

[54] **HIGHWAY DRAINAGE AND EXHAUST SYSTEM**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 14,300, Feb. 26, 1970, Pat. No. 3,610,360, which is a continuation-in-part of Ser. No. 545,117, April 25, 1966, Pat. No. 3,503,188.

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[51] Int. Cl. **E01f 5/00**

[58] Field of Search..... 94/1, 2, 31, 31.1, 31.1 E; 404/1, 4, 2

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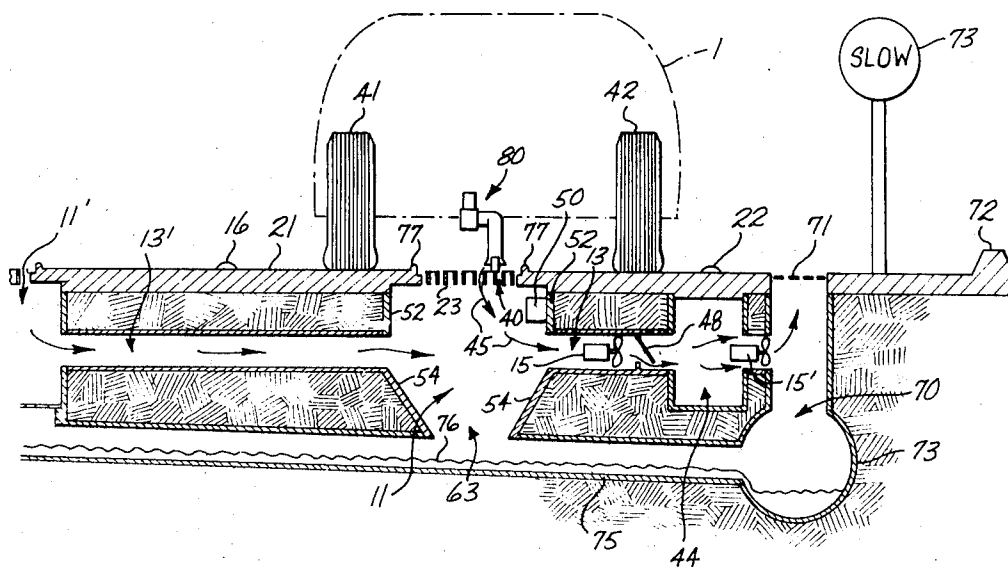
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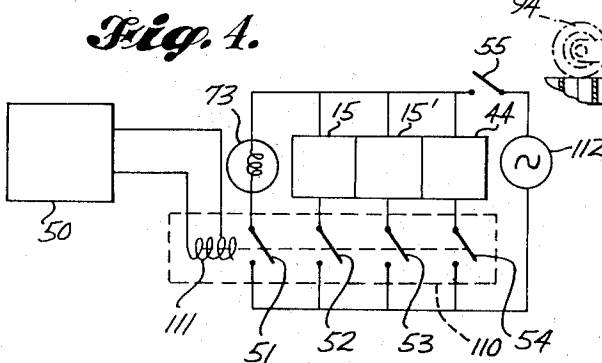
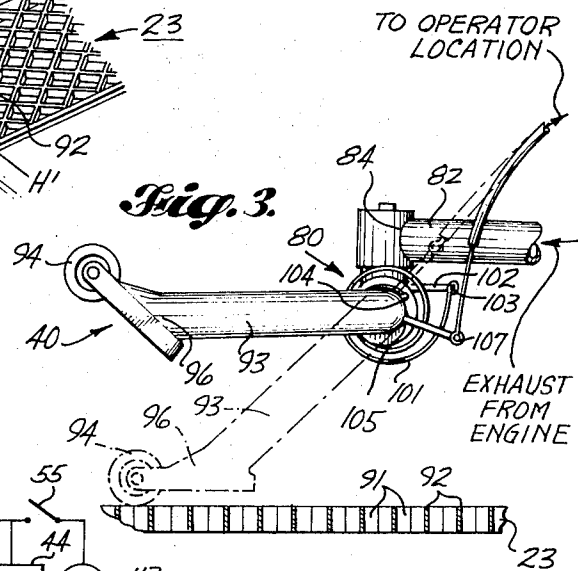
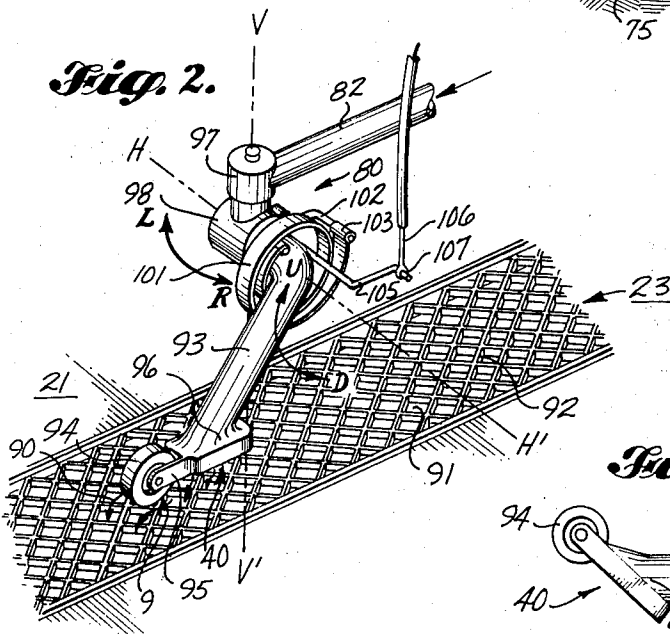
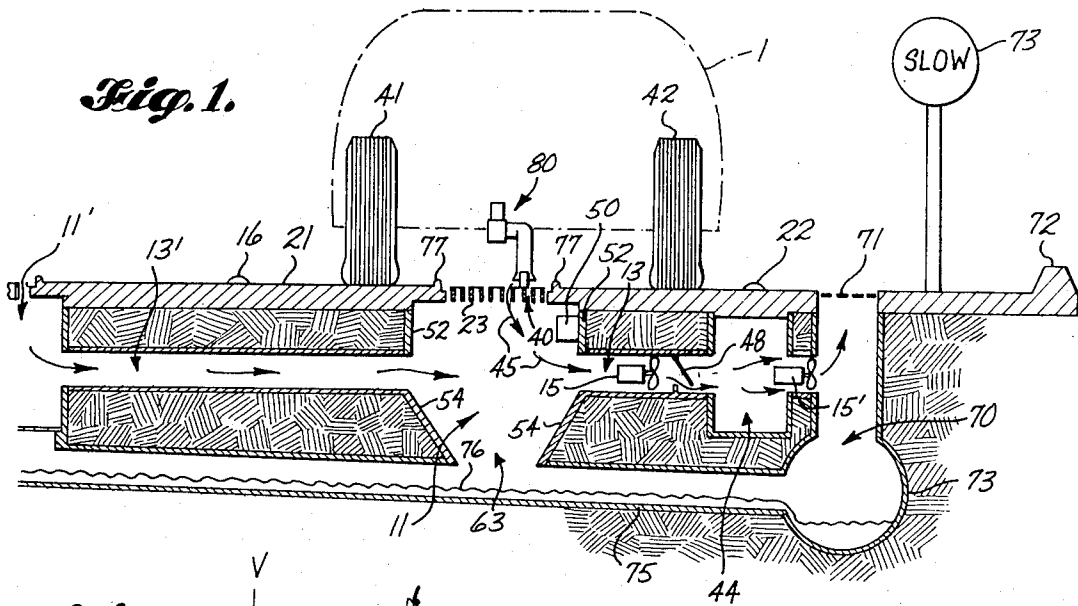
Primary Examiner—Nile C. Byers, Jr.

[57] **ABSTRACT**

Systems for receiving the noise and/or exhaust emissions transmitted from motor vehicle exhaust outlet arrangements. The motor vehicle transmitter of noise and/or exhaust emissions have a modified tail pipe arrangement arranged for close coupling and transmission of the noise and/or exhaust emissions to receiving means for collecting and processing the noise and/or exhaust emissions. The receiving means extends along the length of the highway and attenuates the received noise and/or collecting and passing the received exhaust emissions to processing means for recovering or purifying the exhaust emissions. The duct portion of the receiving means instead or also utilized to provide transmission of electric power to specially designed types of electrically powered motor vehicles along the highway and also provide guidance where it is so desired to instrument the vehicle and duct.

6 Claims, 12 Drawing Figures





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Fig. 5

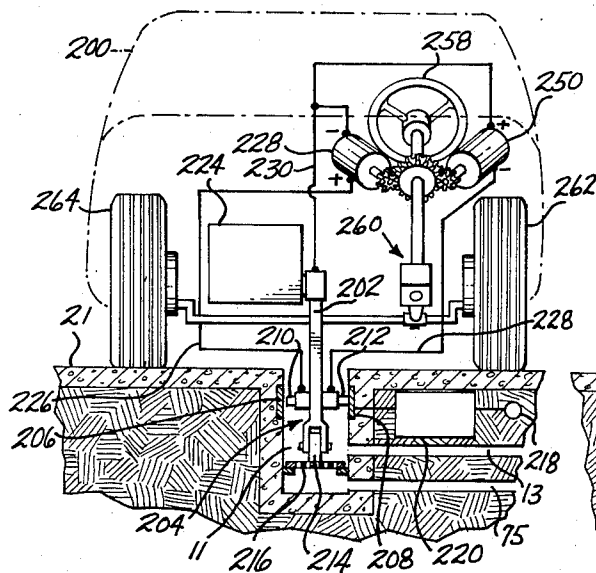


Fig. 6

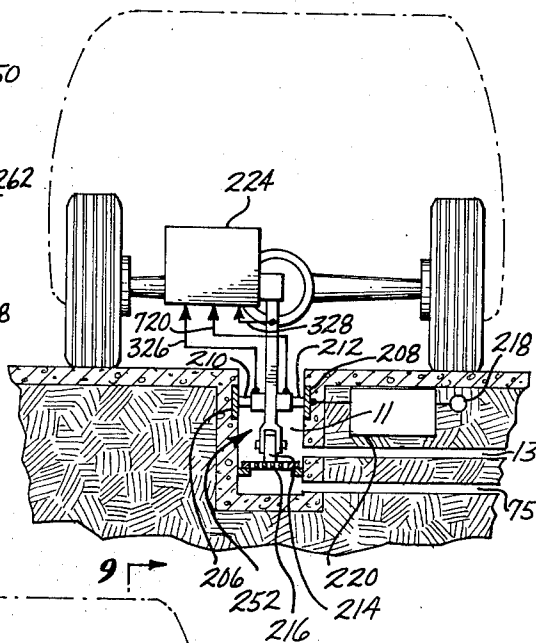


Fig. 8

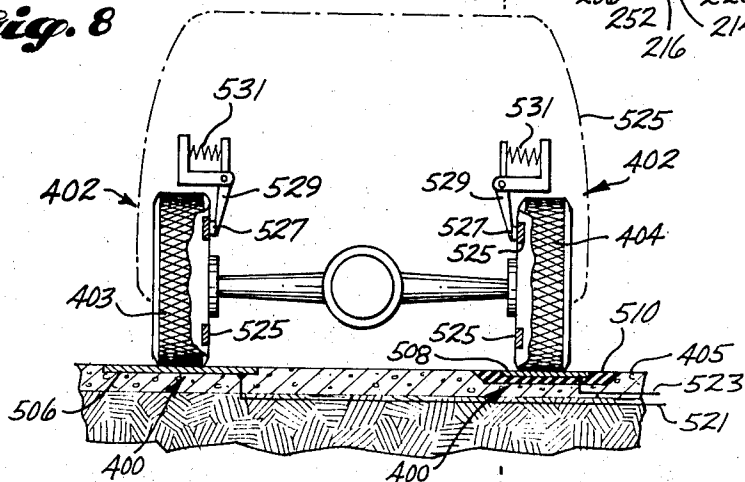


Fig. 7

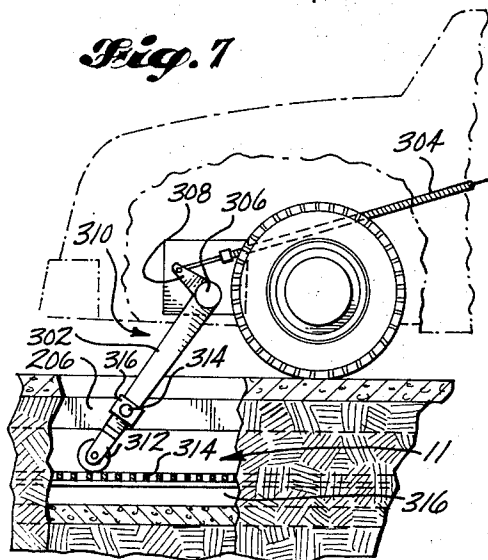
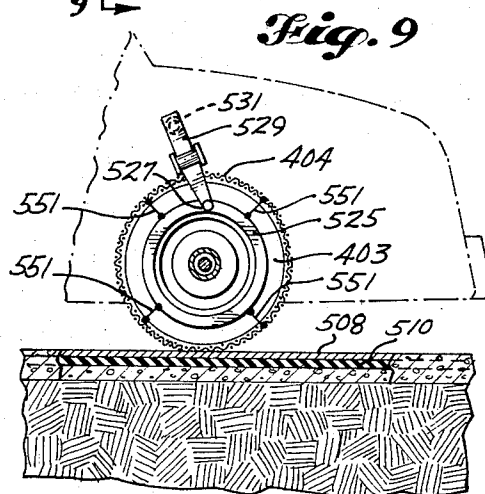
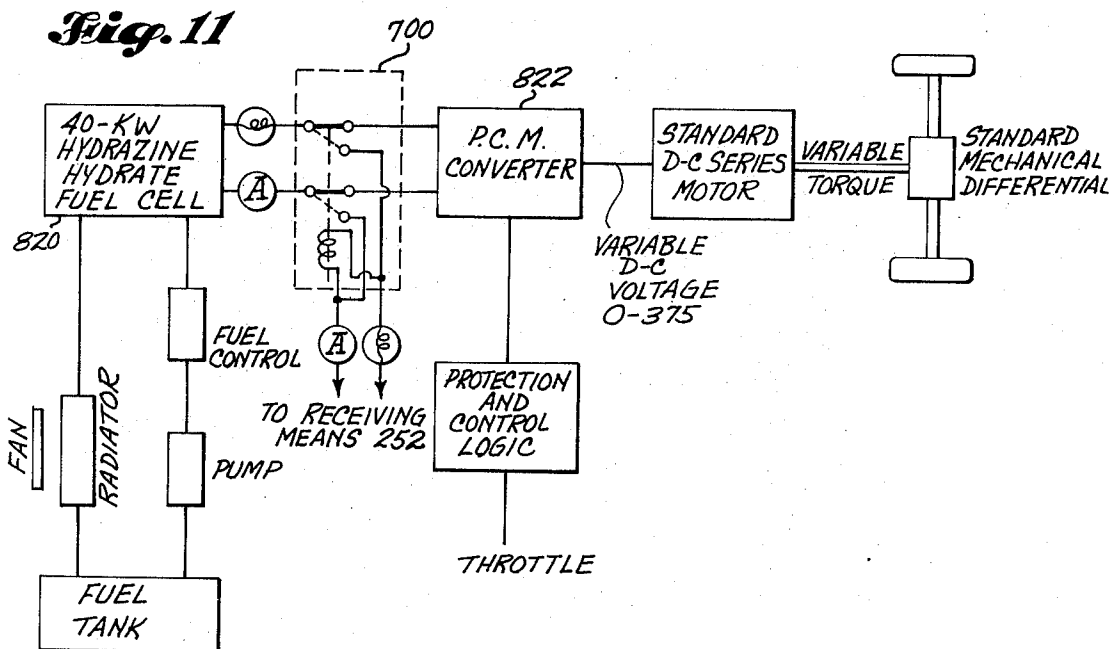
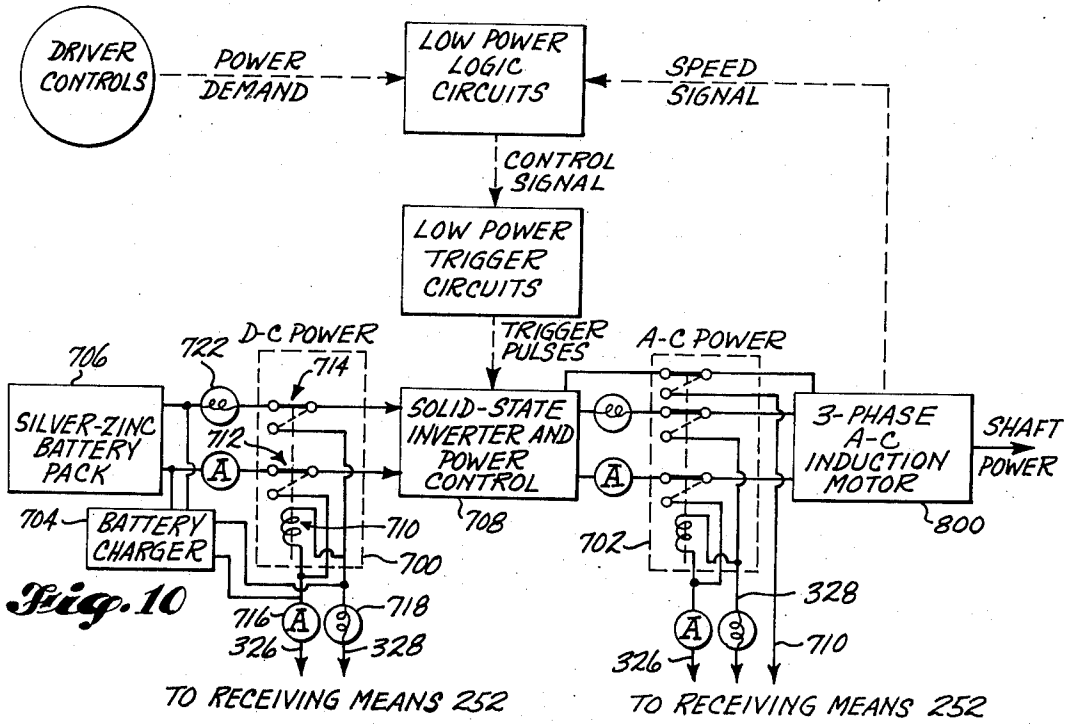


Fig. 9





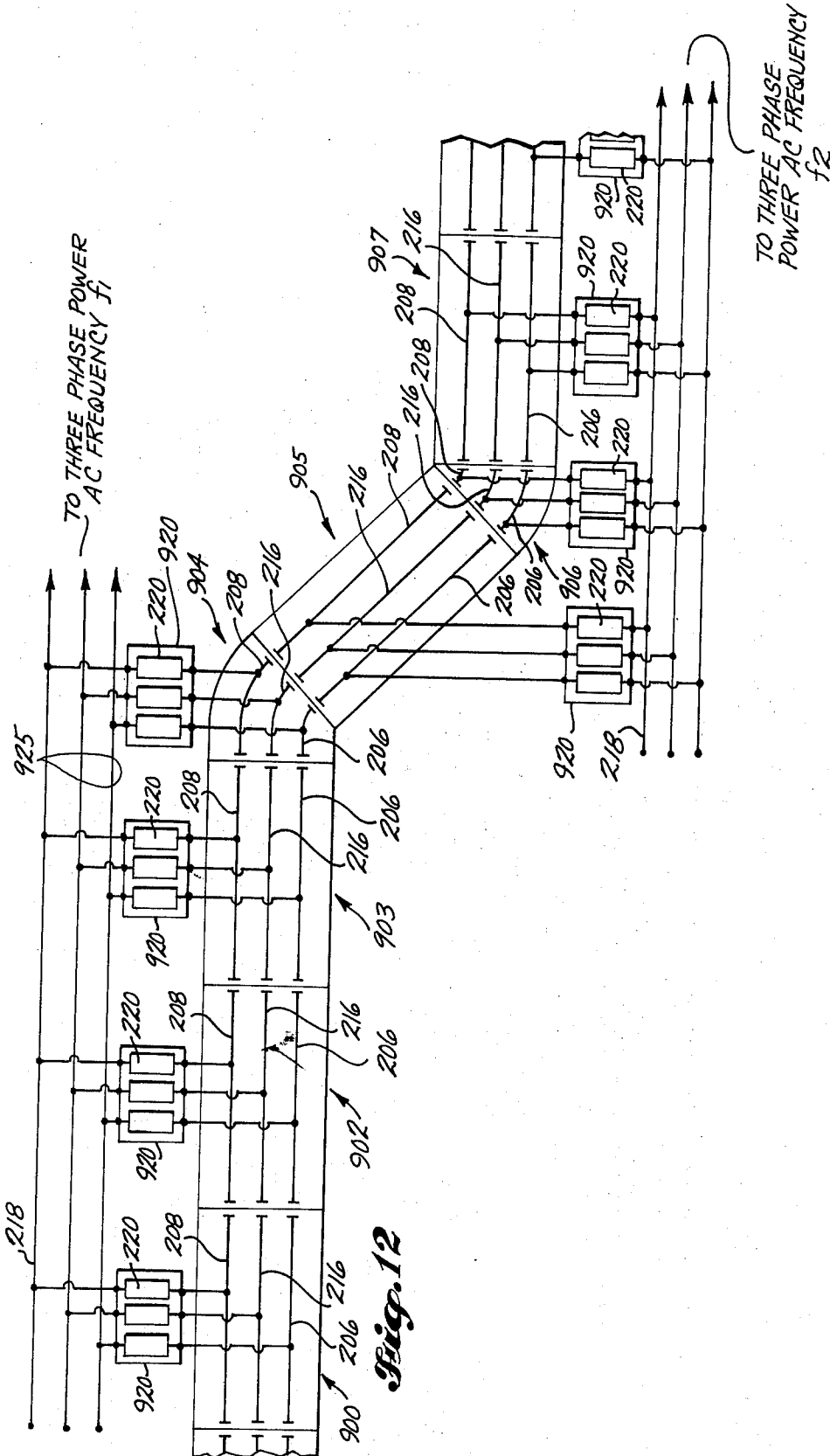


Fig. 12

A HIGHWAY DRAINAGE AND EXHAUST SYSTEM

This application for Letters Patent is a continuation in part of my application Ser. No. 14,300 filed Feb. 26, 1970 which application now U.S. Pat. No. 3,610,360 is a continuation in part of my application Ser. No. 545,117 filed April 25, 1966 now U.S. Pat. No. 3,503,188.

The present invention relates to improvements in duct structures and variations thereof disclosed in my aforementioned copending application Ser. No. 14,300, now U.S. Pat. No. 3,610,360 more particularly to duct structures positioned in the lane of a highway at a location disclosed therein however here for the purposes disclosed therein and/or for the purpose of powering and optionally guiding electrically powered vehicles of special design as specifically herein disclosed.

The virtues of electrically powered automobiles have been extolled by many and their most important well recognized characteristics include: non-emission of pollutants, noiseless operation, and various special advantages of the particular electric motor used in the particular power system, e.g., synchronous motor which has no brushes and therefore contacts problems. Many of those who extoll the virtues are also quick to state the limitations of the energy source of the power plant viz. that present battery capability in terms of storage and rate of energy conversion out limit such vehicles to use as gold carts, fork lifts, and a few intra city low speed small range truck applications. As a consequence, the development of the electric vehicle art is lulled to a virtual standstill everyone awaits the stress to be placed upon battery development or fuel cell innovation which of course absent some major breakthrough will not yield results bringing equivalent performance in electric automobiles to I C (internal combustion) powered automobiles for some years to come as predicated. The current major capital investment in the I C (internal combustion powered) automobile will thus have its life extended until and unless battery and/or fuel cell research provides a battery or fuel cell having the "required" characteristics necessary to provide equivalent electrical vehicle performance acceptable to the consumer. In the years in the meantime awaiting the "ideal" battery, the I C powered automobiles (the term automobiles herein used in the dictionary sense meaning general purpose highway vehicles and including trucks and buses) will continue to pollute the atmosphere and cause noise pollution perhaps at a lesser rate due to regulations increasing the quality of emissions but this savings being offset by the increasing numbers of I C vehicles. The alternatives are well recognized and include increased and accelerated battery and fuel cell research by those business entities or foundations not having any interest in protecting or extending the life of present capital investment in I C vehicle production facilities or oil and gas production facilities or secondly by the extremely expensive immediate deployment of mass transit facilities.

In accordance with the teachings of this disclosure it is not necessary to await development of an ideal battery which would provide the extended range equivalent to that available from a tank of gas. The presently disclosed vehicles and power systems permit slow speed travel by the commuter from his home up to the main highway or freeway utilizing his limited perform-

ance state of the art on board power source and then provide his electrically powered vehicle with all the power he needs to go as fast and far as he wishes (limited by his electric motor characteristics only and not by his on board power source characteristics) to the point where he leaves the highway and proceeds to his parking lot at the office at the low speeds under his on board electrical power source limitations.

Exhaust noise transmitted via the outlets of exhaust pipes of I C vehicles currently in use has been attenuated to some extent upstream by the muffler designers but where a great concentration of vehicles are found a noise level measured in decibels exists which although tolerable for short periods by persons in the region of these vehicles, becomes intolerable over long periods of time and can affect the thought processes and work performances of many persons.

It is accordingly an object of the present invention to provide a system which may be coupled to I C motor vehicle exhaust outlets to attenuate exhaust noise and/or purify exhaust emissions transmitted therefrom and/or power hybrid electric type motor vehicles.

It is still another object of the present invention to provide an electric type motor vehicle capable of unlimited range which may optionally be guided automatically along the lane of a highway.

A further object of this invention is to provide a system for attenuating exhaust noise and/or purifying exhaust emissions which may be deployed in those particular areas or regions or traffic routes where exhaust noise and/or exhaust emissions from I C vehicles can reach undesirable levels due to heavy traffic concentration and/or peculiar terrain and atmospheric conditions prevalent in some low lying regions for example.

Still another significant feature of the present invention is to provide a receiving system for purifying or recovering exhaust emissions in the atmosphere above a highway surface which is operated automatically when the carbon monoxide or other emissions pollutant level adjacent the highway surface exceeds a predetermined level.

In addition to the previously set forth objects, the present invention is arranged in such a manner that highway system modification costs are minimal for the I C or electric vehicle adaptation.

A further object realized in the following description is the substitution of a special electric powered vehicle for the I C vehicle which eliminates the type of planned or inherent obsolescence present in I C power plants and system which require the constant spark plug replacements, tune-ups, valve jobs and replacements of other moving parts and instead utilizes the simple and quiet and non polluting electric motor which is light weight and hopefully can be removed for substitution much more quickly and easily than a 400 horsepower I C engine can be pulled from an I C vehicle. It is hoped that the investment in the electric type vehicles herein disclosed would be more of a one time investment with only the electric motor being substituted for a rebuilt one rather than the junking of the entire vehicle (as in the I C car case) because of the great cost in having the entire engine pulled rebuilt and transmission work done. In this connection it must be recalled that with the series d.c. motor type vehicles there is no need for an automatic transmission, the speed control being the control of electric power applied to the motor itself.

Further objects, advantages and features of the invention will become apparent to those skilled in the art upon the continued reading of this disclosure including the specification and drawings in which:

FIG. 1 is an end view of a motor vehicle having an exhaust outlet arrangement shown in a closely coupled position to a system for receiving and collecting and processing noise and exhaust emissions transmitted from the exhaust outlet which is embedded in the highway, the highway being shown in cross section;

FIG. 2 is a view in perspective of an exhaust outlet arrangement on the exhaust pipe extension of an I C motor vehicle showing details of the structure utilized to obtain various degrees of motion and optional close coupling to the inlet grating portion of the receiving means embedde in the highway;

FIG. 3 is a side view of the exhaust outlet arrangement on the end of the motor vehicle tail pipe shown in FIG. 2;

FIG. 4 is a circuit for automatically detecting and controlling the exhaust processing means of FIG. 1 when carbon monoxide levels along individual lengths of the highway as determined by the individual lengths of the duct sections exceed a predetermined level;

FIG. 5 is a front view broken away and taken in section of an electric powered vehicle showing automatic guidance features and a duct arrangement for coupling thereto showing means for guidance signal coupling thereto along the length of the highway below the highway surface;

FIG. 6 is a rear view of the vehicle of FIG. 5 looking rearward from the mid section showing the vehicle power receiving means coupled to the duct power transmitting means arranged below the highway surface;

FIG. 7 is a side view partially broken away and taken in section of the vehicle of FIG. 5 showing a means for decoupling the automatic guidance structure of the vehicle shown in FIG. 5, or the power receiving means of FIG. 6 when over highway surfaces not guidance and power instrumented and the vehicle is being powered by its on board power;

FIG. 8 is the rear view of another embodiment of an electric vehicle power receiving arrangement and highway power transmitting structure coupled thereto to transmit power to the vehicle;

FIG. 9 is a side view in detail of the power receiving arrangement shown in the automobile of FIG. 8;

FIG. 10 is an embodiment of an electric automobile power and control system schematic showing automatic power transfer features at d.c. or three phase a.c. for inboard to outboard energy source switching and vice-versa;

FIG. 11 is another embodiment of electric powered automobile showing power plant and control system schematic showing means for automatic transfer of power from inboard to outboard power source in this type electrically powered automobile system; and,

FIG. 12 is a three phase electrical power system for controlling the vehicles having three phase synchronous motors for travel at three phase synchronous speed which varies along different portions of the highway or fro powering electric vehicles of the type shown in FIG. 10 when connected to other suitable three phase power sources.

Turning now to FIG. 1, a main duct 11 capped at the highway surface 11 in the same manner as is shown

(with the same reference numerals) in FIG. 2 of U. S. Pat. application Ser. No. 545,117 now U.S. Pat. No. 3,503,188 previously referred to. Lane markers 16 and 22 delineate a lane of the highway upon which the motor vehicle 1 is travelling. Inlet means 23 which comprises a grating is positioned at the center of the highway (midway between lane markers 16 and 22). Since the center of the grating 23 is located equal distances from lane markers 16 and 22 there is little possibility that the wheels of either side of the vehicle will travel along the highway tracking on the grating. In changing lanes however, the wheels of one side of the vehicle will cross over the grating 23 and at such time exhaust outlet 40 will not be located above the center grating 23. The width of grating 23 between lane markers 16 and 22 should be sufficiently large that most motor vehicles with side wheels straddling grating 23 and within lane markers 16 and 22 will have their exhaust outlets over the grating 23. The width of grating 23 would be less than the distance between the inside dimension between side wheel 41 and other side wheel 42, viz. less than 52 inches. The width of grating 23 should be however greater than the diameter of prior art tailpipes, viz. greater than 2 inches. With less than perfect tracking due to imperfect driving exactly in the middle of the lane, the inlet means must exceed two inches in width and must be less than the inside dimension (52 inches) between the two side wheels at the front or rear of the vehicle if the vehicle is not to run along on the grating 23.

The inlet grating 23 may be modified by providing the apertures thereof with means for permitting passage of exhaust only into the system without intake of outside air such as by tubes 27 with pressure valves 28 blown open by exhaust emissions as shown in FIG. 4 of the aforementioned application serial no. 545,117 now U.S. Pat. No. 3,503,188 the details of which are incorporated herein by reference. Another means for maintaining a "closed" system would be by use of a membrane accross and under grating 23 which would pass only certain exhaust emission components and trap out the outside air. Further means and mechanisms which will make inlet means 23 a closed system will become apparent to those skilled in the art. The present system as shown in FIG. 1 is an open system in the sense that exhaust emissions directed from the exhaust outlet 40 freely flow through the inlet means comprising grating 23 into the main duct 11. However the present system is a closed system in the sense that suction fan 15 leads received exhaust emissions along the path represented by arrows 45 through unidirectional flow control means 48 comprising a vertically suspended trapdoor into processing or utilization means 44 only when a predetermined exhaust emission ingredient level is exceeded as indicated by carbon monoxide detector 50. A detailed explanation of how suction fan 15 is turned on by carbon monoxide detector 50 will follow in the discussion of the control system of FIG. 4. The present system as shown in FIG. 1 is "open" from inlet means 23 to the upper and lower side wall portions of main duct 11 which are lined with acoustical materials 52 and 54 which have high sound absorbtive characteristics in the low frequency audio range from 0 to 5,000 cycles per second so that the exhaust noise directed thereagainst is attenuated. The frequency passband of exhaust noise extends beyond the range just mentioned, however results of frequency

analysis of exhaust noise studies already made indicate peak amplitude and sound pressure levels at frequencies within the above defined range (See Handbook of Noise Control By Harris, published in 1957 by McGraw Hill Publishing Co., beginning at page 31-16). The listener during rush hour traffic hears the low pitched hum or drone of many vehicles and this most disturbing frequency of noise is attenuated by accoustical materials 52 and 54 lining the upper and lower side wall portions respectively of main duct 11. Materials such as fiberglass and as mentioned in the previously cited Handbook, felt are among the materials which are capable of providing sound attenuation at exhaust frequencies within the audio range 0 to 5000 cycles and may be utilized for example at 52 and 54 to line respectively the upper and lower side wall portions of main duct 11. Other materials which absorb sound over the audio range 0 to 5,000 cycles may be selected for use at 52 and 54 by those audio engineers familiar with the well known acoustical characteristics of sound absorbing materials and structures, the above being given merely by way of example. It can thus be seen that the system of FIG. 1 is open to receive exhaust noise and to provide attenuation thereof and is yet closed to provide increased efficiency in processing or purifying exhaust emissions. Lower opposite side wall portions 54 slope downward and inward to form slot 63 at the bottom of main duct 11. Each length of duct 11 which runs parallel to and under a lane of the highway, runs along the highway a distance not too long that its volume cannot be processed by a single processing or utilization means or that it cannot be exhausted efficiently by the side duct arrangement coupled thereto and leading to the processing or utilization means. While there is here shown a single side duct 13 for exhausting a duct section it should be recognized that a plurality of ducts extending from processing means 44 and fanning out therefrom to duct 11 may be required if duct section 11 extends for example a plurality of car lengths. Each section of duct 11 is terminated by a common end plate which also forms the wall of the beginning of the next adjacent run of main duct as denoted by the numeral 12 in FIG. 3 of the aforesaid patent application serial no. 545,117 now U.S. Pat. No. 3,503,188. Side duct 13 shown in FIG. 1 of this application and also in FIG. 3 of the aforementioned patent provides the passage from an individual run of the main duct 11 of exhaust emissions received through inlet means 23 to processing or utilization means 44. Suction fan 15 in conjunction with unidirectional flow control means 48 in side duct 13 cause the flow of emissions along the flow path denoted by arrows 45. Processing or utilization means 44 may comprise an electrostatic precipitator of known type which may be utilized to remove particulate matter from the exhaust stream 45. Other forms of processing of the exhaust emissions to remove at least one pollutant and thus purify the stream before returning the remainder to the atmosphere may comprise utilization means which utilizes one or more of the emission products such as for example the carbon monoxide which may be separated out by utilizing its specific weight characteristic or by other means and utilized with steam at about 700° F. for 20 minutes on wet mixtures of garbage deposited in the utilization means to provide useful petroleum like by products as known in the art. It can thus be seen that the by products of imperfect combustion present in the exhaust

stream may be separated out sometimes as in the last mentioned example from the exhaust stream to be piped off to utilization means by the side ducts and be further utilized in other processes at the highway site or remote therefrom when the side ducts 13 are extended to provide further by products of substantial economic value. Such may not always be the case as for example where processing means 44 comprises an electrostatic precipitator and a by product recovered is lead in a form which may or may not be of significant commercial value in the recovered state. Suction fan 15' sucks the processed exhaust stream out of side duct 13 into the storm sewer means 70 so that the processed exhaust may escape to the atmosphere through a chimney stack or as shown through drain entrance means 71 which may be a grating at the edge of the lane of the highway where turnoff emission pollutants which may be made soluble in a liquid by some form of processing at 44 may also be run off by passage into sewer means 70 below fan means 15' and away through pipe 73. The contents of pipe 73 may in such case be of value or further processed and the solution piped back through a pipe (not shown) to processing means 44 in a closed loop process. By way of an illustrative example of such a recirculating recovery stream, the liquid could be simply water which is warmed by the further processing means to recover the carbon dioxide while cooled at the processing means 44 to cause exhaust at 45 bubbled therethrough to pass the carbon monoxide into the water. For other hydrocarbons etc. other solutions and combinations of processing means could be selected for recovery of specified exhaust components, solids being recoverable by filtering or other processes if desired. Further useful processing unit or unit combinations to remove or further utilize one or more emission components will be left to those skilled in the art, the above example being illustrative of the process only.

It can therefore be seen that the system of FIG. 1 provides noise attenuation in the materials 52 and 54 which line and form the side walls of main duct 11 at least over a portion or over the most objectional and disturbing frequencies found disturbing to the human ear by motor vehicles of the passenger car type. Other types of motor vehicles having objectionable noise outputs at other frequencies found disturbing would require sound attenuating materials at 52 and 54 having attenuating characteristics matching these other objectionable frequencies.

The motor vehicle 1 transmits the emissions and noise through outlet 40 to the receiving means of the system which includes inlet grating 23. The transmitting outlet 40 and the receiving means comprising inlet grating 23 are closely coupled to provide maximum transfer of exhaust from the transmitting outlet 40 to receiving grating 23. A nearly flush relationship between exhaust outlet 40 and inlet grating 23 provides the closest coupling possible since less than a nearly flush relationship (with outlet 40 spaced further away from the inlet grating 23 would cause loss and escape of emissions into the atmosphere rather than direction through the inlet grating 23 into the main duct 11 while more than a nearly flush relationship (flush or in contact) would cause friction, vibration of, and possible damage and/or destruction of the portion of the exhaust outlet arrangement adjacent to and carrying the outlet 40. The range between undesirable loose cou-

pling (outlet 40 too far away) and direct contact includes the abovementioned nearly flush relationship where most of the exhaust is directed from the outlet 40 through the inlet grating 23. For motor vehicles such as passenger automobiles the outlet 40 should not be spaced further than 12 inches above the inlet grating 23 since the pressures at which the exhaust is propelled from the outlet 10 are not high enough to cause most of the exhaust to be directed or coupled into the inlet grating 23 at distances exceeding 12 inches. In the case of diesel powered trucks the exhaust can be propelled a distance further and still mostly be caused to enter the inlet grating 23. A nearly flush relationship which provides effective coupling would exist where the spacing between outlet 10 and inlet means 23 is thus less than 12 inches but not flush for the abovementioned reasons. In the abovementioned patent application no. 545,117 now U.S. Pat. No. 3,503,188 the nearly flush relationship necessary to direct an appreciable amount of the exhaust into the system was provided by an extension of the known tail pipe over to and down between the rear wheels to the nearly flush relationship with respect to the inlet grating. A further exhaust outlet arrangement 80 coupled to a known tail pipe 82 on a motor vehicle is shown in more detail in FIGS. 2 and 3 of this application which structure also provides a nearly flush relationship of exhaust outlet 40 with inlet grating 23. Such coupling can be selected at the option of the operator of the vehicle in the embodiments of FIGS. 2 and 3 shown in detail herein. The exhaust outlet arrangement 80 has exhaust outlet 40 arranged in a plane parallel to the plane of the inlet grating 23 as was the exhaust outlet 10 shown in FIG. 4 of the aforesaid patent. Exhaust outlet 40 in the motor vehicle exhaust outlet arrangement 80 shown herein in FIG. 1 and in more detail in FIGS. 2 and 3 is arranged to provide close coupling by the nearly flush relationship with the inlet grating 23 as previously mentioned and is also arranged for positioning substantially midway between rear wheels 41 and 42 of motor vehicle 1, such location providing the requisite degree of coupling with the previously defined position of the inlet grating 23, viz. midway between the lane edges defined by the lane markers 16 and 22. Rear wheels 41 and 42 are thus in most instances not required to brake on inlet grating 23. The coefficient of friction over the inlet grating 23 would not be satisfactory particularly under wet conditions because of the lessened surface area due to the presence of grating inlet louvers 91 and metallic surface areas 92 of the inlet grating surface when compared to the highway land surface 21 on either side of inlet grating 23 between lane markers 16 and 22 where in practicing the present invention the rear wheels 41 and 42 would normally roll during braking and adequate traction would be provided.

Shown in FIG. 1 at the edge of the highway between drain entrance means 71 of storm sewer means 70 and curb 72 is display means 73 which is energized when a detected pollutant level is exceeded as detected by carbon monoxide detector means 50. Display means 73 becomes lighted by energization of the lamp inside when the concentration of vehicles at or past detector means 50 have dumped enough pollutants into main duct 11 to raise the carbon level to the energizing threshold of carbon monoxide detector means 50. The system and circuit for energizing the lamps of display means 73 is shown in detail in FIG. 4 and hereinafter

described. Display means 73 is exemplary of one form of utilization device responsive to the pollutant level detected by detector means 50 which is related by pollution level to the actual number of motor vehicles which are travelling along the highway past detector means 50. Recalling the each run of main duct 11 is provided with its detector means 50, side duct arrangement 13 for coupling exhaust from main duct section 11 to a processing means 44, and suction fan for causing the exhaust captured by the duct section 11 to be exhausted to the processing means 44, it should be recognized that a plurality of such integral subsystems positioned adjacent one another in end to end relationship for example make up a several mile run of the highway, the exact number per given mile depending somewhat on design considerations of detector sensitivity, suction fan and side duct cross sectional area size which can be tolerated and actual number of processing means which can be afforded per mile run of the lane of a highway. A theoretically optimum system viz. where duct 11 subsection length and width are equal and the depth also of same dimension so that a cube in effect is exhausted with one of the side walls thereof comprising the side duct inlet would require an extremely large number of side ducts thereby increasing the exhaust lead off complexity or else a large number of processing means one for each side duct which would make such implementation of the system unrealistic from an economic standpoint. It can thus be seen that there are a number of engineering tradeoffs, the particular engineering design thereof selected depending upon efficiencies desired in capturing the exhaust and the amount of capital available for deployment of the system placing limitations on the abovementioned theoretically near ideal arrangement. A utilization means responsive to each detector means 50 of each run of main duct 11 of each subsystem may comprise instead of display means 73 a lamp on a control panel, a logic circuit in a computer system where a plurality of these signals from the detectors are utilized, e.g., an AND circuit where if enough signals from enough detectors are present the and circuit energizes and provides an output signal in response to the presence of all inputs (from the individual detectors) which output signal can be further processed or utilized to turn on stop lights all along the respective lane subsections so that no more pollution is permitted in the area.

A side duct 13' is shown in FIG. 1 coupling and serving a parallel section of main duct 11' in the next adjacent lane of the highway in a manner which permits a single processing means 44 of large capacity for cleaning or purifying exhaust polluted air to service parallel sections of main duct 11 and 11', the necessary number of side duct connections and exhaust fans also in this case required to be deployed. Pipe 75 is seen in FIG. 1 to pass water 76 from slot 63 at the bottom of main duct 11 and from the corresponding slot at the bottom of parallel duct 11' serving the adjacent parallel lane of the highway over to pipe 73 of storm sewer means 70 which also collects storm water through drain entrance means 71 comprising a grating or other sewer inlet construction if desired. It will be recognized by those skilled in the art that the system embodiment shown in FIG. 1 may be modified for use by motor vehicles of types other than passenger cars such as, e.g., buses and trucks having power systems which emit pollutants. It should be noted that walls 77 extend upward from

the highway surface along the edges of inlet means 23. The height of each wall 77 in the case of motor vehicles such as passenger cars utilizing the highway should not exceed approximately 1 inch and function as director means for exhaust into the inlet means and as indicator means such as lane markers 16 and 22 giving a warning to the passenger car 1 operator that he has caused his motor vehicle wheels to cross over inlet 23 and deviated from a path in the center of the lane of the highway with consequent decoupling of his exhaust emissions from the pollution prevention system. The walls 77 would therefore indicate to a sleepy driver that he has deviated from his lane and constitute an additional warning and safety device over known raised lane markers 16 and 22 of the prior art. In effect then the side wheels of vehicles are seen from FIG. 1 to track between walls 77 and lane markers 16 and 22, e.g., left rear wheel 41 of vehicle 1 between lane marker 16 and raised wall 77 and right rear wheel 42 between the other wall 77 and right hand lane marker 22. In the modified embodiment described where it is desired to have access to processing means 44, such means are disposed while at the level of the highway immediately therebelow where the region below the lane of the highway may be used so that side duct length 13 may be reduced and the processing means 44 coupled closely thereto as contrasted to the processing means 17, 18, or/and 19 of FIG. 2 of the aforementioned application Ser. No. 545,117 now U.S. Pat. No. 3,503,188 which is disposed at the level of the highway however immediately thereabove. In either location, the processing means is easily accessible from the highway surface for cleaning and / or servicing.

Referring now to FIG. 4 there is shown a partial block diagram and circuit schematic depicting one embodiment of a system for energizing pollution control apparatus, e.g., elements of the system of the present invention according to information signals representative of pollutant levels detected by detector means comprising detectors 50 distributed at substantially equal intervals along the lane of the highway viz. at below the highway surface levels in each duct 11 section, or controlling traffic flow or providing such information on signals to other utilization devices such as recording means for recording these information signals or computer circuit means in computer circuits.

Shown in block 50 is the carbon monoxide detector also shown in FIG. 1 position in main duct section 11. Carbon monoxide detectors which indicate a predetermined level of carbon monoxide in the air termed "dangerous level" are well known and a known type may be utilized at 50 such as for example carbon monoxide detector 10 shown in U.S. Pat. No. 3,445,669 to Jordon et al., which shows an output signal which energizes a relay coil in the collector circuit of the output stage of the detector. Relay 110 shown in FIG. 4 herein is energized by the output signal from detector means 50 and energizing coil 111 corresponds to the coil of relay 52 of FIG. 5 of Jordan et al. When a dangerous condition of carbon monoxide is detected by detector 50, coil 111 is energized and relay 110 is closed thereby closing the contacts of single pole single throw (S.P.S.T.) switches S1, S2, S3, and S4. Under dangerously high level carbon monoxide levels with relay 110 energized and switches S1, S2, S3, and S4 closed, the potential from alternating current (a.c.) source 112 is placed across the power terminals for processing means

44 which may be an electrostatic precipitator thus turning it on and also suction fans 15 and 15'. While source 112 may be 115 volts a.c. where suction fans 15 and 15' are of the 115 volts a.c. type, a higher source voltage 112 may be utilized with correspondingly higher voltage fan types 15 and 15'. Display means 73 which comprises a lamp is also of the 115 volt type where source 112 is 115 volts a.c. and is also energized since switch S1 is closed placing lamp 73 across source 112. While utilization means here at 73 is shown as a lamp to show motorists that the system is processing emissions at dangerously high levels at that point, utilization means at 73 may as discussed earlier may comprise an input circuit or device in a computer responsive to the signal voltage developed by the detector or a traffic control system information signal input terminal or the input circuit of another type of monitoring system aiding in pollution or traffic control. Switch S5 is connected in series with source 112 and is the main switch for placing the total pollution control system into operation and which must be closed before detecting means 50 can control processing in the individual duct 11 sections since switch 55 controls the power applied by source 112 to the parallel connected components 73, 15, 15' and 44.

Processing means 44 as heretofore mentioned may, e.g., comprise an electrostatic precipitator for removing particulates such as lead from the exhaust stream 45 or may comprise utilization means previously mentioned for recovering and/or processing the exhaust stream to accumulate products or by products of commercial value. As a further example of a utilization means which could convert the exhaust stream or a portion thereof to a product of economic value, such means 44 could comprise a carbon monoxide to hydrogen converter for utilizing the separated out carbon monoxide of the type shown in U. S. Pat. No. 3 490 872 to Fenton where a high yield of hydrogen is obtained from carbon monoxide at mild temperature and pressure conditions. While the disclosed motor vehicle embodiments show exhaust outlets arranged for direct coupling of exhaust to highway structures for further processing or utilization, processing upstream of the outlet in the vehicle itself is not to be excluded from the present system concept since in such cases the present processing means 44 would either complement and/or supplement such processing means on the vehicle thereby improving the pollution prevention of the same type and/or other types of pollutants respectively.

Turning now to FIG. 5 showing a front view in section of motor vehicle and highway it can be seen how duct 11 which is centered in the middle of the lane 21 of the highway and has exhaust removing side duct 13 and liquid removing side pipe 75 may be utilized with further modification as shown in FIG. 5 to not only retain and process the emissions deposited therein in the manner described in connection with FIGS. 1 to 4 but to also provide powering of and also automatic steering for specially designed electrically powered vehicles herein disclosed. The vehicle 200 shown in FIG. 5 is provided with means indicated generally at 204 for receiving automatic steering control voltages from first and second transmission lines 206 and 208 extending along the length of highway 21.

FIGS. 8 and 9 show an alternate power transmitting and receiving arrangement which may be used with

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outboard d.c. power sources and with automatic transfer features as shown in FIGS. 10 and 11.

Turning now to FIG. 10 there is shown in block and schematic form an electric motor vehicle power system utilizing d.c. to three phase energy conversion for supplying three phase energy to a three phase a.c. induction motor. The system of FIG. 10 provides excellent performance from the on-board power system but is however limited in range, however as shown utilizing automatic switching to d.c. or three phase a.c. power when available from highway transmitting systems and also utilizing power receiving systems coupled thereto as shown in FIGS. 6, 7, 8, or 9 is capable of unlimited range.

FIG. 11 shows show in block and schematic form a power plant for another type motor vheicle (here the M-37 army truck power system) however modified to provide off board power systems of the type shown in FIGS. 6, 7, 8, and 9 in accordance with the teachings of the present invention for extending the range of operation of vehicles of this type.

Turning now to FIG. 12 there is shown a unique three phase power transmission system which can be read with FIG. 6 wherein the same numerals are utilized to denote corresponding structure in the system of FIG. 12.

The foregoing discussion and description relating to preferred embodiments of the invention require the cooperative effort of automobile manufacturing companies and highway builders for most successful utilization of the arrangements and systems which are disclosed for purposes of illustration and not in the limiting sense except as defined by the following claims.

I claim:

1. In combination:

a highway;

a duct which runs parallel to and along the length of said highway; and,

means distributed continuously along said duct for attenuating noise, said means comprising material disposed below the highway surface and lining at least one inside wall of said duct, said material having sound absorptive characteristics in the audio frequency range below 5,000 cycles per second so that exhaust noise directed thereagainst is attenuated.

2. In combination:

a highway;

detector means for detecting a predetermined pollutant level at a point along said highway;

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display means positioned above said highway surface; said display means coupled to said detector means and responsive thereto when said predetermined pollutant level is detected by said detector means; and, wherein

said detector means comprises a plurality of detectors positioned below the surface of said highway, each of said plurality of detectors positioned respectively in a plurality of duct sections of predetermined length extending consecutively along the length of the highway,

3. In combination in the surface of a lane of a highway:

first means extending above the surface and along the length of the highway;

second means extending above the surface and along the length of th highway;

a depression extending below said highway surface and extending between said first and second means;

said depression arranged to run off water gathering on said highway surface between said first and second means;

said first and second means extending less than 1 inch above said highway surface and the cross sectional area of said depression is greater than the cross sectional area of said first and second means combined; and,

said first means comprising a wall extending above said highway surface, said second means comprising a further wall extending above said highway surface, and said depression comprising a duct having outer wall surfaces coextensive with the inner facing wall surfaces of said first and second means.

4. The combination according to claim 3 wherein said first means, said second means and said depressions are of substantially rectangular cross section.

5. The combination of claim 3 wherein said depression extends a first predetermined distance below said highway surface and said first and second means extend a further predetermined distance above said highway surface and wherein said further predetermined distance is less than said first predetermined distance.

6. The combination of claim 3 wherein said first means, said second means and said depression extend along axis parallel to the lane of said highway and at least a car length therealong where a car length equals 20 feet.

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