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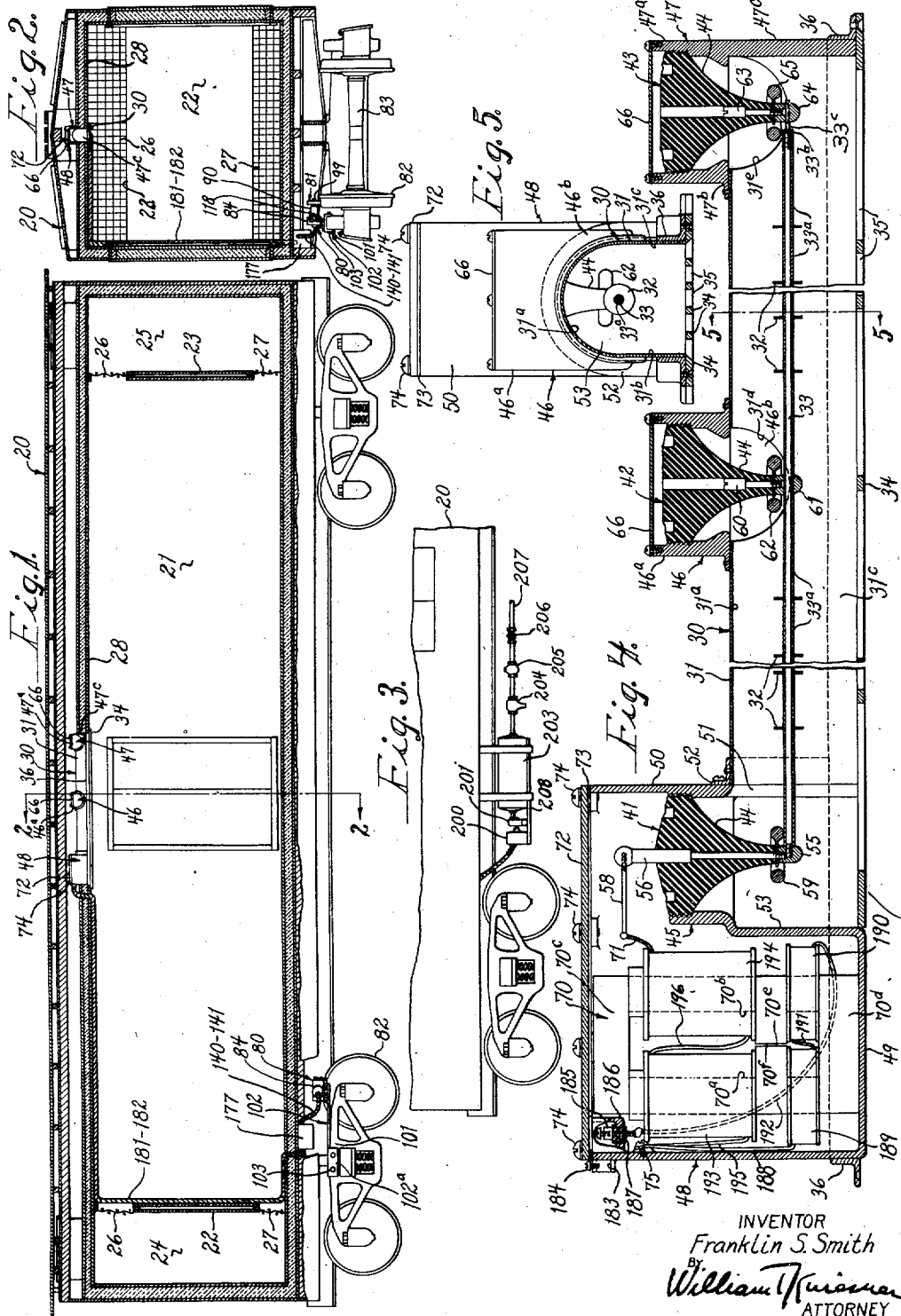
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PRESERVATION OF FOODS IN TRANSIT

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PRESERVATION OF FOODS IN TRANSIT

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This invention related to a method and apparatus for preserving products, particularly perishable food products, during and in course of transportation.

One of the objects of this invention is to provide for safe, dependable, efficient and inexpensive preservation of perishable food products in course of transportation by way of vehicles, or the like, equipped with suitable refrigeration to keep the food at a suitably low temperature as compared with the external temperature or with heating means to protect the food products against undesirably low external temperatures. Another object is to provide a simple, inexpensive, rugged and durable apparatus capable of being readily and inexpensively incorporated into vehicles of the above-mentioned type and to provide such apparatus that will be well adapted and reliably capable of functioning under the varying conditions met with in food transportation by vehicles and capable also of dependably withstanding the relatively rough usage encountered in such transportation, particularly where the vehicle is a railroad vehicle, such as a refrigerator car, or heater car. Another object is to provide an apparatus of the above-mentioned character that will be capable of efficient and dependable food-preserving action at very low energy consumption and to provide for the derivation of its energy from the prime mover of the vehicle or from an appropriate vehicle-carried or vehicle-actuated part or means, and thus to minimize the load or burden on the vehicle prime mover or moving part itself.

Another object is to provide an effective, simple and compact system and apparatus for providing the interior of a vehicle, like a refrigerator car, with ozone, and in a manner capable of meeting dependably the varying requirements and conditions of practical use. Another object is to provide an apparatus of the just stated character that may be readily applied to or incorporated in existing types of refrigerator or like food-transporting vehicles, that may be embodied in compact form and thus avoid undue encroachment upon available spaces in or on the vehicle, that will be substantially foolproof, and in operation simple and dependable. Another object is to provide apparatus of the above-mentioned character in which regulation or control of the production or supply of ozone to the vehicle chamber will be simple, dependable and thoroughly practical.

Another object is to provide an ozone-producing system and apparatus capable of utilizing

as a source of driving power therefor a movable part of the vehicle whose speed might vary substantially with the speed of movement of the vehicle itself, such, for example, as a wheel or axle and to provide for simple, efficient and dependable regulation of the ozone-generating apparatus to insure its appropriate functioning in spite of such changes in speed of drive.

Another object is in general to provide an improved, inexpensive and dependable ozonizing system and apparatus.

Another object is to provide a compact, inexpensive and efficient system and apparatus for producing ozone and capable of dependable and efficient operation even though the frequency or value of the alternating potential employed might vary throughout a relatively wide range. Another object is to provide such a system and apparatus with simple, inexpensive and efficiently operating means for regulating or controlling ozone production within or at the desired rate or quantity even though such factors as potential or frequency of the energizing current might be subject to substantial variations.

Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts, and in the several steps and relation and order of each of the same to one or more of the others, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings in which are shown several of the various possible embodiments of the mechanical and electrical features of my invention,

Figure 1 is a longitudinal, vertical, sectional view of a refrigerator or heater vehicle in the form of a railway car showing one form of system and apparatus for supplying the interior with ozone, certain parts being shown in elevation;

Figure 2 is a transverse sectional view thereof, as seen along the line 2-2 of Figure 1;

Figure 3 is a view like that of Figure 1 but in elevation, certain parts being broken away or omitted, showing another possible form of certain mechanical features of my invention;

Figure 4 is a central, longitudinal, sectional view, on an enlarged scale, of an ozonizer with certain of its related electrical equipment, all of which are shown in elevation in Figure 1;

Figure 5 is a vertical sectional view of the

ozonizer, as seen along the line 5—5 of Figure 4;

Figure 6 is an elevation as seen in the lower left-hand portion of Figure 2 but is on an enlarged scale, showing a preferred form of mounting of and drive for a generator from a rotating part of the vehicle, illustratively a car wheel;

Figure 7 is a horizontal sectional view as seen along the line 7—7 of Figure 6 showing certain features of construction of the generator;

Figure 8 is a vertical sectional view as seen along the line 8—8 of Figure 6 showing certain features of the generator mounting and also of the generator itself;

Figure 9 is a perspective view of the rotor of the generator, and

Figure 10 is a diagrammatic circuit representation of the electrical features of my system and apparatus.

Similar reference characters refer to similar parts throughout the several views in the drawings.

As conducive to a clearer understanding of certain features of this invention, it may at this point be noted that for the transportation of perishable food products it is customary to use vehicles equipped with suitable means for producing in the vehicle space or chamber in which the food products are carried a suitably low temperature to protect the food against the external or outdoor summer and like temperatures or to produce heat to protect the food against unusually low external temperatures such as are met with in winter or in northern latitudes; such means may comprise, for refrigeration purposes, any suitable means for abstracting heat, and for heating purposes may comprise any suitable heating means. Thus, for example, where the vehicle takes the form of a railway car, as at 20 in Figures 1 and 2, it may be of usual construction, being provided with an interior or chamber 21 provided adjacent its ends with partitions 22 and 23 to provide ice bunkers 24, 25 for the reception of suitable charges of ice; the partitions 22, 23 are provided with upper and lower gratings 26, 27, respectively, to permit the movement of warm air from the food-containing chamber or space 21 through the upper gratings 26 into the ice bunkers to be cooled and thence to enter the space 21 through the lower gratings 27. For heating purposes, any suitable form of heat-producing means may be put in the chambers or spaces 24, 25, whence the circulation or movement of the air takes place in reverse directions.

Known equipment or apparatus for transporting perishable food products does not, however, afford any or adequate protection of the food products against bacterial growths and mold development with the result that the transportation of food products has been seriously handicapped. Protection of certain food products against serious loss of color and against injury to food surface flavor requires relatively high humidity but with increase of humidity the growth of bacteria and molds also increases greatly. Depressing the temperature reduces bacterial growth more than mold development; for example, below 3° C. molds grow more rapidly than bacteria unless the bacteria have an advantage by high initial infection. Both absorb moisture in their growth.

Air currents, such as in a ventilated refrigerator railway car, are helpful in retarding development of bacteria and of molds, especially in the case of certain vegetables. In the case of meat, however, they actually increase bacterial growth

if the humidity is above 85% and increase the loss by shrinkage, and in the case of beef, they seriously affect the color, reducing the "bloom." For example, a velocity of 1 meter per second at 7° C. and 90% relative humidity has been found to impair the color of beef to such an extent that the otherwise possible storage time is reduced 50%.

The value of ozone in the commercial cold storage of food products has been definitely established and much data in connection with its use and action and effects for such purpose is known and available; but the transportation of perishable food products continues according to old methods or practices without the realization of any of the advantages that the application of ozone would achieve. For example, much costlier shipment of food products by the speedier express car service as compared to freight is frequently resorted to while efforts have been made to speed up freight service. However, ozone-producing apparatus available for stationary food storage is not necessarily adaptable to refrigerator vehicles or the like, while the impossibility or undesirability of providing constant manual and skillful supervision of the equipment as is possible and requisite in stationary plants add to the difficulties encountered in providing for ozonizing of vehicles used for the transportation of food. Furthermore, the varying requirements of the different kinds of food products which any one vehicle might successively handle injects still further complications.

For example, if the concentration of ozone is too high, say on the order 100 to 200 mg. per cubic meter or from 50 to 100 parts per million, at normal atmospheric pressure, products such as bacon, sausage, lard, butter, meats and bananas are injured. Unless, therefore, adequate safeguards can be provided in a vehicle or like food transporting means to prevent such concentrations from being accidentally or ignorantly produced, considerable damage might be caused. At proper concentrations, food products are not damaged while the destruction of bacteria and molds may be dependably achieved so that the products may be delivered at destination, even though initially infected, substantially free of bacteria and molds.

The effectiveness of ozone in the destruction of bacteria and molds is largely dependent upon the equilibrium concentration. An equilibrium concentration of about 3 parts per million gives nearly the same germicidal effect, whether applied continuously or for two periods per day of two hours each, or for one three-hour period. For relatively "clean" eggs a minimum equilibrium concentration of ozone of 0.6 per million and for "dirty" eggs a concentration of 1.5 parts per million has been found satisfactory and desirable while a continuous concentration of 3.5 parts per million, for eggs, over long periods of time has been found to be not injurious. In general, vegetables require an equilibrium concentration of at least 1.5 parts per million, fruits about 2 parts per million, meats about 2 to 3 parts per million. In stationary cold storage plants, it is possible to vary or control the equilibrium concentration according to the product being stored and in accordance with the general data above outlined, and that may be done manually, and in any case it is a simple matter, in such stationary plants, to provide for appropriate or suitable manual supervision of control

of ozone production and concentrations employed. In mobile equipment, however, such as in a freight car, that kind of control or supervision is impossible or impracticable or otherwise not feasible. According to certain features of my invention, however, I make it possible to achieve in such mobile or transportation equipment the many advantages of ozone in the atmosphere containing the products to be transported and without having to depend upon such manual supervision or control as is practiced in stationary storage plants.

Where, as in the illustrative railway car above described, a circulation or movement of the air takes place along paths as mentioned above, I prefer to position a suitable ozone-producing means, preferably in the form of a single unit, so that the ozone generated by it may be picked up by the moving or circulating air current or currents, and a preferred and illustrative location is along the middle portion of the longitudinal axis of the chamber 21, preferably at or recessed in the ceiling 28. An illustrative and preferred form of ozone-generating device, generally indicated by the reference character 30, is shown so positioned in Figures 1 and 2, the device being of sufficient length along the above-mentioned axis of the chamber 21 to overlap adequately portions of both of the two above-mentioned air circulating paths, the device extending to each side of the central vertical plane or axis of the chamber 21. As ozone is produced by the device, the ozone is picked up by or injected into the atmosphere of the chamber 21 and the air current or currents moving therein; the ozone, having a density, relative to air, of 1.66, easily falls by gravity into the moving air currents in which it diffuses and by which it is carried and distributed throughout the chamber 21.

The ozonizer 30 preferably comprises a housing 31 which preferably also functions as an electrode, being made of sheet metal of suitable characteristics, such as stainless steel or anodized aluminum, and it is to coact with companion electrode means, preferably taking the form of washer-like members 32, made of a suitable metal, illustratively nickel, and a suitable number of which are supported by a suitable rod-like conductive member 33 insulatively supported as later described, tube-like bushings 33^a strung onto member 33 holding the members 32 in spaced relation.

As is better shown in Figure 5, the electrode housing 31 preferably comprises an upper portion 31^a which in cross-section is semi-circular with side portions 31^b and 31^c extending downwardly and preferably in parallelism, thus giving the electrode housing 31 the shape of substantially an inverted U, the lower ends of the arms of which are closed over by a grating 34 which may be made of suitable sheet metal suitably slotted or apertured as at 35.

The assembly of the parts 31 and 34 may be effected in any suitable way, preferably by a peripherally extending angle-shaped member 36 whose horizontal flange projects laterally all around and may take against the periphery of a suitable opening cut into the ceiling 28 to accommodate the housing portion 31 and other parts later described and by which horizontal flange the entire device or unit may be secured to the ceiling, as is better shown in Figures 1 and 2. Thus, the grating member 34 is substantially flush with the ceiling 28 and forms no obstruction

in or to the chamber 21. It is through some of the apertures 35 in the grating 34 that the ozone, produced as later described within the housing 31, gravitates into the chamber 21 and in the illustrative form into the convection current or currents in the space 21, air entering housing 31 through other apertures 35.

As appears from Figures 4 and 5, the axis of the supporting conductor 33, and hence the coincident axes of the electrode members 32, is coincident with the center of the semi-circular cross-section of the portion 31^a of the housing electrode 31, the portion 31^a being substantially half cylindrical with the just stated axes coincident with its own axis. Thus, the peripheries of the electrode members 32 and the cylindrical surface of the portion 31^a are concentric.

A suitable potential difference may be impressed across the housing-like electrode 31 and the disk-like electrodes 32, the former being preferably maintained at ground potential, and the relative radii of curvature of the electrode parts so selected that the voltage gradient at the peripheries of the disk electrodes 32 is sufficiently high to ionize the air in the gap between the electrode parts 32 and 31 but without effecting complete break-down of the air gap or spark-over there-through, a corona discharge emanating from the edges of the electrodes 32. Where the vehicle is to be subjected to substantial changes in barometric pressure, such as where the railway car passes from low to high or mountain altitude, and vice versa, so that the dielectric strength of the air in the air gap varies with the resultant change in atmospheric pressure, the distance between the peripheries of the corona-emitting electrodes 32 and any part of the housing-like electrode 31, is of sufficient length so that even at the highest altitudes and hence lowest atmospheric pressures reached by the vehicle with consequent decrease in dielectric strength of the air, spark-over does not occur; this is the preferred proportioning of the parts because it is preferred to avoid the low rate or quantity of ozone production that accompanies disruptive discharge or spark-over. Illustratively, an alternating E. M. F. may be employed of an average value of on the order of 5000 volts in which case the radius of curvature of the portion 31^a may be 3½" and of the electrodes may be ¾". Electrodes 32 are preferably relatively thin and sharp-edged.

In the preferred arrangement, the housing-like electrode 31 is, as above noted, grounded, and suitable means are provided to insulatively support the high voltage electrode structure 33-32 in position; any suitable number of such supports may be provided, illustratively three, as shown in Figure 4 and generally indicated by the reference characters 41, 42 and 43, suitably distributed throughout the length of the coating electrode structure. These insulating supports, one of which, as the support 41, may be made to function as a terminal insulator, are otherwise preferably generally of the same construction.

Thus, each may comprise a member 44 of a suitable solid dielectric material, such as Bakelite or other suitable and preferably ozone- and moisture-resisting dielectric, having upper large-diametered externally threaded portions screw-threaded into housing-like supports 45, 46 and 47, respectively, with the threaded joints suitably sealed hermetically as with an appropriate cement. Support 45 (Figure 4) is preferably formed integrally with a casing generally indicated at 48 and constructed to contain certain

other parts, as later described; the casing 48 may be a casting generally rectangular in cross-section and is so shaped that its bottom falls in the same plane with the grating 34, its right-hand wall 50 being cut away as at 51 to merge gradually into the U-shaped interior surface of the housing-like electrode 31, the latter being secured to the wall 50 as by the U-shaped angle member 52 (Figures 4 and 5) while an intermediate wall member 53 (Figure 4) acts, with the respective side walls of the casing 48 and with the left-hand portion of the grating 34 to enclose the terminal insulator 41 and the left-hand portion of the electrode structure 33—32, walls 50, 53 and the side walls of the casing 48 being suitably merged to provide the interiorly cylindrical support 45 which is threaded as above stated to receive the Bakelite member 44.

As is better shown in Figure 4, the upper intermediate portion of the electrode member 31 is cut away, as at 31^d, to provide an opening of large enough radius to permit the downwardly tapered insulating support to project there-through and into the interior of the housing electrode 31, the support 46 having an upper cylindrical portion 46^a interiorly threaded to receive the Bakelite member 44 and a lower saddle-like portion 46^b (Figure 5) which fits snugly against the member 31 about the opening 31^d where it is secured as by screws or riveting.

At its right-hand end the member 31 is similarly cut away, as at 31^e, to permit the downwardly tapered portions of the member 44 to project into the part 31, the support 47, which, like the support 46, may be a casting, having an upper cylindrical portion 47^a interiorly threaded to receive the solid dielectric member 44, and a saddle-like portion 47^b that closely envelopes the cut away part 31^e about which it is secured as by screws or rivets; member 47 has a plane downwardly extended side or end portion 47^c that closes over the right-hand U-shaped end of the member 31, its lower end being flush with the lower edges of the portions 31^b and 31^c so that the grating member 34 can rest against all three edges, the angle-securing member 36 coacting to hold the parts 31, 47 and 34 together at the right-hand end of the unit 30.

It is to the lower ends of the downwardly tapered supports 44 that the electrode structure 32—33 is secured. Preferably, the left-hand end of the rod 33 is threaded, as shown in Figure 4, and thereby screw-threaded into a laterally positioned threaded hole in a head or nut 55 having a vertically exposed threaded hole into which is threaded the lower threaded end of a stepped conductive member 56, a suitably stepped hole being provided along the axis of the insulating member 44. Member 56 extends upwardly into the casing 48 where it is exposed and made available to have a suitable high voltage conductor 58 connected to it. Interposed between the nut 55 and the lower end of insulator 44 and clamped thereby when the conductor 56 is screwed up tightly is the web portion of a flux-controlling member preferably in the form of a toroidal member 59 adapted, when the high potential is impressed on the terminal conductor 56 and corona-emitting electrode structure 32—33, to coact with the metal parts into which the insulator 44 is screwed, to relieve the intervening surfaces of the insulator 44 against becoming overstressed.

The central supporting structure 42 has its insulator 44 provided with a suitable axial hole

appropriately stepped to receive a filister head screw 40 whose lower end is threaded into a nut 61 like the nut 55; the latter is provided with a horizontally extending hole through which the electrode structure 33—33^a slidably passes, a toroidal static shield 62, like member 59, being again preferably provided and clamped between the adjacent ends of parts 61 and 44. Preferably in a similar way the right-hand end of the electrode structure 33—33^a is connected to or supported from the insulating bushing 44 of the supporting structure 43; thus, the member 44 again has an axially extending stepped hole to receive a filister head screw 63 threaded into a nut 64 suitably apertured to receive the right-hand end of the structure 33—33^a, with portions of a static shield 65 like the member 59 clamped between adjacent ends of the nut 64 and the part 44. Preferably, the end of member 33 is threaded, as shown, to receive a nut 33^b between which and nut 55 sleeves 33^a and members 32 are clamped or held on member 33, a stud-like extension 33^c of the member 33 slidably engaging in a hole in nut 64. The slidable engagement of the structure with nuts 61 and 64 permits expansion and contraction to take place without straining other parts.

The housing-like supports 46 and 47 are at their upper ends preferably provided with suitable cover plates 66 which may be secured in position preferably detachably, as by screws, and which may be sealed if desired, as by a suitable cement. With the upper ends of the filister head screws 60 and 63 extending but a short distance upwardly into the axial holes in the insulators 44, the walls of the portions of these holes not occupied by the screws coact with the upper generally circular surfaces of the insulators 44 to provide an adequately long surface leakage path between the screws and the upper portions of the castings 46 and 47, thus insuring adequate insulation between these parts. The conductor 56 of the insulating supporting structure 41, however, projects upwardly through the upper generally circular face of the insulator 44 but, as is later described, the interior of the casing 48 is preferably filled with a suitable dielectric, preferably in liquid form, such as a chlorinated non-burning dielectric, for example, so that that dielectric also takes part in preventing leakage currents or break-down between the conductor 56 and the upper interior parts of the casing 48. The downwardly exposed surfaces of the insulators 44 are appropriately shaped, as already above indicated and as illustrated in Figure 4, to provide adequately long surface leakage paths to prevent break-down or leakage currents there-along even under the lowest atmospheric pressures encountered, the toroidal static shields coacting to prevent undue concentration of flux along these surface paths.

Where, as in the preferred form, a step-up transformer is provided to raise the voltage of the initial or generating source, such a transformer is preferably housed in the casing 48, as is better shown in Figure 4, where the transformer is indicated as a whole by the reference character 70 and with its high voltage terminal connected as by conductor 71 to the conductor 58, both of which with the transformer are submerged in the insulating medium in the casing, the latter being provided with a cover plate 72 sealed as by a gasket 73 to the otherwise open top of the casing 48 and connected to the latter preferably detachably as by screws 74. The other

side of the high voltage circuit of the transformer 70 and also one side of the low voltage winding or circuit are grounded to the casing 48 as by a suitable screw or binding post, as indicated at 75 and as later described in greater detail; thereby, when the high voltage circuit of the transformer is energized, the coating electrode structures 32-32 and 31 function, the housing-like electrode 31 being grounded to the casing 48, suitable provision being made, as later described, for the energization of the low voltage winding or circuit of the transformer, one side of which, as just pointed out, is grounded to the casing 48. When the complete unit is mounted in the recess in the ceiling 28, the casing 48 is adequately accommodated, with other upwardly projecting parts, in the space above the plane of the under face of the ceiling 28.

Suitable means are provided for supplying energy in suitable form and such means preferably takes the form of a generator in the form of preferably an alternator driven preferably by a source of energy readily available on or in the moving vehicle, several illustrative forms of which are about to be described. A preferred form comprises an alternator actuated from a suitable rotating or moving part of the vehicle, such as a wheel or axle, and in Figures 1 and 2 I have indicated by the reference character 80 a generator having suitable driving connection with an axle of the car as, for example, by way of a friction roller 81 bearing against the face of one of the car wheels 82 of the axle 83 so that the generator is driven as the vehicle moves.

The generator and the above form of driving connection preferably take the form shown in detail in Figures 6, 7, 8 and 9. The alternator may comprise a metallic body housing or casing 84 in which is a core 85 (Figure 8) having pole pieces 86, 87 provided with suitably curved faces between which is to be rotated the field structure 88 whose shaft 89 (Figure 7) is mounted in suitable bearings which are preferably provided in a bearing housing 90 preferably formed as an extension of an end housing cover 91 suitably secured in closing position on the otherwise open end of the housing 84 as by screws 92.

The bearings for the shaft 89 are preferably of the anti-friction type and I preferably employ two such bearings 93, 94 spaced axially along the shaft 89 by a suitable distance, bearing housing 90 being of suitable axial length for that purpose (Figure 7).

Shaft 89 is suitably stepped to receive the inner race of the bearing 93 and to form a shoulder against which that race may be clamped by a nut 95 threaded onto another portion of the shaft, while the outer race is seated in an annular recess adjacent the inner end of the bearing housing 90 and clamped or held in position by an inner apertured disk-like plate 96 secured to the closure plate 91 as by screws 97.

Adjacent its outer end shaft 89 is also stepped to receive the inner race of the bearing 94 preferably with a friction or press fit, while the outer race of the bearing 94 is friction- or press-fitted into the outer end portion of the bearing housing 90.

The shaft 89 extends through a suitable hole in the outer end of bearing housing 90 and has suitably fixed thereto, as by a key 98 and a nut 99, the above-mentioned driving pulley or roller 81. Where the latter is to be driven by frictional or rolling contact with a moving part, such as the rotating wheel 82, I prefer to provide the

member 81 with a suitable tire of suitable yielding material. Thus, the roller 81 may comprise a hub 81^a of metal or other suitable material, secured as above indicated to the shaft, and it has secured to its periphery, in any suitable manner, as by cementing, interlocking therewith, or molding thereon, a layer 81^b of a suitable resilient material preferably an appropriately resilient rubber; to the outer surface of the yielding rim part 81^b I prefer to apply a suitably heavy layer 81^c of a material that is preferably yieldable and has good heat-resisting qualities with a relatively high friction coefficient. Illustratively, the material of rim part 81^c may be of the kind that is used as a brake lining on automobiles. Thus, when the roller or pulley 81 is suitably pressed against the peripheral faces of the wheel 82, a dependable driving of the rotating part of the generator is effected.

The shaft 89 with the rotating part 88 of the generator may first be assembled and then assembled to the cover plate 91 and bearing housing 90, as above described, and then the pulley 89 applied to the external end of the shaft; thus, manufacture and assembly are greatly facilitated and the resultant assembled parts may as a unit be assembled to the housing 84 and to the core structure 85 and related parts carried by the housing 84; likewise, disassembly for purposes of replacement, inspection, or repair, may easily be achieved. Suitable means may be provided for supplying the bearings in the bearing housing 90 with an appropriate lubricant, such as suitable threaded apertures closed by the plugs 100 (Figure 7), the construction, moreover, being such that a substantial and long-lasting quantity of lubricant may be dependably maintained in the bearings and bearing housing.

Where the generator is to be driven from a car wheel, as in the illustrative form, I preferably provide for a suitable mounting of the generator on or from the truck frame to which the car wheel and its axle are related, and I preferably employ, for that purpose, a portion of the side frame 101 (Figures 1, 2 and 6) of the truck. Preferably, I employ a primary support or bracket 102 that is preferably shaped to overlie the side frame 101 of the truck, having at its left-hand end, as viewed in Figure 1, a U-shaped or saddle-like portion that fits over the middle portion of the side frame 101, providing side flange portions 102^a and 102^b (Figure 6) that take against the sides of the side frame 101 and to which security of mounting may be achieved as by the cap screws 103. The bracket 102 is extended (toward the right in Figure 1) to a point adjacent the vertical center line of the wheel 82 and at that end is provided with two upwardly extending lugs 104, 105 (Figure 8) aligned lengthwise of the bracket 102 and provided with suitable bores to receive a shaft or rod 106, the bores being preferably suitably shaped, as shown in Figure 8, as by enlarging them centrally to retain a suitable lubricant-retaining packing.

With the above-described illustrative form of mounting bracket, I provide the generator housing 84 with suitable means to connect it to the rod 106 in such a way that the generator assembly may pivot about the axis of rod 106 to permit movement of the driving pulley or roller 81 in a direction toward or away from the face of the wheel 82. Preferably, such connections comprise two downwardly directed spaced lugs 108 and 109 (Figure 8) preferably formed integrally with the under side of the housing 84, these lugs being

suitably apertured to take over the ends of the rod 106, the latter being held against movement axially relative to its supporting lugs 104, 105 in any suitable way as by collar 110, 111, and preferably I interpose between the rod 106 and the bores in the lugs 108, 109 a suitable cushioning or vibration-damping means, such as rubber.

In Figure 8 I have shown such means in the form of an annulus 112 of rubber of suitable composition and of suitable dimension, preferably bonded to internal and external metal tubes 113 and 114, the former for bearing contact with the rod 106 and the latter for fitting into the bores of the lugs 108—109. The bores of the latter are preferably provided with lips 108^a and 109^a (Figure 8) at their respective external ends to hold the cushioning means against movement toward the outer ends of the rod 106, while movement of the cushioning means out of the lugs is preferably prevented by so proportioning the parts that the inner ends thereof abut against the collars 110, 111, respectively, fixed to the rod 106.

As is better shown in Figures 6 and 8, rod 106 is preferably extended toward the right (also toward the right as viewed in Figure 1), thus to provide a preferred form of anchorage, as at 115 in Figures 6 and 8, for one end of a tension spring 116 whose other end is made preferably selectively effective to press the driving pulley 81 into or out of driving engagement with the wheel 82.

A preferred anchorage of the other end of the spring 116 comprises a connection thereof to a lug 117 on the under face of a lever 118 (Figures 6, 7 and 8) which is preferably movably supported by the generator housing so that it may be given a manually selectable position. Thus, the housing 84 may be provided with two vertically spaced lugs 119, 120 apertured to form bearings for a stud 121 secured to or integrally formed with the lever 118 and permitting the lever to be swung throughout about 180° and, for example, from the full line position of Figures 6 and 7 to the dotted line positions there shown.

Preferably suitable means are provided to hold the lever 118 in these extreme positions. For example, I may provide in the upper face of the lug 119 (Figures 6 and 8) a diametrically extending V-shaped groove 122, the under face of the lever 118 adjacent its junction with the stud 121 being provided with suitably positioned projecting means like the ends of a pin 123 which seat in the groove 122 both when the lever 118 is in the full line position of Figures 6 and 7 and when it is in the broken line position. In each case the tension of the spring 116 keeps the projections 123 seated in the groove 122 and thus the lever is locked or held against movement out of either of these positions excepting when the pull or tension of the spring is overcome by manually swinging the lever 118 out of its held or locked position about the axis of the stud 121, the projections being cammed out of the V-shaped groove.

In the full line position of lever 118, the lever arm through which the spring 116 acts on the generator housing extends to the right of the axis of the pivot rod 106 (Figure 6) and the driving pulley 81 is pressed into driving engagement with the wheel 82, thus effecting drive of the rotating part of the generator. In this form the rate of generator drive will vary substantially with the speed of the vehicle where the driving member is related to the running gear of the vehicle, as to one of its wheels. In freight train operations the speed may vary from zero to 60 miles an hour.

According to certain features of my invention, where the drive is effected as from a car wheel, I prefer to arrange to disrupt the driving connection for purposes later described and preferably I employ the above-described mounting of the generator and of the spring and its lever to disrupt the driving connection. Accordingly, if the lever 118 is now manually swung through about 180° to the broken line position (Figures 6 and 7), the lever arm through which the spring 116 operates now falls to the left of the vertical plane through the pivot rod 106 and the generator housing 84 and its related parts are swung and held in the opposite direction about the axis of rod 106, as indicated by the broken lines in Figure 6, the generator pulley 81 being thus lifted and held out of rolling contact with the wheel 82.

Preferably, I provide suitable stop means to limit the range of tilting movement of the generator housing about the pivot rod 106 and such a means may comprise an L-shaped bracket 127 (Figures 6 and 7) secured to the supporting bracket 102 substantially underneath the housing 84, as by screws 128, the vertical arm of bracket 127 having a slot or hole 129 into which extends a stud 130 preferably provided with cushioning means 131 substantially like the cushioning means 112—113—114 above described, stud 130 being secured to a lug 132 on the under side of the housing 84. The parts are so proportioned that, with the pulley 81 in driving engagement with the wheel 82, sufficient play exists between the part 130—131 and the coacting parts of the bracket 127 to insure maintenance of the driving connection between pulley 81 and wheel 82, under the action of spring 116, throughout such relative vertical displacements as take place between the wheel 82 and the side frame 101 of the truck, during operation of the vehicle and also throughout an adequate range of wear or change in diameter of the members 81 and 82; however, such play is insufficient to permit the spring 116 to swing the generator casing sufficiently in clockwise direction to bring the bearing housing 90 or the end of the shaft 89 into engagement with the wheel 82 should the pulley 81 become broken or dislodged from the shaft 89. When the lever 118 is swung to its dotted line position so that spring 116 holds the housing 84 tilted in counter-clockwise direction, the cushioning means 131 engages the lower end of the slot 129 and acts to limit the action of the spring 116 in that direction.

The generator is preferably in the form of an alternator and a preferred form is as follows: The core structure 85 (Figure 8) is preferably of laminated iron of good magnetic qualities and is shaped to provide vertical legs 85^a and 86^a about which are positioned or wound the windings 135 and 136 preferably connected in series as by a jumper 137, one terminal of one winding being grounded as at 138 (see also Figure 10), the other terminal 139 being connected to the insulated conductor 140 of a flexible cable construction embodying preferably a flexible metallic sheath 141, the cable being brought into the generator housing 84 through a suitable aperture, as at 143 in Figure 7, whereby its metal sheath 141 may be anchored as by the screw 142 and at the same time grounded to the generator casing to achieve a preferred form of wiring of the apparatus and system as later described. The junction between cable and casing may be sealed and made weather-proof in any suitable way. Incidentally, I prefer (Figures 7 and 8) to provide a suitable flexible

conductor or jumper 144 to ground the generator housing 84 to the supporting bracket 102 and hence to the truck frame. By means of the flexible cable 140—141, the energy output of the generator may be conducted to the related apparatus in or on the car body.

Where, as is preferred, the generator is in the form of an alternator, the rotating part driven by shaft 89 preferably is in the form of a field structure 88 as already above indicated. The latter preferably comprises a suitably shaped permanent magnet or field piece 150 made of a suitable steel and appropriately treated and magnetized for the long retention of its magnetization. Field piece 150 is of an axial length (Figure 7) substantially equalling that of the pole pieces 86—87 of the core 85 and in transverse cross-section is shaped as shown in Figure 8 to provide pole pieces 152 and 153 each having a radius of curvature at its outer face closely approximating the radius of curvature of the stationary pole pieces 86, 87, leaving an appropriate and preferably small air gap therebetween.

Field piece 150 is suitably secured to or mounted on shaft 89. Preferably shaft 89 is made of a suitable non-magnetic metal and has integrally formed with it or suitably secured to it a carrier for the field piece 150. That carrier may comprise a disk-like portion 154 (Figures 7 and 9) of the same radius of curvature as the pole pieces 152 and 153 and provided with two axial extensions 155 and 156 (Figures 8, 7 and 9) externally having the same radius of curvature and internally shaped, as is better shown in Figure 8, to fit snugly into the two diametrically opposed axially extending spaces at the sides of the field piece 150 as the latter is seen in Figure 8, thereby filling in these opposed gaps in the field piece 150 and giving the field structure 88 externally a true cylindrical surface, thus to cut down windage losses, and the like.

The pole portions 152 and 153 are extended in an axial direction somewhat beyond the substantially segment-shaped end faces of the portions 155 and 156, as shown at 152^a and 153^a in Figure 9, where it is desired to achieve or carry into practice certain other features of my invention, as is preferred particularly where the range of speed change of the alternator is substantial, as in the present illustrative form. There remain thus exposed in an axial direction and toward the observer viewing Figure 9, segment-shaped faces 152^a, 153^a of the pole pieces 152 and 153. To hold the field piece 150 assembled to the illustrative non-magnetic mounting 154—155—156, I provide a plate-like member 157 that bridges across the ends of the parts 155, 156 (Figures 7 and 9) having two opposed edge faces that are of the same radius of curvature as the part 154 and two opposed straight edge faces that mate with the opposed inwardly facing edge faces of the segment-shaped axially projecting pole portions 152^a, 153^a, as appears clearly from Figure 9. Rivets, screws, or the like 158 (Figures 7 and 8) passing through suitable holes in the parts 157, 155, 156 and 154 preferably secure the bridging plate member 157, also made of non-magnetic metal, in position, thus securely and accurately mounting the magnetized field piece 150 and completing a field structure 88 which externally is smooth-faced and cylindrical, ideally adapted for high speed of rotation relatively free from windage losses and from dynamic unbalance.

As the field structure 88 is rotated, therefore,

the flux from the field piece 150 coacts with the parallel magnet circuit formed by the stationary core 85 (Figure 8), the flux, with field piece 150 in the position of Figure 8, passing from one pole piece, say pole 152, to the pole piece 86 and thence downwardly through the core legs 85^a and 86^a to the pole piece 87 and thence back to the field piece 150. In a position shifted 180°, the flux again passes through this circuit but now in reversed direction. The resultant reversals and changes in intensity of the flux in the core structure 85, sets up in the windings 135, 136 an alternating E. M. F. whose magnitude and frequency are substantially direct functions of the rotational speed of the field piece 150, and where substantial variations in rotational speed take place I prefer to achieve certain advantages later more fully described by causing the alternator itself to coact toward bringing about the desired control of the magnitude of energy delivered to the ozonizer structure 30 of Figures 1, 2 and 5.

Thus, the bridging plate 157 preferably serves also to provide, as by having it formed integrally with it, a mounting for a stepped shaft 160 (Figures 7 and 9) which is coaxial with the shaft 89. Mounted for sliding movement on shaft 160 is a sleeve 161 whose inner end is slidable on the larger-diametered portion of shaft 160 and whose outer otherwise closed end is apertured to slide on the outer smaller diametered portion of the shaft, a spring 162 being interposed between the outer end of the sleeve and a shoulder formed on the shaft and acting to urge the sleeve 161 in a direction toward the free end of the shaft 160. Sleeve 161 is preferably made of a suitable magnetic material, such as iron, and adjacent its inner end has formed or mounted on it a disk-like part 163 preferably provided with a heavy rim or annular portion 164 whose outer diameter (see also Figure 9) matches that of the field structure 88 and whose radial dimension approximates the radial dimension of the end exposed faces of the pole piece portions 152^a, 153^a. The inner end of the sleeve 161, however, is of slightly greater extent axially toward the field structure 88 than is the rim portion 164, so that, if the structure 161—164 is moved toward the bridging plate 157, thus to diminish the air gap between the part 164 and the pole faces 152^a, 153^a, contact of part 164 with the latter and resultant sticking together thereof is prevented, the sleeve 161 thus acting as a limiting stop but with the above-mentioned air gap brought down to a practicable minimum.

Suitable means are provided for varying this air gap and hence for varying the shunting action of the part 164 upon the field piece 150 in accordance with changes in speed of rotation of the field piece. This means may comprise a collar 170 fixed to the outer end of shaft 160 and provided with diametrically opposed slots 170^a and 170^b in which are pivotally mounted, as by pins 171, 172 L-shaped lever-like members 173, 174, respectively. The short arms of these L-shaped members are engaged by the end wall of the sleeve 161 under the action of spring 162, the latter thus tending to swing and hold the members 173, 174 in a direction to move their long arms inwardly against the sleeve 161, and the spring does so when the rotating parts are at rest or running at insufficient speed.

As the speed increases to a point where it is desirable to start cutting down on the voltage or output of the alternator, the centrifugal force

acting upon the long arms of the members 173—174 swings them in a direction outwardly and away from the axis of the shaft and into or toward the broken line positions indicated in Figure 7. In so doing, however, the short arms of these members move the sleeve 161 and hence the annular shunting member 164 along the shaft 160 against the action of spring 162, thus diminishing the air gap between the shunting member 164 and the axially extended pole pieces or faces 152^a, 153^a to an extent depending upon the magnitude of the speed of rotation. To a substantially corresponding extent, the flux emanating from the field piece 150 and otherwise passing along the paths of the magnetic circuit as earlier above described is shunted away from those paths, across the just-mentioned air gap and through the shunting member 164. Thereby a substantial correction or limitation in rise of voltage may be brought about and among other advantages certain preferably coacting apparatus later described, including also the alternator itself, may be made of smaller physical dimensions and of correspondingly more favorable electrical characteristics. Shunting member 164 preferably rotates with the shaft 160 and hence with the field piece 150 and the opposed end pole faces 152^a, 153^a, thus achieving the advantage of avoiding iron or other losses in the member 164.

The cable 140—141 leads the generated energy to suitable controlling means which preferably coact with the just described shunting feature of the alternator and also with the transformer 70 (Figure 4). Such controlling means preferably comprises a suitable reactance or combination of reactances which I preferably house in a suitable metal box 177 which, as shown in Figures 1 and 2, is preferably mounted on the under or external side of the car body, the metal sheath of the cable being suitably grounded to the casing 177. These reactances may be arranged in the form of a suitable so-called filter circuit which is shown diagrammatically in Figure 10 in the illustrative form of a capacitor 178 bridged across the circuit with a reactor 179 and a capacitor 180 arranged in parallel in the circuit leading to the capacitor 178.

From this filter circuit the circuit is extended as by insulated conductor 181 and flexible metallic sheath 182 grounded suitably to the casing 177 into the interior of the car body (Figures 1 and 2) and led to the transformer casing 48 (Figure 4) where suitable provision is made as by the aperture 183 and set screw 184 to anchor and ground the sheath 182 and an internal binding post or connector 185 for connecting the conductor 181, suitable provision being made, since the transformer casing 48 is filled with oil, to seal off these anchorages or connections of conductor and sheath, as by the wall construction 186, as shown in Figure 4, through which the conductor of the binding post 185 is insulatingly passed in any suitable manner, as by a bushing 187. Thus, the circuit is extended to the transformer casing 48 and to the binding post 185; to the former a conductor 188 grounds one side of the low voltage winding of the transformer 70, that winding preferably comprising two coils 189 and 190 connected in series as by the jumper 191, while to the binding post 185 a conductor 192 extends the circuit to the other side or terminal of the low voltage windings 189—190.

The transformer is preferably of the core type and has a suitable high voltage winding preferably made up in the form of two coils 193 and

194 connected in series by jumper 196, one terminal of which, as of coil 193, is grounded at 75 to the casing 34 by conductor 195 and the high voltage terminal of which, being one terminal of coil 194, is connected by conductors 71 and 58, as above described, to the corona-emitting electrode structure.

The transformer core has preferably two vertical legs 70^a and 70^b with coils 189 and 193 about one of them and coils 190 and 194 about the other, these legs being joined at their upper and lower ends by horizontal core legs 70^c and 70^d, and this arrangement is preferred in that it facilitates providing the transformer core with a magnetic shunt in the form of inwardly directed core extensions 70^e and 70^f with a suitable air gap therebetween, these shunting extensions extending between the high voltage and low voltage windings.

In operation, when it is desired to produce ozone in the atmosphere of the vehicle body, the lever 118 is swung into its full line position, as in Figures 6 and 7, thus completing the driving connection of the alternator to the driving or driven part on the vehicle; this is done upon completion of the loading of the car. As the car is under way, the alternator is driven and in the illustrative form its voltage and frequency vary substantially as a function of the speed of its drive and, as above indicated, that speed may vary throughout substantial ranges, for example, a range from around five or six miles per hour to sixty. Through the circuit connections above described, an alternating E. M. F. is impressed upon the corona-emitting electrodes 32, the companion and common electrode being the housing-like electrode 31, grounded as above described. Ozone produced is circulated or distributed throughout the vehicle interior and hence throughout the atmosphere containing the car loading in the illustrative manner above described.

The amount of ozone produced is relatively small, and is preferably of such an order as to achieve an equilibrium concentration of about 3 parts per million, that being sufficient, in view of what is earlier set forth above, to take care of the maximum requirements, namely and usually for meat, while, if products other than meat are being carried such as would require a minimum equilibrium concentration of less than 3 parts per million, adequate ozonizing follows since it has been found that such other products are not injured by a somewhat higher equilibrium concentration than their respective minimum requirements. The ozone absorption coefficients of such products range from 0.02 for eggs up to 0.1 for meats.

Thus, the amount of ozone formation may be fixed per unit of car volume according to the absorption coefficient of the car contents. For example, where a maximum equilibrium concentration of 3 parts per million is desired, as for meat, such concentration amounts to 0.006 gram of ozone per cubic meter, at normal atmospheric pressure. The ozone absorption coefficient of meat being 0.1, then 0.0006 gram of ozone must be formed per minute per cubic meter of car volume. Taking a refrigerator car in railroad use today, calculating its volume, an illustrative capacity of an ozonizer like that of Figures 4 and 5, calculated according to the just stated considerations and its own electrical characteristics, is the production of 40 grams of ozone per

kilowatt hour, corresponding to an energy requirement of about 1 watt per cubic meter of car volume. Preferably, also, some external air is admitted to the interior of the car body, something on the order of about 0.003 gram of external air per minute per cubic meter of car volume; this may be achieved through the usual leakage or through other suitable apertures such as, for example, the drains in the ice bunkers, so that the incoming air is cooled when the car is operating as a refrigerator and if heating means is in those compartments, such admitted external air becomes heated thereby.

I therefore prefer to arrange the system so that the rate of energy supply, or the power furnished, to the ozonizer remains substantially constant even though the speed of drive of the alternator varies, and the above-described system and apparatus illustrates a preferred form and manner in which that may be done.

As above indicated, the voltage and frequency of alternator output increase with speed. Since with this type of ozonizer, corona emission and ozone production take place primarily at or throughout the peak regions of those half waves of the alternating E. M. F. that are made effective on the electrodes 32, it will be seen that the rate at which such voltage peaks are impressed upon the electrodes 32 increases and decreases with the frequency and that there are more voltage peaks and hence intervals of ozone production at higher frequencies than at lower frequencies. If, therefore, the voltage is permitted correspondingly to increase or to be correspondingly greater at the high frequencies than at the lower frequencies, the energy input to the ozonizer becomes low at low frequencies and exceedingly high at high frequencies. Accordingly, I prefer to so control the voltage of the alternator that it diminishes as the frequency increases. I may bring into coaction a number of instrumentalities or means to bring about substantially constant energy supply to the ozonizer.

For example, the transformer 70 may be and preferably is constructed to take part in these controlling actions. It preferably has a substantial or appropriately high leakage reactance which may be achieved in any suitable way in the design and construction of a transformer, illustratively and preferably as by the magnetic shunt formed by the parts 70^a and 70^b (Figure 4) with the appropriate air gap therebetween. With such an arrangement, therefore, the transformer itself, as the voltage and frequency increase, functions to counteract substantially corresponding increases in the voltage of the output of the high voltage windings 193, 194.

Preferably, coacting with this transformer action is the system of reactances 178—179—180 of Figure 10. Thus, the reactance of the inductive reactor 179 varies directly with the frequency and in the circuit arrangement it is in series with the low voltage windings 189—190 of the transformer 70. If the reactor 179 alone were to constitute the load on the alternator, the current output of the alternator would be substantially constant at all frequencies and in series with the transformer low voltage windings it acts to tend to limit variations in load current, tending to maintain a fairly constant energy input to the ozonizer, and in these actions the leakage reactance of the transformer 70 may and preferably does take part; thus, with relatively wide changes in frequency and with changes in voltage, but in

a direction reversed from the changes in frequency, these reactances aid in governing or controlling the amount of ozone formed in the ozonizer in spite of substantial variations in drive of the alternator.

At low speeds and hence at low frequencies, this circuit arrangement of inductive reactances may have a tendency to over-compensate due to the equivalent capacitance of the ozonizer electrodes becoming nearly in resonance with the equivalent reactance (reactor 179 and the transformer 70) that is in series with this electrode capacitance. I therefore prefer to include in the circuit a capacitance 178 which counteracts this tendency and prevents the achievement or approximation of the above-mentioned resonance condition; this capacitance 178 also has the advantage of decreasing the alternator voltage that is required to pass the desired power on to the ozonizer. At low car and hence alternator speeds, the reactance of capacitor 180, which is shunted about the reactor 179, is relatively high as compared to the reactance of reactor 179, and its effect is small; but at higher car and hence alternator speeds, these capacitances become more nearly equal and the equivalent reactance of these two begins to increase rapidly as resonance is approached. Capacitance 178, therefore, aids to decrease the amount of current passing at the higher alternator speeds. Damping resistors (not shown) may be added either in series with or across the reactor 179, the capacitors 178 and 180, or the low voltage winding 189—190 of the transformer.

Thus, the power supply to the ozonizer may be held reliably within appropriate limits even though the alternator speed and frequency vary throughout wide ranges and in the numerical illustration above set forth, these electrical factors or parts may be so proportioned that energy is delivered to the ozonizer at the rate of about 1 watt per cubic meter of car volume. The volt-ampere capacity of the alternator, due to the substantial range of speeds, is preferably several times as great as the required output in watts.

However, the alternator may be made of smaller volt-ampere capacity than has just been set forth, in various ways. For example, the alternator may be driven from or by any other suitable source of energy, the variations in speed of which are less than in the earlier above described embodiment, or the speed of which is substantially constant. For example, and referring now to Figure 3, the alternator may take the form of that indicated at 200 where its shaft, instead of being provided with a pulley, may be directly connected to an air turbine 201 of any suitable substantially constant speed construction supplied with air under pressure from, for example, the compressed air line of the train. Preferably, I provide an auxiliary tank 203 which has connection with the inlet of the air turbine 201, tank 203 being connected to train line 207 through, for example, a suitable dust separator 204, preferably of the centrifugal type, a check valve 205 and a hand-operated valve 206 by which the alternator is started and stopped as at the beginning and end of the car run.

The alternator 200 of Figure 3 is preferably of the same general form as that above described in connection with Figures 6, 7 and 8, though its casing is preferably rigidly mounted in any suitable way, together with the turbine 201 and tank 203, from a suitable auxiliary frame 208 appropriately provided underneath the car body.

It need not have the centrifugally acting shunting member 164 and related parts of Figures 7 and 9 unless, of course, the pressure variations are so substantial as to make the use of that device, later described, advantageous. Otherwise, the circuit of the alternator 200 of Figure 3 is preferably the same as that of Figure 10 above described, though the various reactances may be and preferably are of somewhat different electrical values and may even be embodied in smaller physical form, since the variations they cope with are of lesser magnitude.

As above indicated, a number of mechanical and electrical advantages may be realized if the alternator, particularly where its speed varies substantially, as in the form of Figures 1 and 2, is provided with the shunting member 164 of Figures 7 and 9 and above described in detail. That shunting member 164, acting upon the field piece 150, is made more and more effective as the increasing speed causes the centrifugally acting levers 173, 174 to move the shunting member 164 in a direction to diminish the air gap and thus to shunt more and more flux from the field piece 150 and away from the magnetic circuit formed by the core structure 85. Thereby, though the frequency may vary directly with speed changes, any desired effect upon the voltage of the output of the alternator may be effected by the shunting member 164. For example, its shunting action may be so determined that its action in diminishing the flux in the magnetic field circuit 85 (Figure 8) is so related to the change in speed of the alternator that the voltage of the alternator output is substantially constant. Or its action may be such that the voltage of the alternator output diminishes with increase in alternator speed or so that the alternator voltage changes at a lesser rate than the change in speed and hence frequency.

Preferably, the action of these parts is such that at low speeds, the frequency being low, the voltage is comparatively high and at high speeds, the frequency being high, the voltage is comparatively low.

And in any case, the shunting member may be so proportioned as to size and the rate of change of shunting action or of air gap so determined, as by appropriately proportioning the speed responsive action of the levers 173, 174, that the electrical constants and physical dimensions of the reactances employed in the circuit may be made materially smaller than would otherwise be the case, it being noted that even the alternator itself may be thus made of a lesser volt-ampere capacity. The potential difference or voltage made effective upon the ozonizer electrodes may be on the order of 5000 volts. Where the alternator is of substantially constant speed, a voltage on that order is preferred. Where the alternator is subjected to substantial changes in speed, as when it is driven from a car wheel or axle, the voltage may vary from around 3000 to 8000 and this is set forth as an illustrative range of change of voltage achieved by the controlling or regulating system even though the speed change of the alternator varies from that around seven miles per hour to that of sixty miles per hour or over.

Though relatively high potentials are preferably employed, the system and apparatus will be seen to be safe and foolproof. High voltage parts are rendered substantially inaccessible in so far as engagement or contact therewith in the ordinary handling, loading or unloading of the ve-

hicle is concerned, the exposed parts or such parts as might be contacted by operatives in the normal handling of the car are all grounded, while in the form of Figures 1 and 2, where the alternator is driven only when the car is in movement, the entire system is dead when the car is standing still for loading or unloading. Also, manual control is reduced to a minimum and in the preferred forms is such that electrical apparatus, such as switches, for example, need not be handled, thus further contributing toward the feature of safety and simplicity. Thus, in the form of Figures 1, 2 and 6-8, a simple movement of the lever 118 conditions the apparatus and system for operation or for inactivity, as may be desired, while in the system of Figure 3, manual control of an air valve serves to start or stop the system.

Stoppages in transit are safely accompanied, in the illustrative forms, by stoppage of the ozonizing system and apparatus, inasmuch as it has been found that, as earlier above set forth, a suitable equilibrium concentration, such as about 3 parts per million, suffices if applied continuously or if applied at appropriate intervals. Accordingly, in the normal operation of freight trains, stop-overs or stoppages, whether in the normal routine or operation of the schedule of the train service or even if caused by emergency, may take place without endangering the lading even if during such stoppages the ozonizing apparatus ceases to function.

In the preferred operation of the system, it will be seen that the power input to the ozonizer, like that of Figure 4, is maintained substantially constant at such a value, or departures from such value held within suitable limits, that ozone production takes place at the desired rate to give the desired equilibrium concentration; illustratively, the latter is preferably 3 parts per million, thus to meet the maximum requirements, as for meat, while other goods requiring a lesser ozone concentration can be safely handled without harm or detriment. In this preferred manner of operation of the system and apparatus I am enabled to do away with the need for manual adjustment and thus I am enabled greatly to simplify the manual control or manipulation of the system or of any of its parts, an advantage highly desirable, particularly where the vehicle takes the form of a railway car. Where the frequency of the alternator undergoes variations or changes sufficient to affect the magnitude of the power input to the ozonizer I preferably achieve such control or variation of other factors as will adequately work toward the achievement of substantially constant power input. The power input may safely vary within limits such as will not detrimentally affect the desired average rate of ozone production appropriate to the requirements of the products in the treatment space and the conditions of operation of the vehicle. Preferably, as above indicated, the voltage is diminished as the frequency increases, and vice versa, but a true inverse ratio of change of these functions is not essential and any desired relative rates of change may be adopted.

By way simply of illustration and not limitation, the generated voltage of the alternator is preferably relatively low and may, for example, average around 200 volts while its frequency change, where the alternator is driven from a member, such as a car wheel or axle, whose speed of rotation varies with the speed of the vehicle, may vary correspondingly, being, say 8 cycles per

second at say 7 miles per hour, varying thereafter directly with the change in speed. Where the alternator is driven at substantially constant speed or at a speed with small variations, a preferred frequency, with a relatively simple 2-pole alternator, is 60 cycles per second. I prefer to employ a relatively low voltage alternator to achieve a number of advantages, such as, for example, the advantage of avoiding, as is possible with the arrangement of Figures 1-5, having to extend as by insulated conductor suitable for handling relatively high voltages, a high voltage circuit through such parts of the vehicle as are located for more easy contact therewith by persons handling or working in the vehicle. And with the casing structure of Figures 4 and 5, where I employ a low voltage alternator, I am enabled to position the step-up transformer and hence its high voltage parts in the same out-of-the-way or relatively inaccessible position as I prefer to locate the ozonizer as above described. I therefore do not limit my invention unless otherwise expressed in the claims, to a source of alternating current necessarily lower in voltage than the voltage of operation of the ozonizer. It is also to be understood that any numerical values set forth above are not to be construed as limitations since it is possible, if desired, to select other values and other relative proportions, and the like, and that they are set forth simply by way of illustration.

Thus, it will be seen that there has been provided in this invention a system and apparatus in which the various objects heretofore set forth together with many thoroughly practical advantages are successfully achieved.

As many possible embodiments may be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A vehicle ozonizing system comprising a vehicle body having therein a space for the reception of perishable products and having means for effecting movement of air along a path in said space to bring it into contact with said products, an ozonizer having electrodes for producing ozone by electric discharge between said electrodes, means for discharging ozone produced by said ozonizer into said path whereby ozone is carried by said moving air, means forming a source of energy moving with the vehicle and having the characteristic of fluctuating in a function of its energy output, an alternator driven by said last-mentioned means and subjected to fluctuations in a characteristic of its output in response to fluctuations in the function of the output of said means forming a source of energy, and reactance means interposed between the alternator and the electrodes of said ozonizer for effecting ozone-producing electric discharge between said electrodes, said means having the characteristic of maintaining substantially constant the product of the functions of voltage and frequency of the output of the alternator as at least one of said last-mentioned functions varies in response to the aforesaid fluctuations.

2. An ozonizing system as claimed in claim 1 in which said means forming a source of energy is a substantially constant speed means whereby the frequency function of the output of said al-

ternator is substantially constant, and said reactance means comprises transformer means to convert the voltage of the output of said alternator to a voltage to effect ozone-producing discharge between said electrodes.

3. An ozonizing system as claimed in claim 1 in which said means forming a source of energy is a variable speed means whereby the function of its energy output that fluctuates is the function of speed and whereby the function of the output of said alternator that fluctuates is the frequency, and said reactance comprises a transformer means to convert the voltage of the output of said alternator to a voltage suitable to effect ozone-producing discharge between said electrodes.

4. In a vehicle ozonizing system that has a vehicle body with a space for the reception therein of perishable products and having in said space a high voltage ozonizer comprising high voltage electrode means for producing ozone, the combination of casing-like means for accommodating said high voltage ozonizer and for mounting the latter within the vehicle and in a position to be relatively out of the way, whereby possibility of human contact with said high voltage ozonizer is lessened, a relatively low voltage alternator carried by the vehicle and positioned to be relatively easily accessible and having means for driving it, and low voltage conductor means leading from said alternator to said casing-like means of the ozonizer, whereby only low voltage parts or apparatus are positioned where they might be contacted or engaged, said casing-like means having associated therewith step-up transformer means connected to said low voltage conductor means with its high voltage output electrically connected to said electrode means.

5. An ozonizing system as claimed in claim 4 in which said conductor means comprises two conductor members insulated from each other, one of them being grounded to said alternator and to said casing-like means.

6. An ozonizing system comprising a space whose atmosphere is to be supplied with ozone, electric discharge means for converting oxygen into ozone for said space, and means for energizing said discharge means and for controlling the rate of ozone production, said means comprising an alternator driven at variable speed whereby its alternating current energy is correspondingly variable in frequency, a transformer of high leakage reactance interposed between said alternator and said discharge means for effecting change in the voltage of the energy supplied to said discharge means in a direction to decrease the voltage as the frequency increases, and vice versa, a variable magnetic shunt operative upon said alternator to affect the voltage of the output of said alternator, and means operating said variable magnetic shunt substantially in response to changes in speed of drive of said alternator to decrease the voltage of the output of the alternator as the frequency increases, and vice versa.

7. An ozonizing system comprising a space whose atmosphere is to be supplied with ozone, electric discharge means for converting oxygen into ozone for said space, and means for energizing said discharge means and for controlling the rate of ozone production, said means comprising an alternator driven at variable speed whereby its alternating current energy is correspondingly variable in frequency, inductive reactance means and capacity reactance means co-

acting in response to variations in frequency to effect changes in voltage of the energy applied to said discharge means in directions to maintain the energy supplied to said discharge means and hence the rate of ozone production thereby substantially or approximately constant, a variable magnetic shunt operative upon said alternator to affect the voltage of the output of said alternator, and means operating said variable magnetic shunt substantially in response to changes in speed of drive of said alternator to decrease the voltage of the output of the alternator as the frequency increases, and vice versa.

8. A vehicle ozonizing system comprising an enclosure having therein discharge means which when operative converts oxygen from the atmosphere into ozone, means for supplying electrical energy to said discharge means comprising an alternator and means for driving said alternator at a speed varying substantially with the speed of movement of the vehicle, whereby the frequency and voltage of the output of the alternator vary, and means for limiting fluctuations in the supply from said alternator of electrical energy to said discharge means, thereby to cause the latter to produce ozone at substantially the desired rate.

9. A vehicle ozonizing system comprising an enclosure having therein discharge means which when operative converts oxygen from the atmosphere into ozone, means forming a source of alternating current energy of fluctuating frequency for energizing said discharge means, and means responsive to variation in a function of the output of said source for controlling the supply of energy to said discharge means substantially inversely as the frequency changes, whereby the rate of ozone production is substantially constant.

10. A vehicle ozonizing system comprising an enclosure having therein discharge means which when operative converts oxygen from the atmosphere into ozone, an alternator for supplying energy to said discharge means, driving means responsive to movement of said vehicle for driving said alternator and subject to variations in speed, whereby the frequency of said alternator fluctuates, and means comprising a transformer of high leakage reactance, interposed between said alternator and said discharge means, for effecting change in the voltage of the energy supplied to said discharge means in a direction to decrease the voltage as the frequency increases, and vice versa.

11. A vehicle ozonizing system comprising an enclosure having therein discharge means which when operative converts oxygen from the atmosphere into ozone, energizing means for said discharge means comprising a source of alternating current energy whose frequency and voltage fluctuate, and control means comprising inductive reactance means and capacity reactance means coacting in response to frequency fluctuations to effect changes in voltage of the energy applied to said discharge means in directions to

maintain the energy supplied to said discharge means and hence the rate of ozone production thereby substantially or approximately constant.

12. A vehicle ozonizing system comprising an enclosure having ozone-producing electric discharge means, an alternator of fluctuating frequency and voltage for supplying electrical energy to said discharge means, and means comprising a transformer of high leakage reactance interposed between said alternator and said discharge means, and means comprising inductive reactance means and capacity reactance means for affecting the voltage in response to fluctuations in frequency.

13. An ozonizing system comprising a space whose atmosphere is to be supplied with ozone, electric discharge means for converting oxygen into ozone for said space, and means for energizing said discharge means and for controlling the rate of ozone production comprising an alternator furnishing alternating current energy of varying frequency and voltage and means for controlling the rate of energy supply to said discharge means, said controlling means comprising a variable magnetic shunt operative upon said alternator, and frequency-responsive reactance means for affecting the value of voltage in a direction opposed to the direction of frequency variation.

14. An ozonizing system comprising a space whose atmosphere is to be supplied with ozone, electric discharge means for converting oxygen into ozone for said space, and means for energizing said discharge means and for controlling the rate of ozone production, said means comprising an alternator furnishing alternating current energy of varying frequency and voltage, a transformer of high leakage reactance interposed between said alternator and said discharge means, means operating upon said alternator and capable of changing the voltage of its output, and means operating said last-mentioned means to decrease the voltage of the output of said alternator as its frequency increases, and vice versa.

15. A system as claimed in claim 11, comprising also means operating upon said source of alternating current energy and capable of changing the voltage of its output, and means operating said last-mentioned means to decrease the voltage of the output of said source as its frequency increases, and vice versa.

16. An ozonizing system as claimed in claim 1 in which said first-mentioned means moves said air along a path past the ceiling of said vehicle body and in which said ozonizer comprises a casing-like structure, the ceiling of said body having a recess therein and said casing-like structure being received in said recess with its underside substantially flush with said ceiling and said means for discharging ozone into said path comprising means in said underside of said casing-like structure forming a passageway connecting the casing-like structure to said space.

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