An electrical power pick-up for vehicles, particularly high speed vehicles comprises a pick-up body shaped partially to embrace a conductor rail without direct contact with the rail. An air stream through the gap between the rail and pick-up keeps the two apart. The air stream may be effected by vacuum suction, in which case ionizing means, such as a radio-active source or a source of radio frequency power are used to assist ionization in the gap. Alternatively, the air stream is a hot gas stream, e.g. from a jet engine, the hot gases facilitating ionization of the gap. In all three arrangements the applied potential between the rail and pick-up body produces an electrical discharge through the gap.

15 Claims, 7 Drawing Figures
ELECTRICAL POWER PICK-UP FOR VEHICLES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical power pick-ups for vehicles and to transport systems employing such pick-ups. The invention finds particular application with high speed vehicles.

2. Prior Art

Present day electrical power pick-ups for vehicles make use of physical contact between a collecting brush and a conductor, which may be a rail or an overhead conductor. It is however increasingly difficult to obtain reliable contact as the speed of vehicles increases and, with the growing interest in high speed tracked vehicle systems such as hover-trains, monorails, etc., proposals have been made for using inductive coupling or capacitative coupling so as to avoid the necessity of direct contact. None of these techniques however has yet been found satisfactory from the practical point of view.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved form of pick-up and, to this end, use is made of an electrical discharge across a gap between the pick-up and the conductor.

According to the present invention, an electrical power pick-up for a vehicle for taking power from a conductor comprising a pick-up body adapted to move along the conductor, with a part of the body, forming an electrode spaced away from the conductor to leave an air gap in the current path between the conductor and the electrode across which in operation an electrical discharge has to occur, and additional means, apart from any applied voltage on the conductor, for ionizing the air in said gap between the conductor and electrode.

The invention also includes within its scope an electrical power pick-up for a vehicle for taking power from a conductor comprising a pick-up body adapted to move along the conductor with a part of the body, forming an electrode, spaced away from the conductor to leave an air gap in the current path between the conductor and the electrode across which in operation an electrical discharge has to occur, and means for reducing the pressure of the air within the region between the conductor and electrode to permit ionization of the air in said air gap. The ionization might be effected by the potential gradient between the conductor and the pick-up body.

Preferably however additional means, apart from any applied voltage on the conductor, are provided for ionizing the air in said gap between the conductor and the electrode.

The aforesaid additional means may comprise an ionizing source such as for example a radio-active source or a source of radio frequency power. Discharge takes place through the ionized region. The pick-up body may be a metal body and the electrode need not be any separate component; it is merely that part of the body where the discharge current is collected.

With a construction in which the pressure is reduced in the gap, the pressure in the space between the conductor and electrode is arranged to be such that the mean free path of electrons in this low pressure air is long enough to permit ionization of the air for relatively small accelerating potentials. The low electrical impedance of the ionized gas then provides the conducting path between the conductor and the electrode.

Preferably the aforementioned pick-up body is supported by an air cushion or vacuum with respect to the conductor to avoid any physical contact. A vacuum support system is preferred if the ionization is dependent on a sub-atmospheric pressure between the electrode and conductor. In one very convenient arrangement, the pick-up body is arranged underneath the conductor and extending upwardly partially around the conductor to leave a constricted air opening between the conductor and the upper part of the body and, on the vehicle, there is provided a vacuum pumping system for extracting air from the region within the body between the body and the conductor. The constriction between the body and conductor at the air entrance results in a sub-atmospheric pressure within the pick-up body. Preferably however there is provided a second restrictive gap in the air flow path between the conductor and the pick-up body immediately before the ionized gap to give a further reduction in pressure. The discharge between the conductor and the pick-up body will occur in such an arrangement in this region where the gap is narrow and the pressure is lowest and hence, with this construction, it is readily possible to make the pick-up body wholly or substantially wholly of integral metal construction, the region of the discharge being determined by the gap and pressure and also preferably by the provision of an ionizing source as described above. In such a construction it is preferable to fit insulating materials, preferably of low co-efficient of friction, in the pick-up to ensure that occasional direct contact between the pick-up and the conductor does not occur but intermittent short circuit the current path through the ionized gas with resulting fluctuations in the applied voltage.

Instead of using a reduced pressure, a hot gas stream may be provided to facilitate ionization of the atmosphere in the gap by the applied voltage between the conductor and the electrode and, in this case preferably the gas stream is used to provide lift keeping the pick-up body spaced from the conductor. The invention thus furthermore includes within its scope an electrical power pick-up for a vehicle for taking power from a conductor comprising a pick-up body adapted to move along the conductor with a part of the body, forming an electrode, spaced away from the conductor to leave an air gap in the current path between the conductor and the electrode across which, in operation, an electrical discharge has to occur and a source of hot gas arranged to provide a stream of hot gases into said gap to ionize the atmosphere therein, the pick-up body being shaped with respect to the conductor rail and the stream of gases so directed that the gas stream lifts or bends to lift the pick-up body with respect to the conductor. The aforesaid source of hot gas may comprise a fossil-fuel burning jet engine, for example a jet engine having a turbine and compressor.

Very conveniently the conductor is a rigid rail. It may be a rail from which the engine vehicle is suspended thereby obviating the need for a separate vacuum or air cushioned system for supporting the pick-up body. With an overhead suspended vehicle, two conductor rails may be provided to enable two conducting paths of the electrical circuit to be completed or more than two conductor rails if a multi-phase supply is required.
The invention thus furthermore includes a transport system comprising a vehicle with a pick-up body as described above and a rigid rail forming said conductor. The vehicle may be suspended from said rail. The vehicle may have two pick-up bodies co-operating with two rails.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a diagrammatic perspective view of a pick-up and part of a conductor rail; FIG. 2 is a vertical longitudinal section through the pick-up of FIG. 1; FIG. 3 is a transverse section through the pick-up of FIG. 1 and FIGS. 4, 5, 6 and 7 illustrate further embodiments of the invention.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Referring to FIGS. 1 to 3 there is shown a pick-up body 1 adapted to co-operate with a conductor rail 2 of cruciform section. The rail is illustrated diagrammatically as being supported from above by support links such as the support link 3. A vacuum pump indicated at 19 on the vehicle is connected by a pipe 4 to a chamber 5 in the pick-up body 1 formed by an upward extension of the pipe 4. Air enters between the upward flange 12 of the rail 2 and two inwardly directed horizontal flanges 13 on the pick-up body and passes through the space 7 between the horizontal flanges 14 of the rail and the aforementioned horizontal flanges 13 on the pick-up body and thence around through the space 6 underneath the horizontal flanges 14 and so down through the narrow gaps 8 on each side of the lower vertical flange 15 of the rail which gap opens up into the chamber 5. If the vacuum pump 19 is not operating, the flanges 13 will rest on the flanges 14. Operation of the vacuum pump however, drawing in the air, will lift the pick-up body 1 to give sufficient gaps 7 to permit of the air flow. The constricted air path however causes a pressure differential. The reduced pressure in the space 6 below the underside of the horizontal flanges 14 of the rail 2 will tend to urge the pick-up body 1 vertically upward tending also to open the space 7 permitting a larger flow of air and thus neutralising the reduction of pressure in the space 6. The result is that the pick-up body assumes the position of equilibrium in which it floats free on both the upper and lower surfaces of the horizontal flanges 14 of the rail 2 and is able to move along the rail with virtually no friction. Because of the narrow gap 8 at the side of the lower flange 15 of the rail, the air pressure in the chamber 5 will be appreciably below atmospheric. This low pressure is arranged to be such that the mean free path of electrons in the air at this low pressure is long enough to permit ionization of the air for a relatively small accelerating potential. An ionizing source 9, which may be either a radioactive source or source of radio frequency power, is provided to ensure that the ionization takes place preferentially in the region at the top of the chamber 5 and hence the ionized air in this region provides the conductive path between the rail 2 and the pick-up body 1. Insulating material 8 with a low co-efficient of friction is provided adjacent the lower vertical flange 15 to ensure that occasional direct contact between the body 1 and this lower flange 15 does not intermittently short circuit the current path through the ionized air with resultant fluctuations in the applied voltage.

Any water, snow, dust, etc. drawn in through the pipe 4 may be separated on the vehicle, e.g. using inertial separation, to prevent such solid or liquid particles passing into the vacuum pumping system.

Provision may be made, as is known in monorail hover-train systems, to ensure adequate lateral stability so that the pick-up body does not tend to run always in contact with one side of the rail. This can be achieved however by a suitable design of the rail and carrier body using known techniques.

With the arrangement of FIGS. 1 to 3, the pressure reduction in the space 6 can readily be of the order of a few lb. per sq. in. by virtue of the pneumatic impedance experienced by the air flowing through the space 7 around the edges of the conductor rail. The gap 8 is arranged to present a substantially greater pneumatic impedance as to ensure that there is a low pressure in the ionization region. It is not essential however to have two constrictions producing pneumatic impedance and FIGS. 4 and 5 illustrate alternative constructions of conductor rail and pick-up body with essentially a single constriction in the air flow path.

In FIG. 4 the conductor rail 20 is of circular section and a pick-up body 21 substantially embraces the rail leaving an opening 22 at the top through which air can pass to enter the narrow gap between the edge of the pick-up and the conductor rail. The air then flows down around the conductor rail into a vacuum pipe 24 connected to the vacuum pump 19. In this construction, the ionization source may be located at the top of the vacuum pipe.

FIG. 5 illustrates a construction using a rectangular conductor rail 25 and a pick-up body 26 shaped substantially to embrace the conductor rail apart from an opening 27 at the top permitting the air to enter the flow over the top surface of the conductor rail 25 underneath inwardly directed flanges 28 on the pick-up body 26 and thence down around the sides of the conductor rail 25 and underneath it to a vacuum pipe 29 leading to the vacuum pump 19.

FIG. 6 illustrates yet another construction. In this a conductor rail 30 is shaped to have a flat top 31. The sides 32 of the conductor rail however converge inwardly and downwardly and, in this particular construction, are slightly concave. A pick-up body 33 has inwardly directed flanges 34 which form the required gap between the top surface 31 of the conductor rail and the pick-up body 33 to give a reduction of pressure. Inner side surfaces 35 of the pick-up body curve inwardly to be closely adjacent the bottom of the conductor rail 30 thereby giving a further constriction leading to a vacuum pipe 36 and the ionization source is placed immediately below this constriction.

FIG. 7 illustrates an arrangement in which hot gases are used to increase the temperature in the discharge gap between the conductor and electrode to facilitate ionization by the applied voltage. The hot gases are obtained from a fossil-fuel burning jet engine, which may be of conventional construction having an air compressor and a turbine driven by the gas stream and driving the compressor. This jet engine provides a stream of hot gases which is directed downwardly to provide lift for the pick-up body. In FIG. 7, there is shown a pick-up body 40 straddling a conductor rail 41 and a source of hot gases 42 feeds a stream of combustion gases via
3,737,590

a duct through the body to give lift with respect to the rail and also, by reason of the high temperature to facilitate ionization of the gas between the pick-up body and rail.

I claim:

1. An electrical power pick-up for a vehicle for taking power from a conductor comprising a pick-up body adapted to move along the conductor, with a part of the body, forming an electrode, spaced away from the conductor to leave an air gap in the current path between the conductor and the electrode across which, in operation, an electrical discharge has to occur, and means for reducing the pressure of the air within the region between the conductor and the electrode to permit ionization of the air in said gap.

2. An electrical power pick-up for a vehicle as claimed in claim 1 and having additional means, apart from any applied voltage on the conductor, for ionizing the air in said gap between the conductor and the electrode.

3. An electrical power pick-up for a vehicle as claimed in claim 2 wherein said additional means comprises a radio-active ionizing source for ionizing the air within said region.

4. An electrical power pick-up for a vehicle as claimed in claim 3 wherein said additional means comprises a source of radio frequency power for ionizing the air within said region.

5. An electrical power pick-up for a vehicle as claimed in claim 1 wherein an air cushion support system is provided for supporting said pick-up body.

6. An electrical power pick-up for a vehicle as claimed in claim 1 wherein a vacuum support system is provided for supporting said pick-up body.

7. An electrical power pick-up system for a vehicle for taking power from a conductor comprising a pick-up body adapted to move along the conductor, the pick-up body being underneath the conductor and shaped to extend upwardly partially around the conductor to leave a constricted air opening between the conductor and the upper part of said body, a vacuum pumping system for extracting air from the region within the body between the body and the conductor, a part of the body spaced away from the conductor forming an electrode to leave an air gap in the current path between the conductor and the electrode across which in operation an electrical discharge has to occur, and additional means, apart from any applied voltage on the conductor, for ionizing the air in said gap between the conductor and the electrode.

8. An electrical power pick-up for a vehicle as claimed in claim 7 wherein said pick-up body and said conductor are shaped to provide a second restrictive gap in the air flow path between the conductor and the pick-up body immediately before the ionized gap to give a further reduction in pressure.

9. An electrical power pick-up for a vehicle as claimed in claim 7 wherein insulating materials are provided in the pick-up body to ensure that direct contact between the pick-up body and the conductor does not intermittently short circuit the current path through the ionized gas.

10. A transport system comprising a vehicle with a pick-up body as claimed in claim 1 and a rigid rail forming said conductor.

11. A transport system as claimed in claim 10 wherein the vehicle is suspended from said rail.

12. A transport system as claimed in claim 10 and having more than one rail each with an associated pick-up body on said vehicle.

13. In a transport system having at least one rigid rail forming an electrical conductor and a vehicle with a pick-up for taking electrical power from said rail, a pick-up body on the vehicle shaped partially to embrace said rail leaving an air gap between the rail and pick-up body means causing a flow of air through said gap, the rail and pick-up body being shaped that the air flow through the gap keeps the pick-up body spaced from the rail and additional means, apart from any applied voltage on the rail, for ionizing the air in said gap.

14. The apparatus of claim 13 further characterized in that the above mentioned means comprise a source of hot gas arranged to provide a stream of hot gases into said gap to ionize the atmosphere therein, and the pick-up body is shaped and the stream of gases so directed that the gas stream lifts the pick-up body with respect to the rail.

15. An electrical power pick-up as claimed in claim 14 wherein said source of hot gas comprises a fossil fuel burning jet engine.

* * * * *