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ELECTROMAGNETICALLY DRIVEN SELF-REGULATING FLUID COMPRESSOR FOR USE IN REFRIGERATING MACHINES

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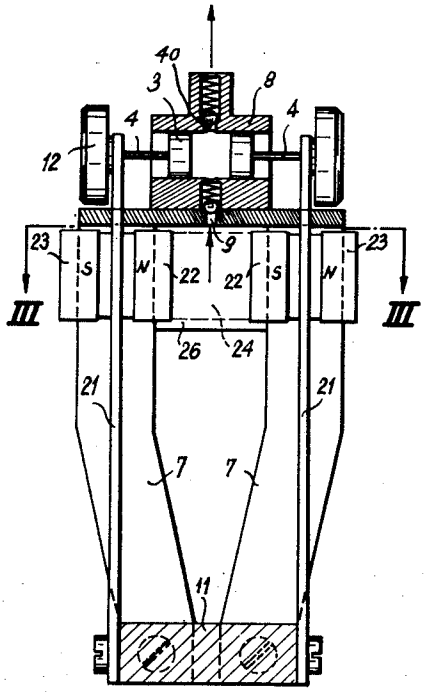


Fig.1

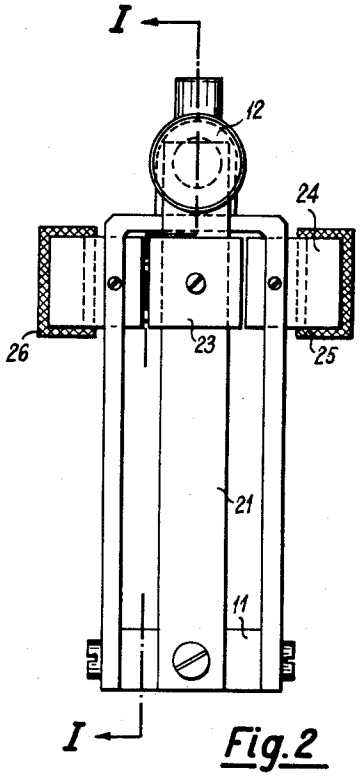


Fig.2

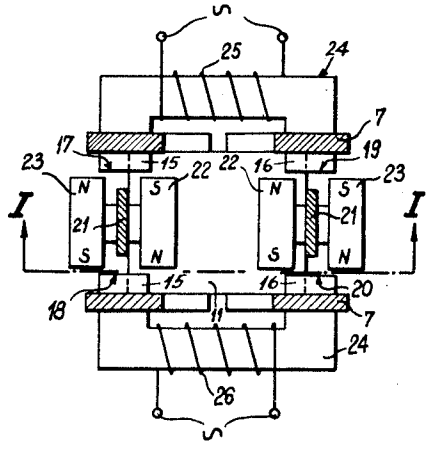


Fig.3

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ELECTROMAGNETICALLY DRIVEN SELF-REGULATING FLUID COMPRESSOR FOR USE IN REFRIGERATING MACHINES

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2 Claims. (Cl. 230—55)

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My invention relates to fluid compressors and more particularly to electro-magnetically driven self-regulating fluid compressors for use in refrigerating machines.

An important feature of the invention resides in the provision of a unit comprising the movable part of the compressor and an armature controlling said movable part, the mass of said unit being subjected to the action of such a spring that the natural oscillating frequency of said unit when running idle be lower than that imparted thereto by the periodic feeding current and equal to the latter when the necessary power for producing a certain rate of compression is added to the power of the spring.

The advantage of this arrangement resides in that the stroke of the movable part of the compressor (for instance the piston), automatically increases with the rate of compression.

In the machine described heretofore, the natural frequency of the unit comprising the weights and the spring is regulated so as to be in resonance with the frequency of the feeding current. When the machine runs idle, the amplitude tends to assume an excessive value, and various means have been described for avoiding this inconvenience. Furthermore, various processes have been described for regulating the power while running.

It is an object of my present invention to automatically attain those results in the simplest way.

The strain of the compression produces in the oscillating movement of the system mass-elastic power not only a damping effect which would lower their own frequency, but also a power which, in the second half of the compression, will be added to that of the resilient blade, and which consequently increases the natural frequency of the system. This fact is in accordance with the fundamental theory of harmonic oscillations whose differential equation is

$$\frac{d^2X}{dt^2} = -K^2X$$

where the frequency increases with K.

In order to use this property according to my invention, the natural frequency of the weights and of the spring power is regulated in such a way that the natural frequency of the system be substantially lower than that which is imparted thereto by the driving current. When idle running, for instance at the beginning of the operation, the amplitude is small because of the frequencies being out of phase, but it increases according as the rate of compression is raised, and

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finally will reach to the resonance and consequently to the maximum of amplitude and power for the maximum foreseen rate of compression.

In the refrigerating machines, the following result is obtained:

When the ambient temperature is comparatively low (15° C. for instance) the pressure within the condenser is low, the rate of compression is small and so is consequently the amplitude, thus realizing saving of feeding current and of wear of the apparatus. According to the ambient temperature rising, the rate of compression increases and so does the amplitude and the mass is dimensioned in such a way that the maximum amplitude occurs at the maximum foreseen ambient temperature. The construction shown herein has for its object to create throughout the coils a reversal of the direction of the induction flux produced by the magnets, thus obtaining an induced electromotive force as high as possible. To this end there are provided two resilient blades each of which carries two permanent magnets whose magnetic axes are parallel and opposite in direction and which successively penetrate at each half-period into the magnetic circuit.

The accompanying drawings represent, by way of examples, one embodiment of the invention.

Fig. 1 is an elevational view of an electromagnetically driven gas compressor taken from a plane, the trace of which is the line I—I on Fig. 3, and including an axial section of the cylinder of said compressor.

Fig. 2 is a side elevational view thereof.

Fig. 3 is a horizontal section thereof, being taken on line III—III of Fig. 1.

The gas compressor shown in the Figures 1 to 3 comprises a base plate **11** to which are secured two resilient blades **21** and two brackets **7** carrying the laminated field frame of an inducing field magnet **24**. To the top of these brackets is fastened a compressor cylinder **8** containing two pistons **3** symmetrically connected each of them by a flexible rod **4** with one of the resilient blades **21**. At its median portion, the cylinder **8** is provided with a suction valve **9** and a delivery valve **10**. The weights **12** are calibrated in such a way that the natural period of oscillation of the blades **21**, together with the corresponding weights **12** and pistons **3**, be lower than that which is imparted thereto by the inducing field magnet **24**.

The field magnet **24** comprises two parallel and opposite portions **15, 16**, each of which is cut by an air-gap with polar faces **17, 18, 19, 20**, respectively, substantially at right angles to the main direction of the flux through the said air-

gaps. Each of the resilient blades or leaf-springs carries two permanent magnets **22** and **23** whose axes of magnetization are parallel to one another but opposite in direction. These magnets **22—23** and the corresponding leaf-springs **21** are adapted to oscillate in the air-gaps in a direction parallel to the polar faces **17, 18** and **19, 20.**

The inducing field magnet **24** is energised by alternating current of predetermined frequency flowing through the coils **25** and **26**, so that both the magnets **22** simultaneously penetrate into the air-gaps of the inducing field magnet at a given half period. In the subsequent half period, both the magnets **23** penetrate simultaneously thereinto. As the magnetic axes of these magnets are opposite in direction, the flux will be reversed throughout the coils thus producing a high induced electro-motive force and substantially increasing the power and the efficiency of the compressor.

A further advantage of this construction resides in that the magnets are always solicited in the very direction where the flux produced by the coils tends to increase the flux which passes through them, that is to increase their magnetization. The demagnetization by accidental excess of intensity within the field-magnets will thus be made impossible.

What I claim is:

1. In an electro-magnetically driven fluid compressor, the combination of a frame, an inducing field magnet secured to said frame and having two parallel and opposite portions, each of which is cut by an air-gap with polar faces substantially at right angle with the main direction of the flux; said field-magnet being energizable by alternating current of predetermined frequency; a pair of leaf-springs secured to said frame by one of their ends, each leaf-spring being adapted to oscillate in a corresponding air-gap, in a direction substantially parallel to said polar faces; a pair of permanent magnets carried by each leaf-spring, said permanent magnets having their magnetic axes parallel to the flux in the corresponding air-gap, but opposite in direction with respect to each other; a compressor cylinder for gaseous fluid secured to the frame, two spaced pistons reciprocally mounted in said cylinder and symmetrically connected to one of the said leaf-springs; a suction pipe and a delivery pipe communicating with the middle part of the cylinder between the two pistons, the weights and sizes of the movable unit constituted by the leaf-springs with permanent magnets, pistons and their connections, being determined in such a manner that the natural frequency of oscillation of said unit, by no delivery pressure in the cylinder, be less than that of the alternating current, said natural frequency increasing when the rate of compression increases so as to become almost equal to the frequency of the alternating current.

2. An electro-magnetic reciprocating motor comprising in combination: a frame, an inducing field-magnet secured to said frame and having two parallel and opposite portions, each of which is cut by an air-gap with polar faces substantially at right angle with the main direction of the flux; said field-magnet being energizable by alternating current of predetermined frequency; a pair of leaf-springs secured to said frame by one of their ends, each leaf-spring being adapted to oscillate in a corresponding air-gap, in a direction substantially parallel to said polar faces; a pair of permanent magnets carried by each leaf-spring, said permanent magnets having their magnetic axes parallel to the flux in the corresponding air-gap, but opposite in direction with respect to each other; the relative arrangement of the permanent magnets in the air-gaps and the flux in the latter being such that at a given half period of the alternating current, two of the permanent magnets are simultaneously attracted to the centre of said air-gaps, and the other two magnets, pushed away from said air-gaps, these motions being reversed at the next half-period; means for adjusting the natural frequency of oscillation of the movable unit constituted by the leaf-springs with their permanent magnets.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
202,764	Smyth	Apr. 23, 1878
1,333,298	Evershed	Mar. 9, 1920
1,689,419	Bronander	Oct. 30, 1928
1,978,866	Konig	Oct. 30, 1934
2,169,827	Whitted	Aug. 15, 1939
2,240,307	List	Apr. 29, 1941
2,245,391	Dickten	June 10, 1941
2,245,981	Knopp	June 17, 1941
2,259,131	Fleischer	Oct. 14, 1941
2,280,610	Young	Apr. 21, 1942
2,429,441	Williams	Oct. 21, 1947
2,430,151	Whitted	Nov. 4, 1947

FOREIGN PATENTS

Number	Country	Date
130,078	Austria	Oct. 25, 1932
496,049	France	July 21, 1919