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POWER SOURCES

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FIG. 1.

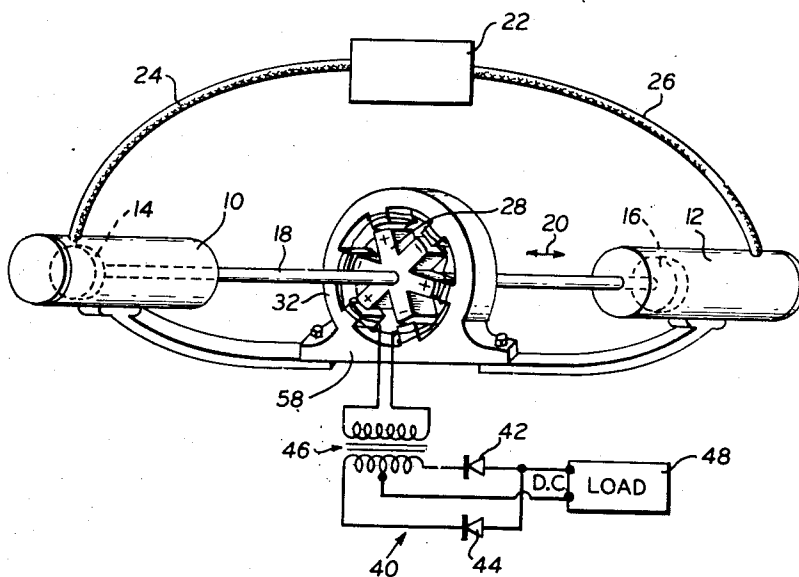
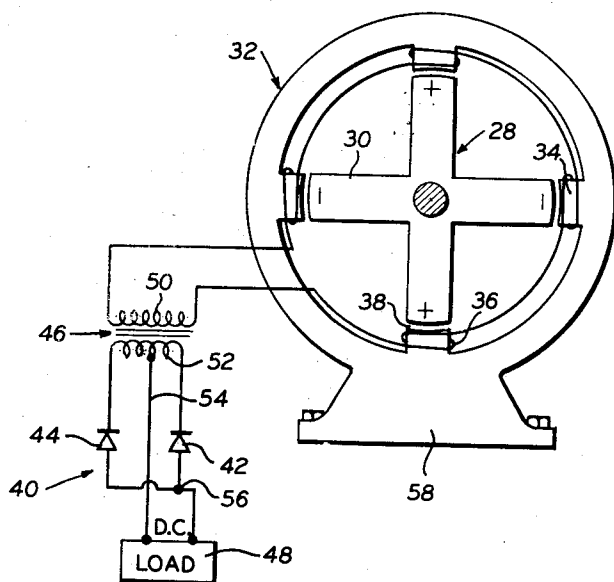


FIG. 2.



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This invention relates to power sources, and more particularly, to apparatus for adapting sources of mechanical power to commercial use.

The invention specifically relates to free piston arrangements and my invention has a principal object, the provision of means for adapting free piston arrangements for use as commercially useful sources of power.

A free piston arrangement is one in which, for example, spaced coaxial cylinders are provided with pistons connected by a common rod which is given a linear reciprocating motion.

Due to the positioning of the rod intermediate the cylinders and due to the fact that the rod is given a linear reciprocating motion, it has been considered difficult to usefully employ such devices for practical purposes. Accordingly, it is a further object of my invention to derive a useful form of energy or power from a free piston arrangement in a manner which has not been heretofore contemplated.

Free piston devices frequently provide a reciprocating motion, the frequency of which exceeds a useful frequency range. Accordingly, it is another object of my invention to provide improvements whereby the reciprocating frequency of free piston devices is not a deterrent to the useful application of free piston arrangements.

Briefly, in accordance with a preferred embodiment of my invention, I associate with a free piston arrangement an electrical signal generating device comprising means for generating a magnetic field and a coil element operatively associated therewith. I then employ the reciprocating movement provided by the free piston arrangement to move the coil in the magnetic field or vice versa to generate an electrical signal. In cases where the frequency of the signal which is generated exceeds the range of frequency which is commercially useful, I employ rectifying means to convert the high frequency electrical signal to a direct current electrical signal. I therefore avoid any deleterious effects of excessive high frequencies while at the same time making full use of the efficiency of free piston arrangements. Moreover, in order to facilitate the production of signals with a useful range of magnitudes, I may employ transformer means intermediate the aforesaid coil and the rectifying device so as to enable a selection of output signal magnitudes.

A feature of my invention is the simplicity with which I employ free piston arrangements for providing useful output power. This feature is amplified by the fact that my methods of applying electrical and magnetic principles to free piston arrangements has not been heretofore employed or suggested despite the fact that there has been a long standing need for finding application for and means for usefully employing the same.

Other objects and advantages of my invention will appear from the following detailed description of a preferred embodiment thereof as illustrated in the accompanying drawing in which:

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Fig. 1 is a diagrammatic perspective view of a preferred embodiment of my invention; and

Fig. 2 is an axial view of magnetic means which I employ in connection with the structure of Fig. 1, the figure illustrating the electrical circuitry which is employed.

The free piston arrangement illustrated in the drawing comprises spaced coaxial cylinders 10 and 12 which cylinders slidably accommodate pistons 14 and 16. The pistons are rigidly interconnected by means of a connecting device such as rod 18, the pistons 14 and 16 giving to this rod a linear reciprocating motion indicated by arrow 20. Diagrammatically illustrated for purposes of rendering the pistons and cylinders effective is a source 22 of a medium such as combustible fuel or the like which is fed via connections 24 and 26 to the cylinders.

The operation of the free piston arrangement itself is conventional but it is important to note that the reciprocating motion of rod 18 is conventionally of a very high frequency which is, in fact, greater than the frequency of electrical signals employed in most commercial applications.

In accordance with my invention, I convert the mechanical motion of rod 18 into an electrical signal, therefore avoiding the mechanical complications which obtain when one seeks to employ a rapidly moving mechanical part. It is to be noted that my invention makes use of a reciprocating motion in generating an electrical signal and that in this respect it differs markedly from the conventional generation of electrical signals by mechanical devices which have relative rotational movement.

Generally speaking, I employ means to produce a magnetic field to which magnetic field is magnetically coupled a coil of electrically conductive material.

The magnetic element shown in the drawing is generally indicated by reference numeral 28. This magnetic element 28 is shown as being fixed to the rod 18 for movement therewith although it will be understood that the coil element of the device may equally as well be fixed to rod 18. The magnetic device comprises a plurality of radially extending poles 30. These poles are alternately positive and negative and may preferably be of the permanent magnetic type.

The coil device which is employed, and as shown by way of example in the drawing, comprises a frame 32 of magnetic material. Directed inwardly in a radial sense from the circular frame 32 are a plurality of projections 34 which are also of magnetic material. If desired, these projections may take the form of permanent magnets although this is not essential to the illustrated embodiment.

On projections 34 are wound coils 36. These coils are the elements in which an electrical signal is generated whereupon a mechanical action is converted into an electrical signal.

It will be appreciated that the relative movements of a magnetic field and an electrically conductive coil may be usefully employed to generate electrical signals. In the illustrated apparatus, magnets 30 establish a magnetic field which, by virtue of the linear reciprocating motion of rod 18, is caused to move relative to coils 36. These coils on cutting the lines of flux which are established, generate a signal which is proportioned to the speed at which the coils cut through the flux per unit time. Alternately or as a supplement to the aforementioned principle of operation, there is defined between projections 34 and magnetic poles 30 air gaps 38 which are integral parts of a magnetic circuit comprising poles 30 and projections 34. It will be appreciated that the linear reciprocating movement of rod 18 causes the effective dimensions of these gaps to be varied as, of course, occurs when two magnetic faces defining an air gap are

relatively moved in opposite circular directions. The continual changing of this air gap induces a change of permanence in the aforesaid magnetic circuit and thus controls the amount of flux in projections 34. This change of flux also results in a generation of current or an electrical signal in coils 36 and, in either or both of the above indicated manners, a signal is generated.

The frequency of the generated signal will conform to that of the frequency of reciprocating of rod 18. As has been noted, this frequency may exceed the range of useful electrical signal frequencies. I thus employ a rectifying device 40 which includes, for example, silicon rectifiers 42 and 44 for purposes of full-wave rectification.

Intermediate rectifying device 40 and coils 36, I preferably employ a transformer 46. This enables me to achieve a voltage magnitude which is independent of the speed of reciprocating of rod 18 or the strength of the magnetic field and the like. In fact, this enables me to provide a voltage corresponding with the requirements of a load 48 which may be coupled to my apparatus.

With more specific reference to the electrical circuitry of my illustrated apparatus, transformer 46 comprises a primary winding 50 coupled to coils 36 which are arranged in series adding relationship. Transformer 46 also includes a secondary winding 52 which may have either a step-up or step-down relationship with primary winding 50 as required.

An output lead 54 is connected with the center tap of winding 52 and rectifiers 42 and 44 are coupled to the extremities of this winding. The rectifiers have a common connection at 56 and the load is coupled between connection 56 and line 54.

To provide a relative movement intermediate the magnetic and coil devices, frame 32 is fixed in position by a support 58 diagrammatically illustrated in Fig. 1 and shown with a greater degree of particularity in Fig. 2. It will be appreciated that various means of supporting the coil device can be employed, it being only necessary to permit a relative motion between the magnetic and coil devices.

Attention is directed to the fact that although I have employed members which are generally circular in configuration I do not use a relative rotation between these parts to generate the desired electrical signal. Instead, I utilize a relative linear displacement between these parts in a manner calculated to provide the cutting of lines of flux by a coil and/or the varying of the flux in a core (projections 34) upon which a coil is wound.

In summary, my improvements provide an extremely simple means and method for usefully employing free piston arrangements in the generation of power, my improvements being susceptible of wide spread application with due respect being given to economic factors.

There will now be obvious to those skilled in the art many modifications and variations of the methods, structures and apparatus set forth above. These modifications and variations will not, however, depart from the spirit of the invention as defined in the following claims.

What is claimed is:

1. A power source comprising a free piston arrange-

ment including a member having a linear reciprocating motion, a circular magnetic element including radial spokes, and a coil element concentric with the magnetic element and including radial spokes aligned with the first said spokes, one of the elements being connected with said member for movement therewith, the other of said elements being stationary in a position whereat it is magnetically coupled with said one element whereby said reciprocating motion causes an electrical signal to be generated in the coil element.

2. A power source comprising spaced coaxial cylinders, pistons in the cylinders, a rod connecting the cylinders, a circular magnetic element including radial spokes, a coil element magnetically coupled to the magnetic element and concentric with the magnetic element and including radial spokes aligned with the first said spokes, one of the elements being rigidly fixed to said rod, the other of the elements being stationary, said pistons driving the rod with linear reciprocating motion and thereby said one element to generate an alternating electrical current.

3. A source as claimed in claim 2 comprising rectifying means coupled to the coil element for rectifying the alternating electrical current.

4. A source as claimed in claim 3 comprising a transformer coupling the rectifying means to the coil element.

5. In combination with a free piston arrangement having spaced coaxial cylinders with pistons in the cylinders connected by a connecting device which is given a linear reciprocating motion at a frequency exceeding corresponding useful electrical frequencies, a power source comprising a magnetic element including radial spokes, a coil element magnetically coupled to said magnetic element and concentric with the magnetic element and including radial spokes aligned with the first said spokes, means supporting one of the elements in substantially fixed position, the other element being fixed to the connecting device for linear reciprocating motion therewith whereby an electrical signal is generated in said coil element and a rectifying device coupled to the coil element for rectifying the signal for application to a load.

6. A source as claimed in claim 5 wherein the magnetic element comprises a permanent magnet fixed on the connecting device.

7. A source as claimed in claim 5 comprising a transformer coupling the rectifying device to said coil device for obtaining a predetermined voltage level.

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