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[54] **METHODS AND MEANS FOR MERGING TWO LANES OF TRAFFIC**

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[51] **Int. Cl.** **B61l 23/14**

[58] **Field of Search** ..... 340/36, 31 R; 246/167, 246/187 C; 104/149; 180/98

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[57] **ABSTRACT**

Two crowded single file traffic lanes of electronically speed-controlled vehicles are merged at a merge point by electronically establishing gaps sufficient to accept vehicles between the vehicles of each lane before they approach the merge point. The vehicles of one lane are then electronically guided into the gaps of the other as they pass the merge point. Lane-side transmitters and receivers along each lane cooperate with the vehicles to control the spacing between the vehicles in the approach toward the merge point.

31 Claims, 5 Drawing Figures

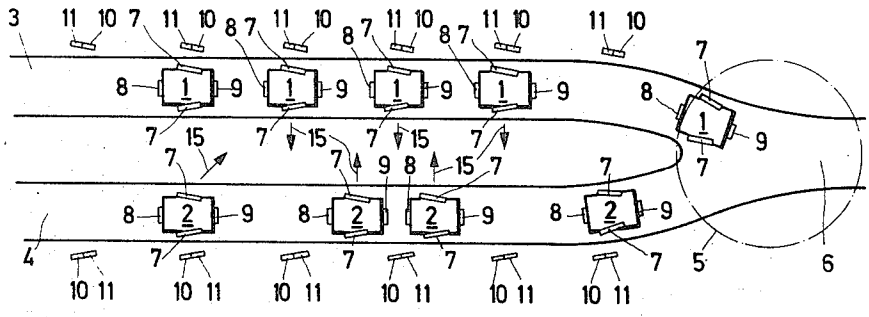
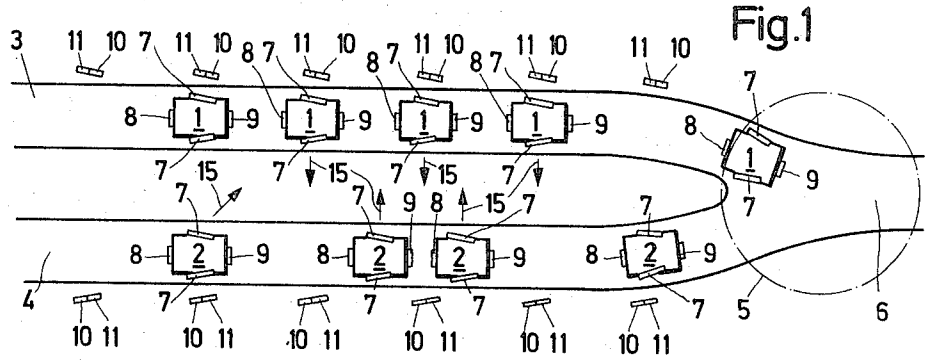


Fig.1



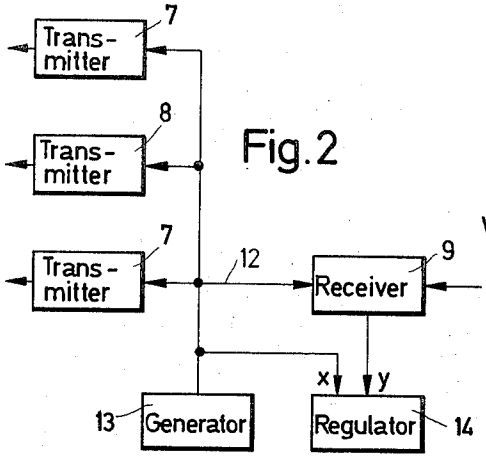


Fig.2

Fig.3

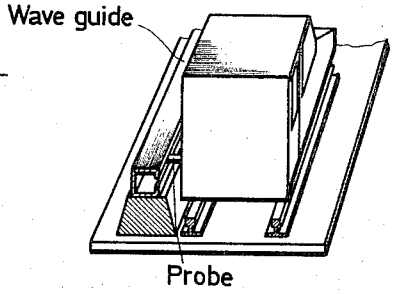


Fig.4

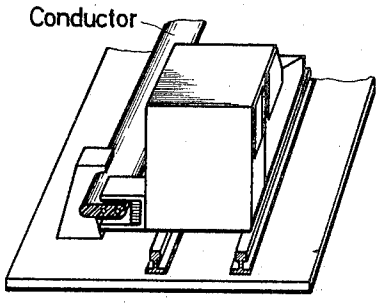
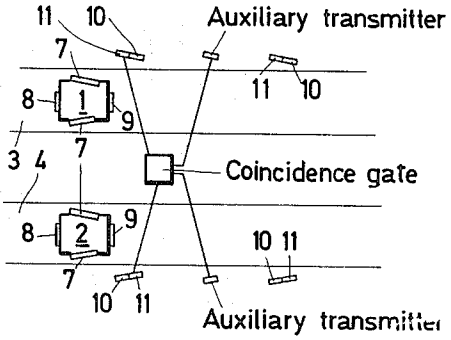


Fig.5



METHODS AND MEANS FOR MERGING TWO LANES OF TRAFFIC

REFERENCE TO RELATED CO-PENDING APPLICATIONS

This application relates to the copending application of Conrad Helmcke and Hans J. Wendt, Ser. No. 234,604, assigned to the same assignee as this application, and filed Mar. 14, 1972.

BACKGROUND OF THE INVENTION

This invention relates to transport or conveyor systems, and particularly to methods and means for merging vehicles travelling in two separate lanes into a single lane.

As used herein the term vehicle is meant in the general sense to include any object whose movement is controlled within a transport or conveyor system.

Any traffic or transportation system with branching roads operating with freely moving objects, for example, street traffic, poses the problem of smoothly merging traffic at merge points, without excessive delays or stops. The problem is especially difficult where individual vehicles are to be fed from one traffic lane into a main traffic artery.

Heretofore, locally operating devices, that is devices which operate at the merge point, have been used for controlling traffic. Systems utilizing light signals are operated by prefixed time controls or remote controls. Television cameras for observing the traffic have also been used to control these local signals. However, such systems do not permit regulation of traffic without delaying the traffic flow. As a rule, such systems are unable to avoid at least one short stop of the vehicles in one traffic lane as they merge into a main traffic lane. In some cases it has been found that traffic can operate more smoothly without such systems, that is without predetermined traffic controls.

If we assume that two traffic lanes to be merged each include some gaps, it is possible to proceed on the basis of the so-called zipper principle. That is, respective vehicles in one lane of traffic each fill a gap in a second traffic lane at the merge point of the two lanes. A disadvantage of this method resides in the fact that two vehicles may arrive at the merge point simultaneously. Then, one of the vehicles must stop. Most of the time the vehicle which does not have to stop and which has the right of way is also forced to reduce its speed. This reduction in speed causes vehicles to jam up and accumulate behind the slowing and stopped vehicles at the approaches to the merge point, while a considerable number of gaps may still remain in the traffic flow that has yet to approach the merge point.

This problem is particularly exacerbated when traffic lanes are densely populated. Therefore, as presently used, the so-called zipper principle fails to offer a suitable solution to the problem of merging traffic.

An object of the invention is to avoid the above-mentioned problems.

Another object of the invention is to improve transport or conveyor methods and means.

Still another object of the invention is to improve the above-described method and system for merging two densely populated traffic flows using the zipper principle, but in a way that avoids accumulations in the traffic lanes approaching the feed point or merge point.

Another object of the invention is to merge vehicles travelling in separate lanes into a single lane without requiring the vehicles to stop.

These objects apply to such means of transportion as automobile and truck traffic on a road, rail traffic , and conveyor systems which transfer goods in individual conveyors. The objects also refer to both methods and systems for accomplishing these ends.

SUMMARY OF THE INVENTION

According to a feature of this invention, these objects are achieved, in whole or in part, by synchronizing the traffic flows in the respective lanes and forming gaps between the vehicles at the approaches to the merge points, and by guiding a vehicle of one lane into the gaps formed in the other lane at the merge point. The gaps are formed to be large enough to receive the vehicles.

According to another feature of the invention, the vehicles are synchronized so as to adapt the speed of each vehicle in one traffic flow approaching the merge point to the density of traffic in the other merging lane.

According to another feature of the invention, within the approaches to the merge point, that is, in the range of the feed point, the vehicles of one lane are imaged into the other lane and each imaged vehicle is sensed by the vehicle directly behind or beside it as an object directly ahead of it. Image staggering in the direction of travel is provided n one vehicle if both vehicles are equadistant from the merge point. Thus, the driving behavior of each vehicle in in approaches to a merge point depends not only on the driving behavior of the vehicle actually ahead of it, but also on the driving behavior of the vehicle imaged directly ahead of it.

According to another feature of the invention imaging is effected by transmitted signals. The speed of each vehicle is regulated in dependence upon a signal transmitted from the vehicle imaged directly ahead of it. The information content of this signal is based on the speed of the transmitting vehicle. The signal is received by the following vehicle and its information content further modulated on the basis of the speed of the following vehicle. Thus, each imaged vehicle which is to pass through the feed point before a following vehicle automatically influences the driving behavior of this following vehicle.

According to another feature of the invention, each vehicle is equipped with automatic driving and braking controls. Each following object then compares the received signal with a control quantity varying with the speed of the following vehicle to slow down the vehicle when the control quantity exceeds the received signal.

Imaging of the vehicle thus automatically slows down the vehicle behind the image if this vehicle is proceeding at a higher speed than the image and the distance between the vehicle and the image is too small or nonexistent. According to another feature of the invention, the slowing of a vehicle in response to an imaged vehicle as it approaches the merge point is accomplished uniformly over an extended period of time. As a result, it is unnecessary to slow the vehicle suddenly. Preferably, each vehicle in each traffic lane follows the other vehicles so that slow down of one vehicle in a lane automatically results in a corresponding delay in the following vehicles.

According to another feature of the invention each vehicle includes transmitting and receiving means

whose power (and, if necessary, degree of modulation) and sensitivity depend upon the speed of the vehicle. Additional stationary receiving means arranged along the lanes cooperate with stationary transmitting means along the second lane, where the vehicles are imaged. Thus, stationary transmitting and receiving means are provided on both lanes. Each stationary transmitting means in one lane cooperates only with the opposite receiving means in the second lane. A conventional coincidence circuit prevents simultaneous transmission of opposing stationary transmitting means, that is, transmitting means which are located at positions equally distant from the merge point. An auxiliary transmitting device staggered in the direction of the merge point relative to the stationary transmitting means emits a signal when corresponding stationary receiving means receive signals simultaneously. This permits the above-mentioned staggered imaging of the vehicles.

According to another feature of the invention the transmitting powers (or degree of modulation, if necessary,) of the stationary transmitting means vary. The variation is such that more powerful signals are transmitted from stationary transmitting means in the proximity of the merge point than more remote stationary transmitting means at the start of the approaches to the merge point. The operating behavior of the vehicles thus also depends upon the distance from the merge point. The vehicles can thus reduce their speeds over larger periods of time corresponding to the intensity of the signals which vary with the distance from the merge point.

These and other features of the invention are pointed out in the claims. Other objects and advantages of the invention will become obvious from the following detailed description when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing :

FIG. 1 is a plan view of a traffic pattern which is controlled by a system embodying features of the invention and which involves cars travelling in two separate lanes which merge into a third lane;

FIG. 2 is a block diagram illustrating the driving and braking control embodying features of the invention with which each car of FIG. 1 is equipped;

FIGS. 3 and 4 are perspective views of vehicles and tracks suitable in FIG. 1; and

FIG. 5 is a plan view of a portion of a traffic pattern controlled by a variation of the system in FIG. 1 and embodying features of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. 1 two sets of cars 1 and 2 constitute individual vehicles or means of transportation in a commuter system wherein each car must move automatically without stopping between a departure and a target station. The cars 1 move along a lane 3 while the cars 2 move along a lane 4. The cars 1 and 2 are to be fed at a merge point 5 defined by a circle into a third lane 6. The cars 1 and 2 move in the direction of the merge point 5 and pass through the merge point without stopping. Gaps are formed between the respective cars 1 in lane 3 and between the respective cars 2 in lane 4 so that these gaps can be occupied at the merge point 5 as the cars 1 and 2 alternately merge into the lane 6. Thus, only one car of lane 3 or 4 reaches the merge point or feed point 5 at any one time. The manner of creating the gas for interleaving and merging the cars is described below.

Each of the cars 1 and 2 is equipped with transmitters 7 and 8 and receivers 9. According to one embodiment of the invention the transmitters and receivers transmit and receive electromagnetic waves. According to another embodiment of the invention, these electromagnetic waves are light waves. According to still another embodiment of the invention the transmitters and receivers operate with sound waves, such as ultrasonic signals.

The transmitters 7 are mounted on the longitudinal sides of the cars 1 and 2. The transmitters 8 are mounted on the rear of the cars 1 and 2. The receivers 9 are mounted on the front of the cars.

The transmitters 7 and 8 and the receivers 9 are portable transmitters by virtue of their being mounted on cars 1 and 2.

Stationary transmitters 10 as well as stationary receivers 11 are located in the range defining the approaches to the merge point 5 along the lanes 3 and 4. Each stationary receiver 11 receives signals from an associated portable transmitter 7 facing it from a car 1 or 2 travelling on the adjacent lane. Each transmitter 10 transmits signals to the portable receiver of the car approaching it. The portable transmitters 7 on the cars 1 which face lane 4 do not emit signals. Similarly, the transmitters 7 on the cars 2 which face lane 3 do not emit signals. They thus transmit only when they are directed toward a receiver 11 in the lane of the car. Of course, the system can be embodied so that the transmitting devices 7 on the cars 1 and 2 can be directed toward the opposite lanes if the receivers 11 are arranged on the latter.

The stationary transmitters 10 and receivers 11 are equally spaced along the lanes 3 and 4. The transmitters 10 of lane 3 are associated with the receivers 11 of the lane 4 which are arranged at the same level in the direction of the merge point. Correspondingly, the transmitters 10 of lane 4 are associated with the receivers 11 of the lane 3 that are arranged in the same level in the direction of the merge point. Each receiver is coupled to its associated transmitter so as to send signals thereto. However, each receiver 11 can transmit signals to only one transmitter, namely the transmitter that is arranged at the same level in the direction of the merge point.

The above-described arrangement of stationary transmitters and receivers 10 and 11 thus permits the transmission of signals between two cars 1 and 2 which are moving on separate lanes 3 and 4 respectively. The transmitters 8 on the rear of the cars also furnish communication but only between cars following each other directly in the same lane. According to an embodiment of the invention, the transmitters 7 on the longitudinal sides of the cars 1 and 2 and the stationary receivers 11 operate in a different frequency band than the transmitters 8 and 10 and the receivers 9. A conventional coincidence circuit causes only one of two transmitters at the same level to transmit when two cars move side by side, such as the last two cars 1 and 2. An auxiliary transmitter, not shown, staggered in the direction of a merge point 5, emits the signal transmitted from one of these cars.

Thus, such auxiliary transmitters are located between the transmitters 10 of FIG. 1.

The signal transmitted from a car serves to control the driving behavior of the immediately following car in such a way that a collision is practically impossible. This is explained below. In this environment it is irrelevant whether the signal received by a car is emitted from a car in the lane of the receiving car or from a car in an adjacent lane. In either case the signal temporarily reduces the speed of the receiving car if there is no distance or an insufficient distance between the receiving car and the transmitting car. Consequently, with cars 1 and 2 occupying the lanes 3 and 4 as shown in FIG. 1, the cars between which there are no gaps that can be filled by a car of the adjacent lane will be slowed to form a gap

As far as the last two cars are concerned, the car 2 in lane 4 can receive a signal from the car 1 of lane 3 through the beforementioned auxiliary transmitters. Both cars thus receive signals. However, the car in lane 3 slows down more. This is because in car 1 it is the nearest transmitter 10 arranged at the same level that transmits. Consequently, when both signals have equal intensity, one can be received so that it is stronger than the other.

Each car 1 and 2 includes an automatic drive and brake control system including the transmitters 7 and 8 as well as receiver 9. The system in one car is illustrated in FIG. 2. A common control line 12 applies a modulating voltage from a generator 13 to the transmitters 7 and 8 as well as the receiver 9. The generator 13 furnishes a voltage which varies with the speed of the car. For this purpose the generator 13 is coupled to a wheel of the car. The generator voltage along the line 12 varies the output power of the transmitters 7 and 8 inversely with the speed of the car. On the other hand, the output of the generator 13 along the line 12 varies the sensitivity of the receiver 9 with the speed of the car. Thus, when the car stops the transmission power of the transmitters 7 and 8 reaches a maximum and the sensitivity of the receiver 9 falls to a minimum. At the maximum speed of the car the transmitting power reaches a minimum and the sensitivity a maximum. Correspondingly, the intensity of the transmitted and received signals will vary.

The output of the generator 13 forms a control quantity or control value x which is applied to a regulator 14 associated with the drive (not shown) of the car. The output of the receiver 9 forms a guide quantity or guide value y which is also applied to the regulator 14. The guide quantity y varies not only with the speed of the receiving car but also with the speed of the transmitting car and with the distance between the two cars. The regulator 14 controls the braking of the car as part of the beforementioned drive (not shown).

If the regulator 14, in comparing the control value x and the value y, notes that the guide value y has been exceeded by the control value x, the receiving car is automatically slowed down by braking or deceleration. The value x exceeding the guide value y is always in indication that the car must reduce its speed of the collision with the transmitting cars to be avoided. If the transmitting car is actually in the adjacent lane at the same level as the receiving car, or there is insufficient distance, relative to the merge point from the transmitting car, the receiving car will increase its distance from the car actually ahead of it. The deceleration will continue until there is a sufficient distance from the transmitting car. This way a gap for the transmitting car is produced ahead of the receiving car. This gap can be filled by the transmitting car at the merge point 5. It goes without saying that deceleration of a car 1 or 2 also can be caused simultaneously by a car actually ahead of the receiving car and by a car moving in the adjacent lane. In this case the signals received are added to each other.

If all the cars 1 and 2 move at the same speed in the approach to the merge point 5, this insures that the merge point can never be reached simultaneously by two cars. The speed of all cars will be adapted to the possible traffic flow at the approaches to merge point 5. This can be achieved by means of additional receivers arranged along the lane 6. These receivers (not shown) can then transmit speed information about the respective cars to the stationary transmitters 10 before the merge point 5 and thus to the cars 1 and 2.

As a rule each car that receives a signal from a car in the adjacent lane will effectively sense that there exists no clearance between it and the other car. The receiving car thus receives a signal whose intensity corresponds to that of an impending collision or an actual collision. In order to prevent the car from responding by suddenly breaking, the transmission power of the stationary transmitters 10 varies. The transmitters 10 just prior to the merge point 5 transmit far stronger signals than those before them. The transmitting power of the transmitters 10 decreases with the distance from the merge point 5. This is accomplished by the use of suitable amplifiers in each stationary transmitter 10.

The above-described transmitters and receivers 10 and 11 along the lanes 3 and 4 thus cause the drive and brake controls of all the cars 1 and 2 with transmitters and receivers 7,8 and 9 to behave as if the approaches to merge point 5 in each lane 3 and 4 were occupied by all the cars within the approaches. They can thus pass through the merge point without stopping. In addition, no gaps are formed in lane 6 as might have been if cars stopped at the merge point.

It will be recognized that the arrangement of cars in FIG. 1 is only an example that depends upon the sequence of the cars 1 and 2. Gaps can be created between the cars of each lane 3 and 4 for several car lengths in the approaches.

Moreover, the invention is not limited to methods and means utilizing wireless transmission of signals. According to another embodiment of the invention, each of the transmitters and receivers are coupled to wave guides which are laid along the lanes. These wave guides are in the form of slotted tubular conductors into which the probes of the cars can be introduced. According to an embodiment of the invention the probes are introduced on a contact-free basis. The probes serve as antennas of the transmitters and receivers of the cars.

According to another embodiment in the invention, ordinary conductors are used instead of tubular conductors. In this case the signals are transmitted inductively, if necessary, between the conductors and the transmitters and receivers of the cars.

According to another embodiment of the invention virtual images of the cars are simulated by laser beams.

According to still another embodiment of the invention, all the transmitters and receivers are equipped with identical antennas that are rotatable for curves.

It should be noted that in the operation of this system the cars, by means of transmitters 8 and receivers 9

space, each other along the lanes in accordance with their speeds. If their speeds are identical they can be virtually touching each other and proceed at the speed. As the cars approach the merge point **5**, the transmitters **7** announce the presence of the cars to the receivers **11**. Each receiver **11** then actuates a transmitter **10** to transmit signals toward receivers **9** of the opposite lane. This in effect forms an electronic image of a car in one lane in the adjacent lane. The receiver **9** in the receiving car then causes the receiving car to behave as if the car in the other lane were actually directly ahead of it. Thus, the spacing between the cars is increased so that the cars can pass through the merge point, while the cars are approaching point **5**.

The lanes **3** and **4** as well as the lane **6** may constitute roadways, tracks, conveyor paths or any other arrangement of a transport system according to various embodiments of the invention.

The term merge point or feed point as used herein may be regarded as the merge zone defined by the circle in FIG. **1**.

The general operation of the cars **1** and **2** as they proceed along a single file is described more fully in the copending application, mentioned before. The content of that application is herewith made a part of this application as if specifically recited herein.

According to an embodiment of the invention, the signals received by each of the receivers **11** in each lane are passed to the transmitter **10**, in the opposite lane, whose distance from the point **5** equals the distance of the receiver, by suitable conductors.

While embodiments of the invention have been described in detail, it will be obvious to those skilled in the art that the invention may be embodied otherwise.

FIG. **3** and **4** illustrate various other types of transmission systems usable between the transmitters and receivers of the cars **1** and **2**.

FIG. **5** illustrates the use of coincidence circuits and auxiliary transmitters as described above.

What is claimed is:

1. The method of merging vehicles travelling single file in each of two separate lanes, into a single lane, which comprises electronically synchronizing the operation of vehicles and gaps therebetween in each of the lanes, indicating the approach of a merge point at which the lanes merge to the vehicles, electronically responding to the indicating of the approach and electronically changing the operation of the vehicles as the vehicles approach the merge point to form additional gaps, and filling the additional gaps of one lane with the vehicles of the other lane at the merge point, the step of changing the operation including forming an electronic image of each vehicle of one lane in the other lane in a predetermined range approaching the merge point and electronically controlling the behavior of each of the vehicles as if each image formed by the vehicle just closer to the merge point or equidistant to the merge point were an immediately preceding vehicle.

2. The method as in claim **1**, which further comprises the steps of sensing the appropriate speed of the vehicle beyond the merge point and adapting the speed of the vehicles approaching the merge point to the appropriate speed beyond the merge point.

3. The method as in claim **1**, wherein the images are formed by transmitting signals corresponding to the vehicles of one lane to the vehicles of the other lane.

4. The method as in claim **2**, wherein the images are formed by transmitting signals corresponding to the vehicles of one lane to the vehicles of the other lane.

5. The method as in claim **1**, wherein the behavior of each vehicle is controlled on the basis of the image formed directly ahead of the vehicle.

6. The method as in claim **5**, wherein the images are formed by transmitting signals corresponding to the vehicles of one lane to the vehicles of the other lane.

7. The method as in claim **5**, wherein the step of controlling the behavior of each vehicle includes transmitting signals from each vehicle to the immediately following vehicle and receiving the signals in the following vehicle, and further modulating the transmission by changing the information content of the signal to vary with the speed of the transmitting vehicle and modulating the reception in the following vehicle on the basis of the speed of the following vehicle.

8. The method as in claim **7**, wherein the transmitted signal is modulated so that its intensity varies inversely with the speed of the vehicle transmitting the signals.

9. The method as in claim **7**, wherein the signals are transmitted so that the intensities of the signals reach a maximum when the vehicle stops and a minimum when the vehicle reaches its maximum speed.

10. The method as in claim **9**, wherein the transmitted signal is modulated so that its intensity varies inversely with the speed of the vehicle transmitting the signals.

11. The method as in claim **7**, wherein each of the vehicles receives the transmitted signals while changing the sensitivity to these signals with the speed of the receiving vehicle, the sensitivity being maximum when the receiving vehicle stops and maximum when the receiving vehicle reaches its maximum speed.

12. The method as in claim **11**, wherein the transmitted signal is modulated so that its intensity varies inversely with the speed of the vehicle transmitting the signals.

13. The method as in claim **11**, wherein the signals are transmitted so that the intensities of the signals reach a maximum when the vehicle stops and a minimum when the vehicle reaches its maximum speed.

14. The method as in claim **7**, wherein receiving the signal includes forming a guide quantity corresponding to the speed of the receiving vehicle and comparing the guide quantity to the value of the received signal so as to control the speed of the receiving vehicle.

15. The method as in claim **8**, wherein receiving the signal includes forming a guide quantity corresponding to the speed of the receiving vehicle and comparing the guide quantity to the value of the received signal so as to control the speed of the receiving vehicle.

16. The method as in claim **9**, wherein receiving the signal includes forming a guide quantity corresponding to the speed of the receiving vehicle and comparing the guide quantity to the value of the received signal so as to control the speed of the receiving vehicle.

17. The method as in claim **10**, wherein receiving the signal includes forming a guide quantity corresponding to the speed of the receiving vehicle and comparing the guide quantity to the value of the received signal so as to control the speed of the receiving vehicle.

18. A system for merging vehicles travelling single file along respective paths toward a merge point at which the paths merge, comprising control means mounted on each of said vehicles for controlling the

speed of each vehicle and spacing the vehicles, a plurality of sensing means along given ranges of said paths approaching the merge points for sensing the presence of the vehicles in the ranges, and a plurality of regulator means each responsive to one of said sensing means and communicating with said control means for constraining said control means in each of the paths to form gaps between the vehicles at locations corresponding to the vehicles in the other of the paths, said control means on each of said vehicles including electrical means which co-act with electrical means in the control means of an immediately preceding vehicle and an immediately following vehicle to control the speed of each vehicle on the basis of its speed as well as the speed of the immediately preceding vehicle.

19. A system for merging vehicles travelling single file along respective paths toward a merge point at which the paths merge, comprising control means mounted on each of said vehicles for controlling the speed of each vehicle and spacing the vehicles, a plurality of sensing means along given ranges of said paths approaching the merge points for sensing the presence of the vehicles in the ranges, and a plurality of regulator means each responsive to one of said sensing means and communicating with said control means for constraining said control means in each of the paths to form gaps between the vehicles at locations corresponding to the vehicles in the other of the paths, said control means in each of said vehicles including transmitter means and receiver means, said control means including modulator means responsive to the speed of the vehicle having said control means and coupled to said transmitter means and said receiver means for varying the power transmitted by said transmitter means inversely with the speed of the vehicle and varying the sensitivity of said receiver means with the speed of the vehicle, the transmitter means and said receiver means on each of said vehicles being arranged so that the receiver means on one vehicle receives the signals transmitted by the transmitter means on the preceding vehicle.

20. A system as in claim **19,** wherein said sensing means includes a plurality of detecting means distributed along the paths approaching the merge point, and wherein said regulator means includes a plurality of transmission means distributed along the paths, each of said transmission means of one path being located at a location substantially corresponding in distance from the merge point to the location of a detecting means in the other path and being in communication with the detecting means in the location substantially equal from the merge point so as to receive signals indicating that said detecting means has sensed the presence of a vehicle in the other path, said transmission means being in communication with said receiver means on said vehicles as said vehicles pass each of said transmission means so that said control means of a vehicle whose receiver means receives signals from said transmission means responds to both the transmission means and said transmitter means to form the gaps.

21. A system as in claim **19,** wherein sensing means includes detecting means located along one of the paths, and wherein said regulating means includes transmission means located along the other of the paths at a distance from the merge point corresponding to the position of said detecting means, said detecting means being responsive to a vehicle passing said detecting means along the path, said transmission means being responsive to said detecting means, said receiver means being responsive to said transmission means for constraining the control means to form a gap between the vehicle whose receiver means responds to said transmission means and the preceding vehicle.

22. A system as in claim **19,** wherein said transmitter means and said receiver means operate on the basis of electromagnetic waves.

23. A system as in claim **19,** wherein said transmitter means transmits light waves and said receiver means receives light waves.

24. A system as in claim **20,** wherein said transmitter means and said transmission means each transmit electromagnetic waves and wherein said receiver means and said detector means each receive and operates with electromagnetic waves.

25. A system as in claim **19,** wherein said transmitter means transmits sound waves and said receiver means receives and operates with sound waves.

26. A system as in claim **19,** wherein said control means includes wave guides extending along said paths, said transmitter means and said receiver means being coupled to said wave guides.

27. A system as in claim **26,** wherein said transmitter means and receiver means each include probes extending into said wave guides.

28. A system as in claim **26,** wherein said wave guides form tubular conductors slotted in the longitudinal direction, said transmitter means and said receiver means each including probes extending into the slotted tubular conductors.

29. A system as in claim **19,** wherein said regulator means, in response to said sensing means, forms an image in said control means of the vehicles in one lane of vehicles in the other lane whose distances from the merge point correspond to the distance from the merge point of the vehicle having said control means and said control means responds to the image to form the gaps.

30. A system as in claim **21,** further comprising a transmitting device on each of said vehicles for energizing said indicator means as each vehicle passes said indicator means.

31. A system for merging vehicles travelling single file along respective paths toward a merge point at which the paths merge, comprising control means mounted in each of said vehicles for controlling the speed of each vehicle and spacing the vehicles, a plurality of sensing means along given ranges of said paths approaching the merge points for sensing the presence of the vehicles in the ranges, and a plurality of regulator means each responsive to one of said sensing means and communicating with said control means for constraining said control means in each of the paths to form gaps between the vehicles at locations corresponding to the vehicles in the other of the paths, said control means in each of said vehicles including electrical means which co-act with electrical means in the control means of an immediately preceding vehicle and an immediately following vehicle to control the speed of each vehicle on the basis of its speed as well as the speed of the immediately preceding vehicle, said regulator means constraining said control means in each of the paths to control the speed of each vehicle as if the vehicle in the other lane just closer to the merge point or equidistant to the merge point were in the immediately preceding gap.

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