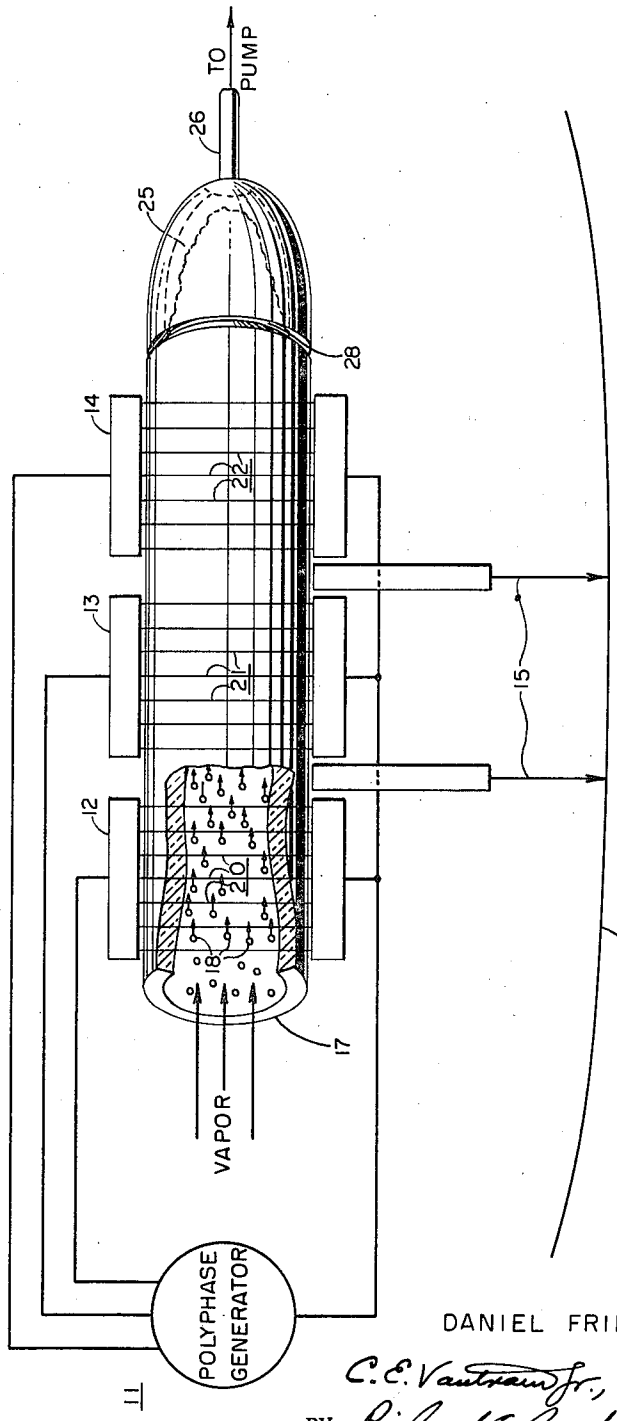
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METHOD AND MEANS FOR IMPROVING HEAT TRANSFER
UNDER ZERO GRAVITY CONDITIONS
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METHOD AND MEANS FOR IMPROVING HEAT TRANSFER UNDER ZERO GRAVITY CONDITIONS

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to heat transfer apparatus and more particularly, to heat transfer apparatus adapted for use under conditions of zero gravity.

Under conditions on the earth's surface, the conventional methods of obtaining high heat transfer rates include condensing of a vapor of a cold surface, forced movement of a condensing fluid through a cooling system wherein gravity is used to obtain flow through a designated portion of the system, and other such systems wherein gravity provides for either movement of the coolant fluid or removal of a cooled volume or mass away from the object to be cooled. Since the specific gravity of liquids used in conventional liquid-vapor systems is much greater than the specific gravity of the vapors, differential density forces are available under gravity conditions to remove the condensed liquid from the condensing surface. In such systems a cool surface is maintained for condensation thereon of the vapor.

However, under space conditions where there is no gravity the condensed liquid will probably tend to adhere to the surface of the condenser and in this way present a high resistance path to heat flow. Here it is possible to spin the condenser or heat exchanger, however, for space vehicles, satellites, or any other transporting vehicle where attitude control is required the spinning of the condenser is unacceptable or impractical for several reasons, among which are the expenditure of power and the rotating of mechanical seals. Where personnel are in an area or where equipment is within a predetermined distance of the condenser the particles thrown off may cause an undesirable disturbance and therefore render spinning further impracticable.

Accordingly, it is an object of the present invention to provide effective heat transfer means for use under zero gravity conditions.

It is another object of the invention to provide effective heat transfer means for use as part of a satellite or space vehicle generation or cooling system.

It is a further object of the present invention to provide heat transfer means operative under zero gravity conditions wherein size and weight are at a minimum.

It is a still further object of the present invention to provide heat transfer means applicable to zero gravity conditions without removal of condensation by spinning of the condenser.

It is a still further object to provide heat transfer means which are effective under zero gravity conditions wherein the transfer medium is a conductor of electricity and thus may be moved by electric or magnetic forces.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing.

In the embodiment of the present invention depicted herein, recovery of a vaporized metal such as mercury,

sodium, lithium, etc., is obtained through condensing the vapor to droplets, and inducing electric currents in the droplets by magnetic fields impressed about them whereby the fields created in the droplets by the induced currents interact with the impressed fields causing the droplets to be forced along the condensing surface in a given general direction.

The figure is a view of the invention with the cylinder shown partly in section.

In the drawing, polyphase generator **11** provides three-phase power to successive coils of wire **12**, **13**, and **14** along a nonconducting cylinder **17**. Vapor is directed through cylinder **17** and, since the cylinder may be cooled by contact, **15**, with the shaded side of the skin **16**, of the space vehicle or satellite, droplets will form on the surface thereof as indicated at **18**. Since the condensed vapor is a conductor of electricity, and since magnetic fields are impressed across cylinder **17** by energy from the coils of the polyphase generator at **12**, **13**, and **14**, the magnetic fields created being indicated at **20**, **21**, and **22**, such magnetic fields will induce electric currents in the droplets formed on the under surface of the cylinder **17**, with the induced electric currents producing their own magnetic fields which oppose magnetic fields **20**, **21**, and **22** thereby causing a force to be applied to move the droplets successively from field **20** to **21** to **22**. The droplets will acquire a momentum from the forces of interaction between the fields which will be in the direction from left to right as shown in the drawing and will result in an accumulation of condensed liquid metal in the area indicated at **25**, which collection upon further force from the incoming droplets will cause a flow through pipe or tube **26** to a pump and by pumping to a heat producing generator such as a reactor whereupon the cycle will begin again.

Cylinder **17** is in effect a pump as well as a condenser since the fluid is forced along its length toward an end where it is collected. The opening at **28** is to provide for exit of air or other matter which is not condensed on the surface of cylinder **17**, while, as explained above, the droplets of metal are forced into the area **25** where a solid flow of liquid metal to the pump is produced.

The cooling of cylinder **17** may be effected by connecting it to a section of the skin of the satellite or space vehicle which is remote from the sun. Where the space vehicle revolves or rotates and thereby presents different portions of its surface to the sun and simultaneously opposite portions away from the sun, the cooling may be obtained from whichever part of the body's surface is not heated by rays from the sun. In an alternate embodiment, not shown, of cylinder **17**, the cylinder could be double walled, in which case a coolant could be pumped between the walls to provide desired condensation of vapor on the inner surface to form droplets **18**.

It will be appreciated that cylinder **17** must be of nonconducting material—an example would be a ceramic material capable of withstanding relatively high temperatures. Further, the collected and accumulated droplets could be scooped off through an opening, not shown, near the end of cylinder **17** in lieu of being forced into a pipe as shown in the present embodiment.

It will be appreciated that the present invention provides a means for collecting, as well as pumping, a heat exchange medium which has been converted into the vapor state for purposes of providing electrical energy, such as driving a turbine, and that the system presented has no moving parts and therefore should be exceptionally durable as well as reliable in operation. The present invention is particularly suited for use in metal, liquid-vapor, closed-cycle systems.

Obviously many modifications and variations of the

present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. The method of providing for heat transfer in a space vehicle under zero gravity conditions comprising the steps of transporting said space vehicle to zero gravity conditions, condensing the vapor of an electrically conductive substance, impressing across the surface where said vapor is condensed a series of magnetic fields varying in time phase consecutively from the point of introduction of said vapor whereby condensed vapor will be forced to move with respect to said lines of magnetic force, and collecting said condensed vapor droplets in liquid form.

2. The method of providing heat transfer in a space vehicle under zero gravity conditions in closed-cycle systems wherein liquids of conducting material are vaporized and are to be returned to a liquid state comprising the steps of transporting said space vehicle to zero gravity conditions, directing the vaporized material into a condenser, cooling the condenser by conducting heat to the skin of said space vehicle, impressing a series of successive magnetic fields across the condensing surface, imparting motion to the condensed material by having said magnetic fields vary in time phase consecutively from the point of introduction of said vaporized material into the condenser, and collecting the condensed material in liquid form.

3. A means for providing heat transfer under zero gravity conditions comprising:

a condenser for condensing vapor passing in intimate contact with said condenser,

means for transporting said condenser to zero gravity conditions, said means for transporting including an exposed skin,

means for impressing successive magnetic fields of successive phase relationships across said condenser,

cooling means coupled to said condenser for cooling said condenser, and

means coupled to said condenser remote from a point of introduction of vapor into said condenser for collecting condensed material in liquid form.

4. A means for providing heat transfer under zero gravity conditions as recited in claim 3 wherein said condenser is a hollow, ceramic condenser wherein said vapor passes through said condenser.

5. A means for providing heat transfer as recited in claim 3 wherein said means for cooling includes means connecting said condenser to the skin of said means for transporting.

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