on their way to merge with the major traffic on the outer roads **22** and **26** at the far-end fork. A sign MERGING TRAFFIC may be placed at that fork at G if desired.

At time IV(*b*) as indicated by FIG. 6, major traffic is leaving the intersection on the outer roads **22** and **26**. The following cars of major traffic have almost filled the length of the inner roads **20** and **24**. Lights D are about to change. At time I, as indicated by FIG. 2, lights D open the way to minor traffic and the cycle repeats.

It will be noted that FIG. 1 further shows an ALL TURNS FROM RIGHT sign F with outer connection road **32** to minor the highway **12**. This device also permits the major traffic to make U-turns by joining with the minor traffic and making a left turn at the second A light or D light.

The "Diamond Switch" combines a large number of advantages. They are listed as follows:

(1) Continuous, uninterrupted flow of traffic on major highway without the necessity to have recourse to grade separation.

(2) Less waiting for minor road traffic than with the usual traffic lights of the previous art; so, that, even though the crossing requires two or three steps, less total time is spent by minor traffic at the intersection.

(3) Any 4-leg intersection of the simplest design can be used at the crossing of the inner roads and also at the crossing of the outer roads. All crossings are made at right angles, over an empty road.

(4) Facility and safety of maneuvers: right-turn, through crossing, and left-turn for both highways; U-turn for major highways. (U-turns for minor highway are equally easy and safe should they be required.)

(5) All turns in the intersection are directional.

(6) No special re-education of the public is required; the new system uses familiar signs and is self-explanatory.

(7) Applicability to urban as well as to rural problems.

(8) The "Diamond Switch" is well adapted to stage development; if an overpass is built later, the outer roads can be used to build a diamond interchange.

(9) The "Diamond Switch" is flexible in design.

Two examples of geometric design are shown in FIGS. 1 and 2. The critical points are indicated by the letters that have been used to designate the lights. In particular, the storage reservoir enclosed between inner and outer roads bound in one and the same direction can vary in size very considerably. The capacity of the system can be sufficient to accommodate an increasing minor traffic until such time as the minor highway would itself become a major highway, when the slowing down of its traffic would cease to be acceptable and grade separation would become indicated.

(10) From the point of view of purchase of real estate, the area inside the diamond need not be purchased; present use of the land, for gas stations, restaurants, etc., can be continued. This can be contrasted with the acreage that must be acquired in a cloverleaf interchange, for instance.

(11) Existing ALL-TURNS-TO-THE-RIGHT outer connections may be used, in certain cases, as part of the outer roads, thus keeping down to a minimum the purchase of new right-of-way.

(12) Finally, as to maintenance cost, the system of light signals would be the main item. As the "Diamond Switch" would normally be installed at a problem intersection that needs correction, a system of traffic lights would already be in operation there. Although it would have to become more elaborate, it would not have to be a particularly sophisticated system.

As an example the following description shows how the invention can be used, without any outer connections (**32**, on FIG. 1), in case the major highway is a two-lane

highway, instead of a four-lane highway as shown on the FIGURES 1 to 6. At B and C, instead of lights that alternately change from green to red, changeable luminous signals are placed that alternately read THROUGH TRAFFIC ONLY and FOR ALL TURNS. The cycle of operations is as follows:

At time I (FIG. 2) B is open to THROUGH TRAFFIC ONLY and C reads FOR ALL TURNS: motorists who are on the major highway, **14** or **16**, and wish to turn right do so at D onto road **12**, those who wish to turn left or to make a U-turn turn left at D onto road **28–30** and wait at stoplights A; motorists who approach the intersection on the minor highway will stop at A unless they wish to turn right at D to merge at G.

At time II (FIG. 3) B has changed to read FOR ALL TURNS and C has changed to read THROUGH TRAFFIC ONLY, while D stops minor traffic from crossing outer roads **22** and **26**. Lights A remain red to minor traffic in reservoir, **28–30**, while the inner roads **20** and **24** empty of traffic. During this time motorists on the major highway who wish to turn left may do so at A, while those who wish to make a U-turn can do it, before they reach the minor highway at A, on half-turn connections (not shown on FIG. 3) between the inner roads **20** and **24**.

From then on the cycle proceeds essentially as described above, with the different meaning attached to signals B and C, as already noted.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A highway intersection system comprising a major road consisting of a pair of lane means divided by a median strip, with one of said lane means being for traffic in one direction and the other of said lane means being for traffic in the opposite direction, each of said lane means having a divided section to form an inner road and an outer road, a minor road extending transversely across the divided section of each said lane means of said major road, first means for directing traffic to pass alternately and simultaneously along with the inner road of each said divided section and the outer road of each said divided section to thereby simultaneously free of traffic first each said inner road and then each said outer road, and second means for directing traffic on said minor road to cross said inner and outer roads of each said divided section when alternately freed of traffic by said first means and to halt at the intersection with said inner and outer roads when in use by traffic according to the direction by said first means.

2. The highway intersection system as recited in claim **1** wherein said second means directs traffic on said minor road to cross the outer road of each said divided section but halts said traffic at the intersection of said minor road with the inner road of each said divided section until each said inner road is freed of traffic by said first means.

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JACOB L. NACKENOFF, *Primary Examiner.*