April 20, 1937. R. P. PESCARA 2,078,157

MOTOR COMPRESSOR WITH FREE PISTONS

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Fig. 1.

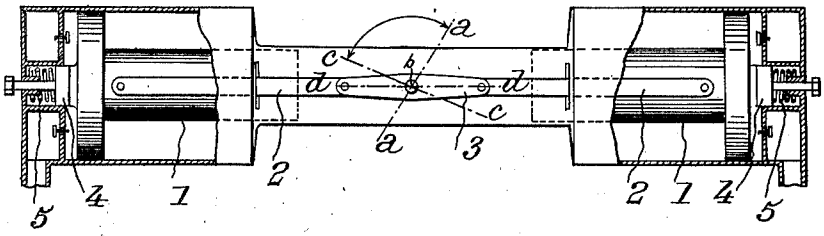
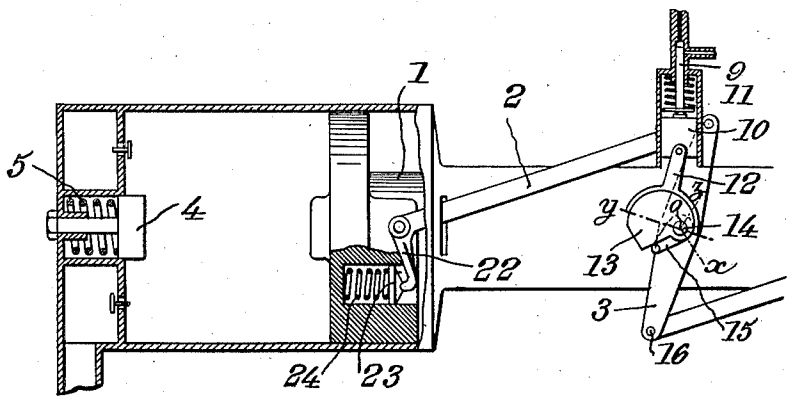


Fig. 2.



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Fig. 3.

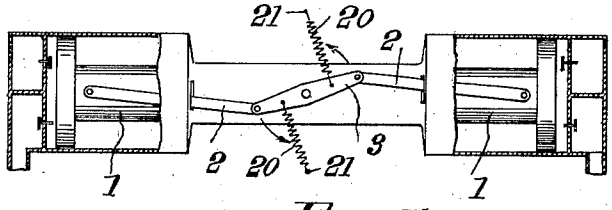


Fig. 4.

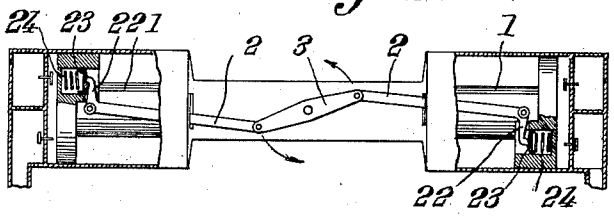


Fig. 5.

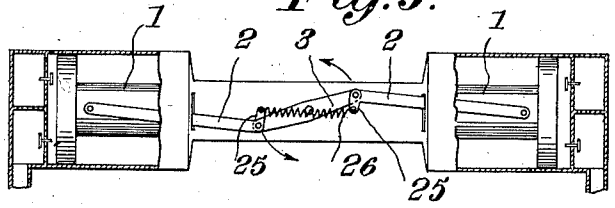


Fig. 6.

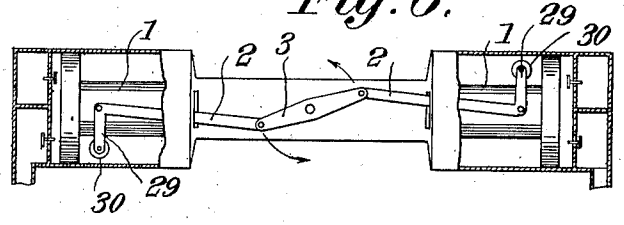
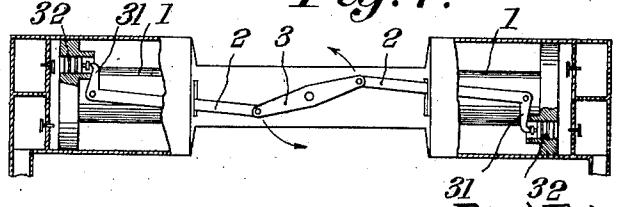


Fig. 7.



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MOTOR COMPRESSOR WITH FREE PISTONS

Raul Pateras Pescara, Paris, France

Application November 21, 1932, Serial No. 643,689
In France November 27, 1931

11 Claims. (Cl. 230—56)

This invention relates to motor compressors with free pistons and is particularly concerned with a safety arrangement for compressors of the kind which embody oscillating cranks and levers arranged in a known way.

It has for its object more particularly to provide means whereby the pistons of the compressor cannot strike against the cylinder-heads particularly if for any reason the cushioning means employed for the return of the piston only functions imperfectly or if it should become insufficient by reason of the increase of the motive energy.

The invention consists essentially in choosing the angles of oscillation of the cranks in such a way that at the true outer dead point the pistons do not reach as far as the cylinder heads.

The invention consists further in arranging elastic abutments between the pistons and cylinder heads which are sufficiently strong to prevent the pistons reaching their true dead point when the pistons are operated by hand but which permit on the contrary this point to be attained and even to be passed during the operation in the case of accident.

The invention consists further in providing a control for the injection pump in such a way that this latter is freed in the event of an accident when the cranks pass through the true outer dead point.

Finally, the invention consists in reducing the stresses on the crank and connecting rod joints during the normal functioning by accelerating the connecting rods at their dead points, either by the action of suitably arranged springs, by the inertia of masses fixed to the connecting rods or by the action of compressed air on an auxiliary piston solid with the connecting rods.

The invention will be well understood with the aid of the following description and the attached drawings which show by way of example one of the possible realizations of the invention.

Fig. 1 shows diagrammatically partly in elevation and partly in longitudinal section a motor compressor according to one embodiment with free pistons.

Fig. 2 represents a mechanism provided with means for securing the control of the injection pump.

Figs. 3, 4 and 5 show a piston-connecting rod assembly showing variations in the arrangements of springs operating on the connecting rods.

Fig. 6 shows a further piston-connecting rod assembly with an arrangement of masses operating on the connecting rods by inertia.

Fig. 7 shows a piston-connecting rod assembly with a pneumatic arrangement for operating on the connecting rods.

In accordance with Fig. 1, the pistons 1 are connected by the connecting rods 2 and the cranks 3. These latter oscillate in normal operation between the position *a—b—a* corresponding to the internal dead point and the position *c—b—c* corresponding to the outer normal dead point. These dead point positions can vary. The crank may, in the case of accident, pass the extreme position *c—b—c* and continue its movement of oscillation as far as the point *d—b—d*. Near the true outer dead center represented by the position *d—b—d* the pistons press against the abutments 4 and compress the springs 5 which are so strong that by hand one can never move the connecting assembly as far as the true outer dead point shown on the figure.

According to Fig. 2, the piston 9 of the injection pump is actuated in one direction by a piston 10 and in the opposite direction by a return spring 11 which always ensures contact between the pistons 9 and 10. The movement of the piston 10 is itself effected by an eccentric collar 12 pressing upon an eccentric 13 mounted loosely on an oscillating shaft 14 of the cranks 3. A member 15 keyed to the shaft 14 drives the eccentric 13 by means of a finger 16. In normal operation the angle of oscillation of 14 being for example *x—o—y*, the pump is always operated. If, on the contrary, the pistons of the compressor pass their true dead point, the angle of oscillation of the shaft 14 becomes *x—o—z*, through which angle the finger 16 oscillates freely without oscillating the said eccentric 13 which leads to the stopping of the motor compressor.

During operation of the device when the pistons move inwardly, for example, from their normal outer dead point considerable forces have to be exerted in the members which connect the rods 2 and with the levers 3 in their almost horizontal position in order to turn the lever back again. The considerable magnitude of this force is due to the condition that by reason of t approximately horizontal position of the leve. the components of the force acting on the double armed lever, and which can exert a rotary moment on the lever, are only slight. On the other hand the absolute magnitude of this force due to the acceleration which must be imparted to the lever is not inconsiderable. Thus, in order that the relatively small components be sufficiently great to effect the turning of the lever, the total force

of power engaging said members must be very great.

In order to reduce the total magnitude of this force provision is made for additional forces which arise substantially at the dead points of the pistons. These additional forces aid the return rotary movement of the double armed lever **3**. For example, they can be exerted by means of springs, the inertia of a mass or by air pressure.

In the form shown in Fig. 2, connecting rods such as **2** for this purpose each carry a projection **22** pressing on a guide piston **23**, which piston compresses a spring **24** and the operation of this spring is arranged to be at the maximum near the dead centers.

According to Fig. 3, springs **20** are attached at two symmetrical points to the crank **3** and are fixed at their other ends to fixed points **21**, these springs operating only near the dead centers.

Fig. 4 shows a spring arrangement similar to that of Fig. 2, but without the fuel control device.

According to Fig. 5, the connecting rods such as **2** each carry a projection **25**. The projections of the two connecting rods are connected by a spring **26** the action of which is at a maximum near the dead points.

According to Fig. 6, the connecting rods such as **2** each carry projections **29** terminated by a mass **30** the acceleration of which, at a maximum near the dead center, acts on the connecting rods **2** in the correct direction. In this embodiment the forces supporting the rotation of the lever **3** are the inertia forces of the mass **30**.

According to Fig. 7, the connecting rods such as **2** each carry a projection **31**, the extremity of which presses on a piston in communication with the compressed air. Near the outer dead center the movement of the connecting rods is accelerated by the action of the compressed air on the piston **32**. Near the inner dead center the piston **32** functions by its own inertia.

It is clear that in this embodiment the additional forces mentioned are exerted by air pressure acting on the auxiliary piston **32**, when the pistons **1** are at the outer dead point, while when they are at the inner dead point the inertia forces developed by the auxiliary piston **32** exert a favorable rotary movement on lever **3**.

An additional rotary moment acting favorably at the outer as well as the inner dead point of the pistons **1** is also exerted on the rod **2**, **3** in the embodiment of Fig. 4. At the inner dead point of the main pistons the lever **3**, which then assumes the position *a—b—a* (see Fig. 1) does not so nearly approach the horizontal as in the outer dead point, although the accelerations acting on the rod are greater at the inner than at the outer dead point. Thus, it is advantageous to exert a favorable additional rotary movement which facilitates the reversal of lever **3** at both dead points.

It will be evident from the above description that the invention relates to means for producing on the lever **3** a moment in the direction of its return oscillation just before the pistons would normally reach their dead points so as to prevent the pistons from normally reaching their dead points, and in controlling the fuel pump by means of the lever **3** or the axis on which it oscillates so that the fuel pump injects fuel into the combustion chamber during normal operation but is rendered inoperative in the event the pistons accidentally attain their dead center points.

What I claim and desire to secure by Letters Patent of the United States of America is:—

1. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, means combined with said system for producing on said lever a moment in the direction of its return oscillation just before said pistons would normally reach their dead points, a pump adapted to inject fuel into said combustion cylinder, means connected with said system for actuating said pump, and means operative if and when said pistons reach their dead points to render said pump inoperative and prevent fuel from being injected into said combustion cylinder.

2. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and an oscillating member between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, a pump adapted to inject fuel into said combustion cylinder, and means connected with said system for actuating said pump.

3. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and an oscillating member between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, a pump adapted to inject fuel into said combustion cylinder, means connected with said system for actuating said pump, and means operative if and when said pistons reach their dead points to render said pump inoperative and prevent fuel from being injected into said combustion cylinder.

4. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, a pump adapted to inject fuel into said combustion cylinder, and means connected to the axis of said lever for actuating said pump.

5. An internal combustion motor compressor comprising, in combination, two pistons, a com-

bustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, a pump adapted to inject fuel into said combustion cylinder, and an eccentric connected to said lever for actuating said pump.

6. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, a pump adapted to inject fuel into said combustion cylinder, an eccentric connected to said lever for actuating said pump, and means operative if and when said pistons reach their dead points to render said pump inoperative and to prevent fuel from being injected into said combustion cylinder.

7. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, and means combined with said system for producing on said lever a moment in the direction of its return oscillation just before said pistons would normally reach their dead points.

8. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, and means combined with said system for producing on said lever a moment in the direction of its return oscillation just before said pistons would normally reach their dead points, said means including at least one spring acting on said system.

9. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, and means combined with said system for producing on said lever a moment in the direction of its return oscillation just before said pistons would normally reach their dead points, said means including at least one spring acting on said lever.

10. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, means combined with said system for producing on said lever a moment in the direction of its return oscillation just before said pistons would normally reach their dead points, resilient abutment means between said pistons and the heads of the compressor cylinders, a pump adapted to inject fuel into said combustion cylinder, means connected with said system for actuating said pump, and means operative if and when said pistons reach their dead points to render said pump inoperative and prevent fuel from being injected into said combustion cylinder.

11. An internal combustion motor compressor comprising, in combination, two pistons, a combustion cylinder common to the two pistons, compressor cylinders individual to each piston, said pistons moving in said combustion and compressor cylinders, a system including two connecting rods and a double armed oscillating lever between said two pistons, the length of the elements of said system being such that when the system is in extended position the pistons do not contact with the heads of the compressor cylinders, and resilient abutment means between said pistons and the heads of the compressor cylinders.

RAUL PATERAS PESCARA.