

May 4, 1954

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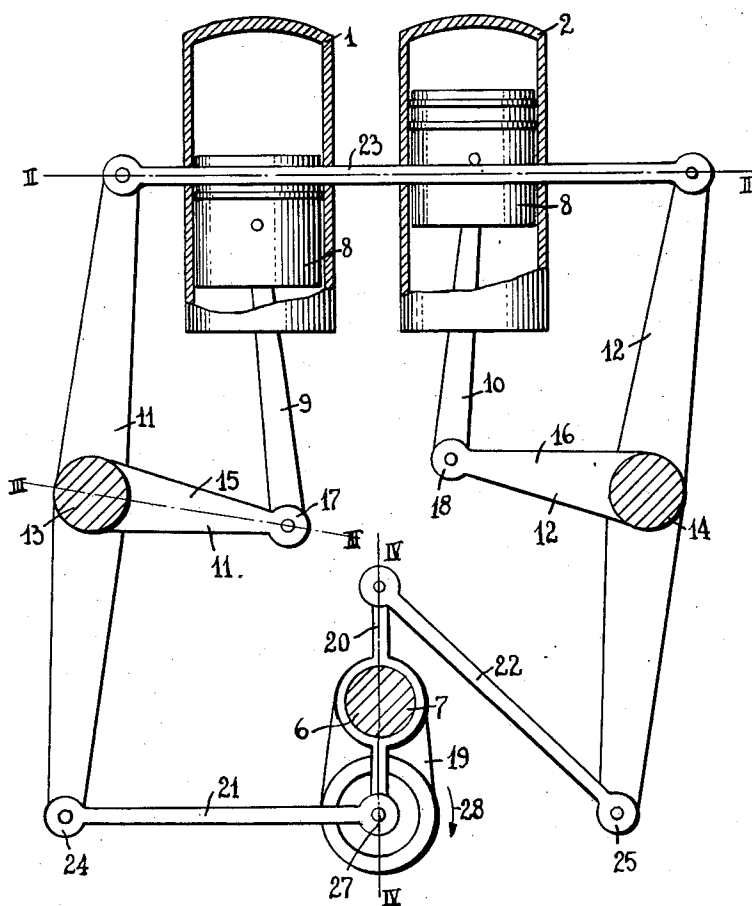
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MECHANICAL MOVEMENT

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3 Sheets-Sheet 1

Fig.1



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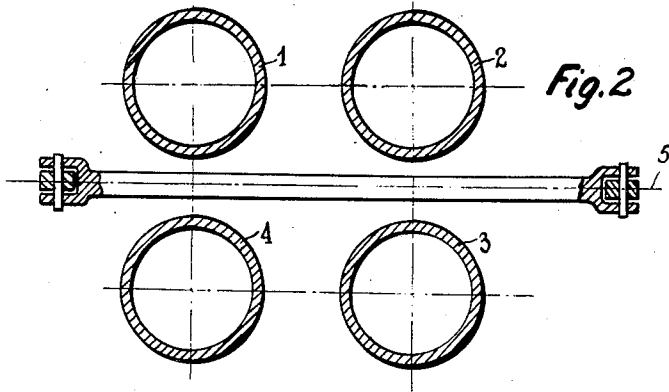


Fig. 2

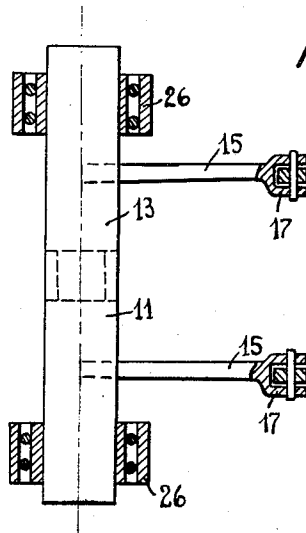


Fig. 3

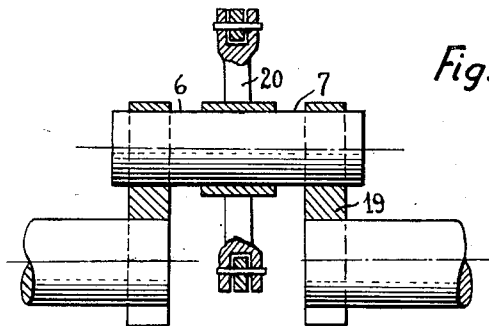


Fig. 4

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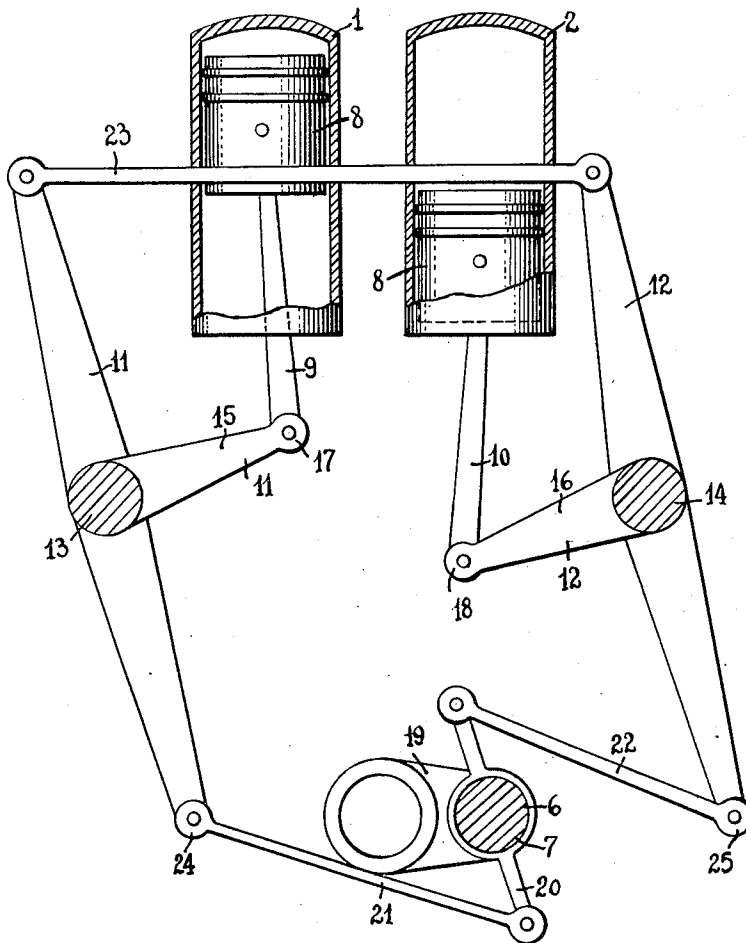
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MECHANICAL MOVEMENT

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Fig.5



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MECHANICAL MOVEMENT

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The present invention relates to a machine having cylinders, pistons, and transmission means, said machine comprising at least four cylinders the axes of which are substantially parallel and the heads of which are substantially at the same height on these axes, in each of which cylinders a piston performs a reciprocating movement, each of these pistons being connected to one end of a connecting rod, these connecting rods connecting these pistons to a same crankshaft which performs a rotational movement when the pistons perform the aforesaid reciprocating movement.

The aforesaid machine may, for example, constitute an engine or a compressor; it may comprise four cylinders, or a plurality of groups of four cylinders.

The invention has essentially the object of increasing the efficiency of machines of this type, that is of engines and compressors.

To this end, there are provided at least two bent levers located on either side of the cylinders and having their fulcras, which are located in the bends proper, fixed in relation to said cylinders, the end of one of the arms of each of the levers being hinged to one end of a connecting rod, said arm being directed towards the cylinders and occupying a position substantially perpendicular to the axes of the cylinders when the piston, connected to one end of said connecting rod, is half-way in its stroke in the cylinder, the end of the other arm being connected to a crank-pin of the aforesaid crankshaft through the medium of at least one member which is fixed by a hinge to said end.

In one advantageous embodiment of the present invention, the machine comprises a member which is hinged to the arms of the bent levers, the ends of which arms are connected to the aforesaid crankpin.

In a preferred embodiment, the machine comprises four cylinders situated symmetrically in relation to the aforesaid crank-pin and to the arms of the levers connected to said crank-pin.

Other details and features of the invention will be clear from the description, given hereinbelow by way of non-limitative example and with reference to the accompanying drawings, of a machine having cylinders, pistons, and transmission means according to the present invention.

Figure 1 is a schematic view in section of the device or machine according to the present invention.

Figure 2 is a view in section along the plane II—II of Figure 1.

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Figure 3 is a view in section along the plane III—III of Figure 1.

Figure 4 is a view in section along the plane IV—IV of Figure 1.

Figure 5 is a view similar to Figure 1, the pistons being nevertheless in a different position. In the different figures, like elements are designated by like references.

The device or machine comprises four cylinders, 1, 2, 3, and 4. The cylinders 1 and 2 are located on one side and the cylinders 3 and 4 are located on the other side of a plane 5 perpendicular to the axis 6 of the crank-pin 7 and passing through the middle of said crank-pin. The axes of these cylinders 1 to 4 are parallel. The lines which are located in a plane perpendicular to these axes and which connect the points of intersection of this plane and of these axes form a square, as moreover is clearly shown in Figure 2. However, there is nothing to prevent these lines from being given the shape of a rectangle. In each of the cylinders 1 to 4 there is provided a piston 8 which performs a reciprocating movement. The pistons 8 situated in the cylinders 1 and 4 are connected to the ends of the connecting rods 9, while the pistons 8 situated in the cylinders 2 and 3 are connected to the ends of the connecting rods 10. Bent levers 11 and 12 are located on each side of the cylinders and have axes 13 and 14 respectively moving in bearings 26 which are fixed in relation to the aforesaid cylinders. Each of the bent levers 11 and 12 comprises one first arm 24 and 25 directed downwards and two second arms 15 and 16 (Figure 3), the ends 17 and 18 of which are hinged to the connecting rods 9 and 10; i. e. the arms 15 are connected to the connecting rods 9, while the arms 16 are connected to the connecting rods 10. The arms 15 and 16 are directed towards the cylinders and occupy a position substantially perpendicular to the axes of the cylinders when the pistons are located half-way along their stroke in the cylinders. These first ends of the arms 24 and 25 of the bent levers 11 and 12 are connected, through the medium of different members described hereinbelow, to the crank-pin 7 of the crankshaft 19. This crank-pin 7 is the only crank-pin on the crankshaft 19; it is surrounded by a member 20 which is rotatably mounted on said crankpin and hingedly connected to the ends of two members 21 and 22, respectively, the other ends of which are hinged to the lower ends of arms 24 and 25. Third arms forming upwardly directed extensions of the first arms 24 and 25, are located on the other side of

the axes 13 and 14. The upper ends of these third arms are interconnected by a link member 23 which is hinged to these ends of said extensions.

It is easily understood from the foregoing that the pistons 8 of the cylinders 1 and 4 perform the same movement; it is moreover the same as regards the pistons 8 of the cylinders 2 and 3. A rising movement of the pistons in the cylinders 1 and 4 will nevertheless always be accompanied by a descending movement of the pistons in the cylinders 2 and 3. A rising movement of the pistons in the cylinders 2 and 3 will in turn be accompanied by a descending movement of the pistons in the cylinders 1 and 4. This results more particularly from the fact that the bent levers 11 and 12 always move in the same direction and that their arms 24 and 25 always remain parallel. The opposite movement of the pistons 2 and 3 arises from the fact that the arms 15 and 16 are directed in opposite directions. The member 23 ensures parallelism of the arms 24 and 25 and has the effect that the movement of one of the bent levers necessarily, even without the intervention of the crankshaft, entails the movement of the other, and consequently has the effect that the movement of one piston necessarily entails the movement of the three other pistons, which promotes the good functioning of the machine according to the present invention.

The members 20 to 22 have been provided to permit the rotation of the crankshaft 19, i. e. the member 20 comprises two extensions opposite one another which are the connecting links respectively hinged to the members 21 and 22. Such link or lever system is necessary, because the members 21 and 22 cannot be connected direct to the crankshaft 7, in view of the fact that the distance between the ends of the arms 24 and 25 remains constant because of the element 23. In fact, it can easily be understood that the ends of the arms 24 and 25 perform equal movements on equal axes. If the members 21 and 22 were connected directly to the crank-pin 7, the axis 6 of the latter would have a movement similar to that of the ends of the arms 24 and 25. Now, the axis 6 of the crank-pin 7 must describe a circle around the geometrical axis 27 of the crankshaft 19. It is obvious that the movement of the axis 6 is essentially a function of the movements of the ends of the arms 24 and 25, of the distance between the axes 6 and 27, and of the length of the members 20, 21, and 22. For the machine illustrated in Figures 1 and 5, these movements, distance, and lengths are such that if the crankshaft turns in the direction indicated by the arrow 23, the pistons are not situated halfway along their stroke when the plane formed by the axes 6 and 27 is parallel to the axes of the cylinders 1 and 4, and are not located at their dead centre when the plane 6—27 is perpendicular to the plane of the axes of the cylinders 1 and 4. This displacement between the limit positions (highest and lowest positions, positions most to the left and most to the right) of the crank-pin 7, on the one hand, and the highest, lowest, and midway positions of the pistons 8, on the other hand, entails by no means negligible advantages, such as quicker acceleration and less rapid slowing down of the pistons.

It is to be observed that in the machine according to the present invention, the four pistons 8 have always the same acceleration or the same deceleration, which indisputably constitutes a remarkable advantage in relation to known ma-

chines of the same type, which generally have connecting rods and cranks.

In relation to machines having connecting rods and cranks, the machine according to the present invention has the advantage that the pistons are subjected to smaller lateral thrusts, as the result of lesser obliquity of the connecting rods.

By way of example it is to be noted that if the machine according to the present invention constitutes a four-stroke engine having four cylinders, the firing order will preferably be as follows: firing in cylinders 1, 2, 4, 3, 1, 2, 4, 3, and so on.

The arms 24 and 25 of the bent levers 11 and 12 may have a certain elasticity without giving rise to harmful oscillations.

The machine may furthermore have spiral springs fixed by one end to the ends of the axes 13 and 14, and by the other end to joints which are fixed in relation to the cylinders 1 to 4. These spiral springs, which have not been illustrated, must be so placed as to be slack when the pistons are at the upper dead centres and under tension when the pistons are at the bottom dead centres.

The springs therefore act as return springs. These springs have essentially the object of supplementing the influence of the elasticity of the arms 24 and 25. The elasticity of the arms 24 and 25 offers many advantages. Amongst these advantages the following particularly merits attention:

The volume of the combustion chamber has automatically become variable. This volume tends to increase proportionally to the amount of gas admitted into the cylinder, to be compressed therein before firing, and to diminish proportionally to the speed of rotation of the crankshaft. This latter tendency arises more particularly from the fact that the four pistons, which are rendered solid with one another, more particularly by the axes 13 and 14 and by the member 23, have a certain inertia.

It is to be observed that the forces of inertia of the members which move in the machine according to the invention constitute essentially two couples acting in contrary directions.

The first couple arises from the ascending and descending movement of the pistons, while the second couple arises from the movement of the bent arms and from the members 20, 21, and 22.

The machine according to the present invention may be constructed in all cases where a machine has at least two cylinders, pistons which perform a reciprocating movement in cylinders, and transmission means.

The embodiment described hereinabove relates to an engine having four cylinders. It is nevertheless clearly understood that a plurality of series of four cylinders may be provided, or use may even be made of an engine or a compressor which comprises one or more series of two cylinders. When the machine comprises only two cylinders, the latter are disposed like the cylinders 1 and 2 in Figures 1, 2 and 5. It is quite understood that, in this case, each of the bent levers 11 and 12 has only a single arm 15 and 16 respectively, directed towards the cylinders. The other details of the machine illustrated may remain unchanged.

It is finally obvious that the invention is not in any way limited to the embodiments described hereinabove, and that many modifications may be made thereto, particularly as regards the shape, constitution, number, and arrangement of the members participating in its execution, without

departing from the scope of the present application for patent.

I claim:

1. A device comprising four cylinders, the axes of which are substantially parallel and the heads of which are substantially at the same height on said axes, four pistons in said cylinders, four connecting rods, two bent levers the fulcra of which are located in the bends proper and are in fixed relation to said cylinders, each of said bent levers ending on one side in a first arm and on the other side in two second arms, the latter being directed towards said cylinders and occupying positions substantially perpendicular to the axes of said cylinders when said pistons are halfway along their strokes in said cylinders, said connecting rods each being connected by one end to one of said pistons and by the other end to one of said second arms, a crankshaft mounted rotary with respect to said cylinders, two members hinged each at one end to one of said first arms and at the other end being operatively connected to said crankshaft in order to effect rotation of said crankshaft, a third arm on each of said bent levers, and a link member operatively intercon-

necting said third arms of said bent levers to secure coordinated movements thereof.

2. A device according to claim 1, wherein a crankpin is operatively connected to said crankshaft and wherein a member rotatably mounted on said crankpin and having two extensions opposite one another is provided as an operative connecting link between said crankshaft and said other ends of said two hinged members, each of which being hinged to one of said extensions.

3. A device according to claim 1, wherein said link member interconnecting said third arms is arranged on the opposite side of the bend in relation to the ends of said first arms.

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