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This invention relates to rail transportation systems, and more particularly is directed to systems in which the speed obtainable is greater than that now attainable in commercial air line transportation.

Rail transportation has in recent years keenly felt the competition of commercial airlines and buses. While it is a safe mode of travel, nevertheless the present demand in transportation is not only safety, but also speed and comfort commensurate with dependable service.

The present invention contemplates, broadly, a means of rail transportation that will give maximum speed and yet retain all requirements of safety, dependability and comfort. The present railroad facilities, including road bed, equipment and the like, are inadequate to cope with the present demand for high speed service, that is, speeds running up to three and four hundred miles per hour. The dependability of schedules and the safety required by business travelers has thus far defeated the widespread use of air transportation, which of course always has to cope with weather conditions.

We propose to provide a rail transportation system in which the cars themselves are substantially hermetically sealed enclosures having means for continuously supplying properly conditioned and treated air at substantially atmospheric pressure to the interior of the car. The air treating means is of high efficiency and operates with a minimum expenditure of energy.

The cars or train of cars is propelled through a duct or air tight jacket which has been evacuated to the necessary degree to provide a tunnel for the course of the train or cars in which little or no air resistance to movement of the train is provided. It is of course necessary to provide a tunnel construction, or duct, which will suit the topography of the country traversed, and the present construction is therefore adaptable for bridges, crossings and underground tunnels through mountains and the like. For this reason the air treating means is made a substantially integral part of the car or train, and operates entirely independently of outside sources during travel of the car. From experimentation we believe that with the present type of transportation system speeds as high as 500 miles per hour will be obtainable.

The present invention is intended to disclose broadly the main underlying features which make possible a transportation system such as disclosed herein, and it is not intended to cover the many smaller details of mechanical construction and control which such a system may entail. Such details will be covered in subsequent disclosures, the present disclosure being directed to the system as a whole.

In creating the desired air conditions within the body of the parlor cars, which must be maintained at substantially atmospheric pressure, we prefer to manufacture and produce the desired conditions and pressure rather than employ oxygen from pressure cylinders and other conditioning apparatus such as commonly employed on submarines, although it is to be understood that such latter methods of supplying the properly conditioned air fall within the scope of the present invention. However, the air treating and conditioning system herein disclosed is believed more economical in operation and results in a better conditioning of the air for this purpose.

Another feature of the present invention resides in the provision of a sealed car or train adapted to be propelled through an enclosed duct or tunnel, in which the tunnel may be evacuated forwardly of the car and air under pressure forced into the tunnel rearwardly of the car to assist in its propulsion and thus increase the speeds attainable, the car itself reacting similar to a piston in a cylinder under these pressure conditions.

Still another feature of the present invention is the provision of suitable means at stations, depots and terminal points in the system for moving the car into sections of the duct or tunnel which can be automatically shut off from the main duct or tunnelways between various locations, and which sections can then be brought up to atmospheric pressure so that the passengers may enter and leave the cars in perfect comfort.

Another object attained by the present invention resides in the improved car construction which can be employed in such a system. The cars can be of extremely light weight, since they are running in an enclosed chamber, and the interiors of the cars are arranged for maximum comfort and convenience. Since the speed is sufficiently high so that no overnight service need be provided, the cars can all be of the parlor or lounge car type with all interior conveniences of a private home.

Other objects and advantages of the present invention will appear more fully from the following detailed description which, taken in conjunction with the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of a preferred form of the present invention.
In the drawings:

Figure 1 is a sectional view through a car and tunnel construction embodying the present invention;

Figure 2 is a partial transverse sectional view through one of the cars;

Figure 3 is a longitudinal sectional view showing the manner in which the train may enter a loading and unloading section of the system;

Figure 4 is a diagrammatic view showing a preferred form of air conditioning the interior of the car;

Figure 5 is a somewhat diagrammatic view of a modified form of construction;

Figure 6 is a sectional view taken on line 6—8 of Figure 5;

Figure 7 is a longitudinal section view of a still further modification of the system;

Figure 8 is a transverse section taken substantially on line 6—8 of Figure 7; and

Figure 9 is a diagrammatic view showing a modification of the air conditioning system.

Referring now in detail to the drawings, we have with Figure 1 the tube 10, which is in the form of an elongated tubular duct or tunnel, of sturdy construction and preferably fabricated of steel or a similar metal; although, it may also be formed of concrete, brick work or other built-up material, and which is suitably supported by means of the displaced 12 and the central crane support 13 which may be of earth, rock or the like.

The tunnel then is provided adjacent its lower portion with the rail or track members 14, which may be of more or less standard construction, suitably anchored or the abutments 16 formed within the tunnel. Disposed within the tunnel is a car, indicated generally at 20 and shown more in detail in Figure 2, the car having the generally cylindrical portion formed preferably of light weight metal such as aluminum or light weight alloys such as commonly used in airplane construction.

The car is preferably provided with a plurality of driving trucks, indicated generally at 22, which are provided with center bolster supporting members 23 adapted to receive the bolster pins 24 carried by recessed portions 25 of the car body. Suitable soft rubber cushioning members 26 and 27 are provided for cushioning the weight of the vehicle on the trucks, and resilient spring member 28 is disposed in the motor 29 and extends above the bolster pin 24 for resiliently supporting the car on the trucks and adapting the trucks for substantially universal movement with respect to the car body. Obviously, this type of bolster construction may be varied within the scope of the present invention and we do not intend to be limited to the particular details shown. Each of the trucks is provided with a pair of driving axles 30 having the wheels 31 adjacent the ends thereof, the wheels having relatively deep flanges for guiding the car on the rails 15. The ends of the axles are mounted in suitable journal boxes 32.

In the embodiment of the invention shown in Figure 1, each of the axles is adapted to be separately driven by an electric motor indicated generally at 33, one of the motors having drive means extending rearwardly to the rear axle of the truck through suitable gear means 34, and the other motor having forwardly extending drive means for connection to the forward axle. Intermediate the trucks, the cylindrical portion of the car body is continued as indicated at 35 in order to complete its streamlined appearance and to more or less completely shroud the truck members in order to reduce air resistance and also to adjust its upper end and substantially centrally of the car body there is disposed a trolley contact member 38 suitably supported for rocking movement on a trunnion member 39 carried by a resiliently mounted pedestal support 40, which is adapted to have contacting engagement with a suitable current conducting trolley 42 carried in insulated relation at the top of the tube 10. This supplies the electric power for driving the motors 33, and also for energizing the various auxiliary equipment such as the lights in the car and the air conditioning equipment.

In order to prevent swaying of the car during its high speed travel, the tube is preferably provided with suitable restraining guide members 43 disposed in angular relationship to be respectively engaged by restraining spring mounted roller members 44 carried on the outer surface of the car body. These rollers prevent any appreciable lateral movement of the car within the tunnel. Suitable constriction is provided at loading and unloading stations or the like are provided by the brush member 46 carried by the car body and adapted to engage suitable contact shoes 47 disposed at the desired locations within the tube.

Considering the details of the car construction, it will be noted that the car body, as shown clearly in Figure 2, is divided into a plurality of longitudinally spaced passenger compartments 50, each compartment being separated from the adjacent compartment by partition members 51 which enclose the cross bracing diagonal reinforcing members 53 shown in Figure 1. Disposed at one lateral side of the car is a passageway or aisle 54 which runs along the length of the car and communicates with the respective compartments through doorways 55 and steps 51 leading down into the compartments. At opposite ends of the aisle 54 there are provided toilet facilities, such as indicated at 51, including wash basins, chemical toilets and the like. A main entrance or exit doorway 56 is provided in the side wall of the car body 20 and the hero, provides for hermetically sealing the interior of the car from the interior of the tube 10. The compartments 50 are arranged to receive parlor car seats or the like indicated at 59, and the car itself is basically of articulated construction as shown in Figure 3 with the front and rear ends formed as tapered nose portions 60 and 62. These portions of the vehicle may be used for storage space and for the accommodation of the air conditioning equipment for the interior of the car.

Considering now in detail Figure 4 in which we have diagrammatically shown the air conditioning system for the interior of the car, this system essentially comprises a hot water tank 70 and a cold water tank 72 disposed at one end of the car, the hot water tank being connected through the line 73 to the wash basins and drains indicated generally at 74. The pipe 75 conducts cold water to the wash basin and drains in a similar manner, and from each of these members 74 there is provided a drain line 76 connecting through the line 77 with the water fitter 78.

From the filter 78 the purified water is led to an electrolyzing cell indicated generally at 79 having an oxygen compartment 80 and a hydrogen compartment 82, into which the two disassociated constituents of the water are respectively conducted. The contacts for energizing
this cell are indicated generally at 83 and may be connected through any suitable means to the power supply for the car.

From the oxygen cell 88 the oxygen is led through the line 84 to a suitable T connection 85 from which a portion of the oxygen is conducted produced, we find that for economy it is preferable to employ straight electric heating for heating the water and the air when required. This latter method also eliminates the necessity of hydrogen production.

The air conditioning system proper for the interior of the car, in its broadest sense, comprises means for withdrawing the heated air from the interior of the compartments 50, and passing this air through a cooling and dehumidifying unit 104 disposed at one end of the car. The cooling and dehumidifying unit 104 is adapted to receive cold water from the tank 72 through the line 105, and the water is returned to the tank through the line 106 controlled by the pump 107. A suitable drain 108 is provided for the line 104 and the flow of water through the line 106 to the main drain line 77 leading to the water filter 78.

The tank 72 is provided with a float control mechanism 110 for controlling the operation of the motor 112 which, in turn drives the water vapor machine 113 having its exhaust 114 open to the interior of the tube 10. The chilling of the water in tank 72 occurs due to the vaporization of part of the water, which occurs because of the high degree of vacuum in the space above the water. This is the well known use of water as a refrigerant. Due to the greatly reduced pressure in the tube 10, into which the water vapor from the water vapor machine 113 exhausts, a small motor 112 and water vapor machine 113 may be used, whereas, if the exhaust were subject to atmospheric pressure, the machinery would have to be so large and heavy in order to take care of the volume of the very large expansion of the water vapor and maintain a high vacuum above the water level in tank 72, that the use of this type air conditioning in a car or train of the type described would not be practical. Thus, the air withdrawn from the interior of the compartments 50 is passed through the cooling and dehumidifying unit, and in this unit is brought to the proper temperature and humidity condition through suitable control means (not shown) and is then discharged back into the compartments. In order to make up for the consumption of oxygen by the occupants of the compartments, the ozone line 88 is adapted to discharge ozone into the compartments at a rate such as to replenish the oxygen being consumed. Thus, a very economical and efficient air conditioning system for the interior of the sealed car is provided, since the electrolyzing cells are capable of employing the waste water as a source of ozone, and also as a source for fuel for producing hot water. Obviously, under certain conditions, it may be desirable to provide connection from the hot water tank 70 to suitable coils in the cooling and dehumidifying unit 104 in order to raise the temperature of the air when such increase in temperature is found desirable. During this time, of course, the cooling action of the unit is discontinued.

Considering now the details of Figure 3, when the train is approaching the terminal station, it is desirable to isolate the section of the tube within which the train is to stop and admit air thereto in order to facilitate loading and unloading of the passengers. For this reason the sections 30 and 32 are suitably connected through the exhaustor 20 so that the air may be evacuated therefrom.
and the gates raised in order that through or express trains will encounter no resistance while passing through such sections. The present design is based on a system which is absolutely safe. In addition to the regular pressure control mechanism there is an auxiliary pressure safety control 123 which, in the event of a substantial fall in pressure, opens ports to allow the tube to come to atmospheric pressure. However, prior to this action, the mechanism is adapted to actuate suitable indicating means in the operator's cab whereby the operator may adjust the pressure manually or check the operation of the automatic pressure control means. Additional pressure controls operated at points intermediate the pressure settings of the automatic pressure control means and the safety vacuum release may be installed to bleed in oxygen from storage drums and to operate additional air conditioning equipment if such additional safety features are found necessary. It may be advisable and is within the scope of the present invention to provide air pressure building apparatus in the vacuum tube, which will improve the performance of the car and avoid or reduce the vacuum line pressure at the rear of the car. We preferably provide for driving the car through the wheels 155 by means of suitable electric motors, but at the same time may assist in increasing the speed of the car by producing a vacuum forward of the car and a pressure rearwardly thereof, which is accomplished by having the tube in front of the car at subatmospheric pressure. As the forward part of the car passes over contacts 160, the control 162 stops the motor 163 driving the evacuator 164 and simultaneously actuates the control mechanism 165 for closing the exhaust valve 166. At the same time, the rear portion of the car passes over a separate set of contacts 170 which, through the control 172 operate the valve mechanism 173 to open the valve 174 providing communication to the interior of the tube through the line 175 which may be under atmospheric or greater pressure. Contacts 160 and 170 are disposed at suitable intervals throughout the length of the tube, depending upon the length of the train and the required amount of distance traversed by the train in the time it takes to produce the desired operation of the various mechanisms. We preferably provide a suitable intake fan 176 at the rear of the car which draws air from the interior of the tube 180 into the interior of the car in order to raise the air pressure within the car to atmospheric pressure. This fan may be suitably driven from an electric motor or the like operated by suitable pressure control mechanism which responds to the fall of the air pressure within the car to activate the fan for supplementing the self-contained air conditioning unit. It is within the scope of the present invention to provide means for connecting the exhaust from the evacuator 164 directly to the intake line 175 in order to produce an increase in pressure at the rear of the car above atmospheric. This is of considerable economy since the discharge from the evacuator must necessarily be above atmospheric pressure. Under such conditions, the fan 176 may be eliminated, and the control 177 may provide for the opening and closing of a suitable grill through which the air can be admitted to the interior of the car if the pressure falls below atmospheric.

Considering now the embodiment of the invention shown in Figures 7 and 8, we provide a tube 200 having at its upper end a raised portion 202 housing the rail members 203 upon which the car body 204 is supported by means of the wheeled trucks 205. The car in this embodiment of the invention is therefore suspended from the rails 203 and is guided to prevent lateral sway by the movement of means of the spring mounted guide rollers 206. Suitable contact shoes may be carried by the trucks 205 to contact a trolley 207 disposed at the upper surface of the portion 202 of the tube in order to supply current for driving the trucks through suitable electrically operated drive means.

As a variation of this type of drive or to supplement the same, we may provide the motor 210 at the rear portion of the car adapted to drive a propeller 212 to cause the air at the rear of the car to push the car at high speeds through the tube. The portion of the tube ahead of the car being at subatmospheric pressure as described in connection with Figure 5.

It is to be understood that both the cars 154 and 204 are thereby provided with air conditioning equipment substantially as described in connection with Figure 4, and that the tubes 150 and 200 are adapted to be formed of metal or any other suitable material and suitably supported upon earth or fabricated structures. The details
of crossing sections, bridges, tunnels and the like do not form a part of the present disclosure, and are therefore not described herein.

Instead of, or auxiliary to, the air conditioning system described, a dehumidifying system of the well known type using a brine spray, may be utilized. In order to remove the absorbed moisture from the brine solution to effect recondensation of it, a system such as shown in Fig. 9 may be used.

We have found that the regeneration of an absorbing solution used for chemical dehumidification is capable of much more efficient operation when carried on in a partial vacuum such as is found at the rear end of the car of the present invention. The system which we prefer to employ will be the standard type of brine solution which is heated to drive off the absorbed water and the concentrated solution is returned to the dehumidifying portion of the air conditioning system. As shown clearly in Figure 9, the dilute solution from the dehumidifier is passed through the conduit 200 into a long counter-current contact with a coil 202 leading from the compressor 203. The flow of the dilute solution is controlled by the valve 204 responsive to the humidity control member 205, and the weak solution from the dehumidifier is returned to the blower in the conduit 200 into a long counter-current contact with a coil 202. The weak solution is drawn into the flash pan 206 where it is hot, and the water vapor is sucked off into the compressor 203. From the compressor the water vapor is discharged into the coil 202 whereby it condenses and provides the heat for assisting in evaporating the absorbed water out of the brine solution. The concentrated solution from the flash pan is directed back to the air conditioning system through the pipe 207, and since it passes through the heat exchanger, its temperature is approximately 80 degrees, as is also the temperature of the water being discharged through the conduit 202. It will thus be seen that the system is highly efficient, and is controlled solely by the amount of solution passed into the heat exchanger through the valve 204 and the speed of the compressor which controls the capacity of the regenerating means.

The condensing of the water by means of the compressor produces the heat required for assisting in the evaporation of the water from the dilute solution, and consequently the concentrator is operated at high efficiency with substantially no heat losses and no energy requirements outside of the effort required to force the solutions through the coils of pipe.

By reason of the vacuum existing at the rear of the car, it will be apparent that the water can be separated from the brine solution at a lower temperature than required under normal conditions, and consequently the regenerating system shown in Figure 9 is especially adapted for use under such situations.

We are aware that various changes and modifications may be made in certain details of the structural parts disclosed herein, and we do not intend to be limited to any particular car construction or running gear arrangement, but only insofar as defined by the scope and spirit of the appended claims.

We claim:

1. A device of the character described comprising a tube through which cars are adapted to move at a high rate of speed, a car in said tube conforming to the inside of said tube, friction reducing supporting means between the car and the tube constructed and arranged to enable the car to travel rapidly through the tube, air resistance reduction means external to and independent of said car for reducing the pressure within the tube on the front of the car and for increasing the pressure in the tube on the rear of the car, thereby serving to assist in the propulsion of the car through said tube, independent propulsion means carried by said car, means for maintaining the air conditions within the car satisfactory for humans, and air flow control means in the rear portion of said car and in communication with the air in said car and with the air in said tube for changing the relative air conditions between the interior and exterior of said car, said last mentioned means affecting the air temperature, humidity and pressure conditions within the car.

2. A device of the character described comprising a tube through which cars are adapted to move at a high rate of speed, a car in said tube, friction reducing supporting means between the car and the tube constructed and arranged to enable the car to travel rapidly through the tube, air resistance reduction means external to and independent of said car for reducing the pressure within the tube on the front of the car and for increasing the pressure in the tube on the rear of the car, thereby serving to assist in the propulsion of the car through said tube, independent propulsion means carried by said car, means for maintaining the air conditions within the car satisfactory for humans, and air flow control means in the rear portion of said car and in communication with the air in said car and with the air in said tube for affecting and changing the relative air conditions between the interior and exterior of said car.