Oct. 17, 1939. G. PINAZZA 2,176,801

PERCUSSION IMPLEMENT

Filed June 8, 1937

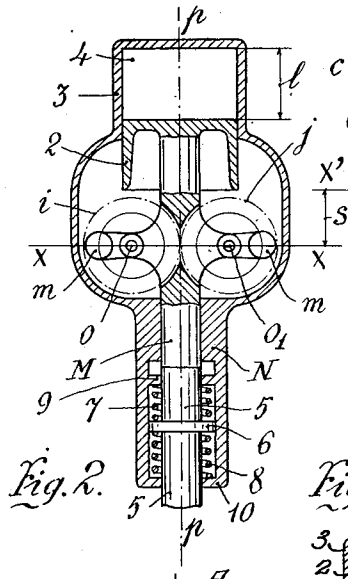


Fig. 2.

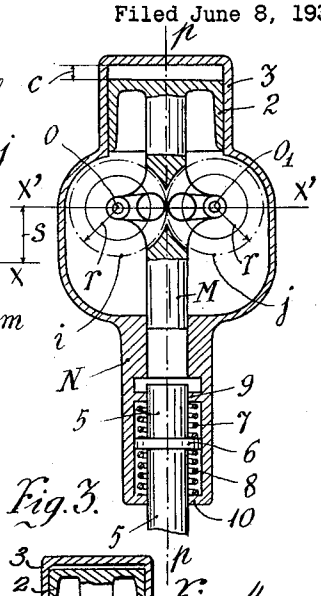


Fig. 3.

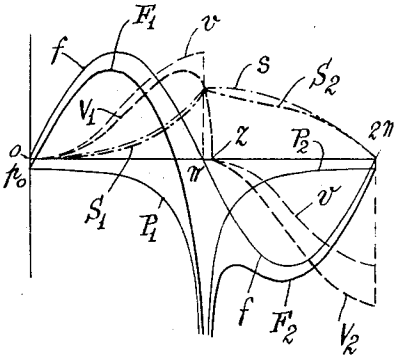


Fig. 1.

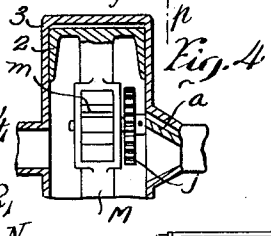


Fig. 4.

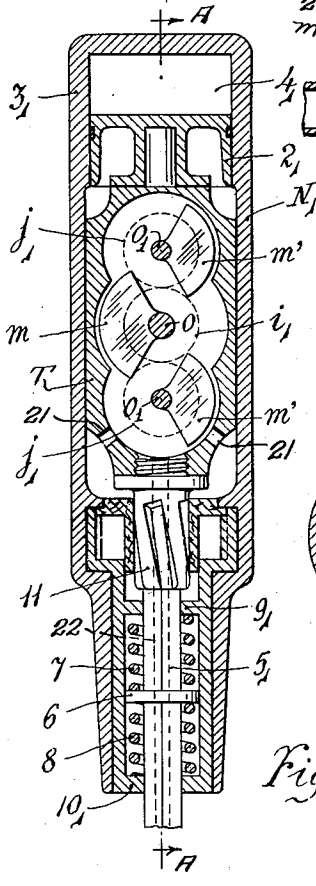


Fig. 5.

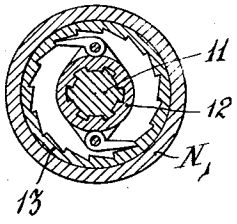


Fig. 7.

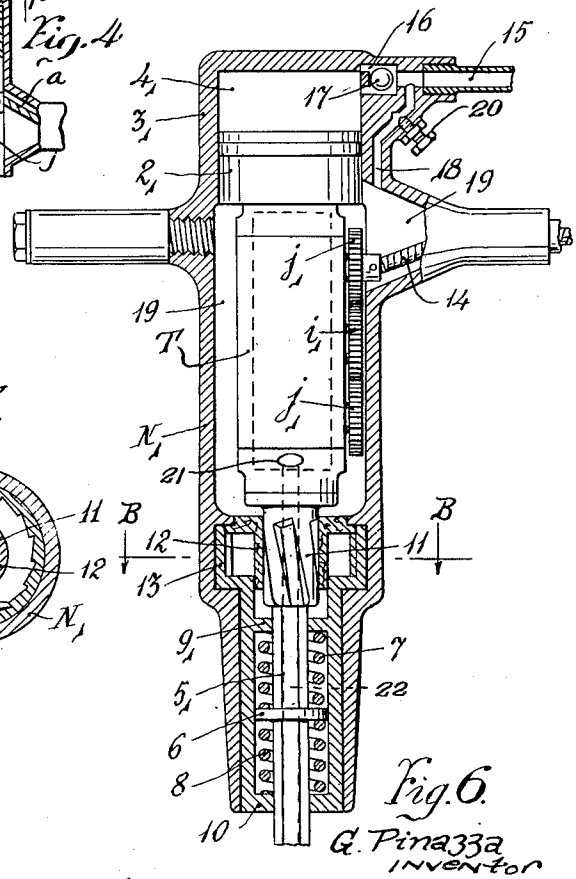


Fig. 6.

G. Pinazza
INVENTOR

By: Glascock Downing & Seebold
Attys

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UNITED STATES PATENT OFFICE

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PERCUSSION IMPLEMENT

Giosuè Pinazza, Milan, Italy

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In Germany June 20, 1936

4 Claims. (Cl. 255—42)

In the percussion tools which are operated by means of the centrifugal forces of suitably arranged masses which rotate with uniform velocity, the strength of the resulting force that acts upon the percussor takes a course equal to a sine curve, so that the percussor with its forward stroke, i. e., when it effects the shock, acquires the same kinetic energy as with the back stroke.

In order to reduce the destroying influence which, in practice, with the end of the back-stroke is exerted by the shock that the percussor effects against the bottom of the casing of the apparatus—an influence which is to be added to the rebound that takes place with the efficient working shock—a shock-absorbing means, in general a spring, is disposed between the said two parts, which shock-absorber is for the purpose of absorbing the kinetic energy and accumulating it in the form of potential or static compression energy.

Although the particular vehemence of the back shock is thus avoided, there still remains, nevertheless, a considerable inconvenience. As the said damping means in its turn supports itself against the bottom of the casing, it exerts upon the bottom a static pressure which has a tendency to press the casing backwards. As long as the worker who is operating the apparatus is in a position to exert an equal or greater counter-force, the casing does not recede; but when the worker is no longer able to resist the said force, the casing falls back. As a consequence, after the first blow the shocks no longer take place at the same moment at which the speed of the percussor passes through its maximum, but with a lag, i. e., when the velocity is already diminishing. As each lag is now added to each preceding lag, the working possibility and the efficiency of the apparatus will finally, after a certain relatively limited number of shocks, fall to practically unserviceable values. As the lag of the apparatus is in inverse proportion to the mass of the casing, this mass could be enlarged, but the apparatus would thus become excessively heavy; and besides, a limited lag would still occur. Therefore in order to remove such inconveniences there would in reality be no other possibility but to reduce the operating force so far that the back shock will become inferior to the force which could be brought up as a counter-effect on the part of the worker, and which amounts to about 50 to 60 kilograms. Taking also into consideration the fact that each spring has a definitive natural period of vibration, by which fact one is forced to choose a frequency of stroke which is smaller than the natural vibration frequency of the spring, it will easily be evident that movable percussion implements of this kind in their present state could render only very restricted services and would extraordinarily fatigue the worker who operates such apparatus.

The object of the present invention is to provide percussion apparatus in which the above-mentioned inconveniences are entirely removed, and in which therefore operating forces could be applied which are even higher than the counter-force which the worker could produce, and this without therefore being compelled to increase the weight of the apparatus and, in which, moreover the frequency of stroke could be brought up to a very high value. Furthermore, by the help of the present invention, it is possible to regenerate a particularly large part of the energy which is accumulated in the damping means with the return stroke, and, finally, a long active stroke of the percussor is obtained, that means a corresponding increase of its kinetic energy.

The invention consists essentially in the feature that the casing at its posterior part, by means of a compressed gas chamber, that is, a chamber into which a suitably compressed gas is filled, finds itself in communication with the posterior part of the percussor. Similarly at the front part, that is, at the percussion end, a conveniently fixed elastic means is inserted between the casing and the tool, which is meant for taking up the shock, the said means being designed to return both the said elements into one and the same position relative to each other at the end of each stroke. In this way the desired result, that is, the fact that the frequency of the stroke could be increased at will, is obtained, because the cushion of air has no period of natural vibration, and because the lag will every time be compensated with every stroke before the retrogression which is caused by the next stroke occurs.

In the accompanying drawing two examples of embodiments of the invention are shown.

Figure 1 shows diagrammatically the manner of working of the apparatus;

Fig. 2 is a side sectional view of one embodiment of the invention showing the percussor in striking engagement with the tool;

Fig. 3 is a view of the same embodiment of the invention similar to Fig. 2, but showing the percussor in the retracted position;

Fig. 4 is a fragmentary sectional view of the same embodiment, taken at right-angles to Fig. 3;

Fig. 5 is a side sectional view of another em-

bodiment of the invention showing the percussor in striking engagement with the tool;

Fig. 6 shows a section along line A—A of Fig. 5;

Fig. 7 shows a section along line B—B of Fig. 6.

The invention comprises not only the principal inventive idea but also the details of the relative conformation.

In the embodiment illustrated in Figures 2 to 4, two equal masses m are rotating with constant speed and with a movement which is entirely symmetrical in relation to the percussion axis p—p, the symmetrical movement may be obtained for instance with the help of corresponding toothed wheels i, j driven, for example, by a flexible shaft a. The said masses revolve on circumferences of radius r around the shafts O, O_1, which are carried by a percussor M, that can move freely within a casing N. Should there be a greater number of gyrating masses, these could always be regarded as equivalent to two masses, rotating under the said conditions. As is well known, the rotating masses, under the condition explained above, develop an alternating resultant force, the intensity of which varies according to a sine curve, which is represented by the curve f in Figure 1. The speed which the percussor obtains is represented by the curve v. At the moment at which the shock takes place, and at the moment of the rebound against the bottom of the casing, this speed suddenly becomes equal to zero. The curve s represents the path traversed by the percussor, the total path being given by the distance S between the two positions (x—x in Fig. 2 and x'—x' in Fig. 3) of axes drawn across the centres of rotation.

According to the invention, the percussor M is provided at its backward end with a piston **2**, which glides in a fluid-tight manner in a cylinder **3**. The end of this cylinder, which is disposed at the posterior end of the gear casing, is at a distance l (Fig. 2) from the position which the surface of the piston occupies at the beginning of the stroke. This distance l is longer by the amount c than the total piston stroke S. As the piston effects its return stroke, the gas or air which is filled into the chamber **4** with an initial pressure p_o will be compressed, wherefrom a counter-force is produced, the intensity of which may be represented by the curve P_1 in Fig. 1. The force that acts upon the percussor will be the algebraic sum of the values f and P_1, which sum is given by the curve F_1. By this force the movement of the percussor is gradually retarded so that the speed no longer follows the curve v, but the curve V_1.

At the moment when the masses attain the position x'—x' as shown in Fig. 3, the percussor has still a certain speed, which will be braked by the further compression of the gas which fills the chamber **4** and by the reversal of the resulting centrifugal forces. At the point z (Fig. 1, beyond the point π, a stationary state will be reached, so that the return stroke will last more than half a period, while the duration of the forward stroke will be correspondingly reduced. The result of this is that the travel is brought to a maximum, and that at the same time the velocity of the subsequent forward stroke will be increased from v to V_2.

In the following forward stroke the active force F_2 is the algebraic sum of the forces f and P_2, where P_2 denotes the expansion energy of the gas in the cylinder **3**.

The distance covered during the forward stroke and the return stroke is represented by the curves S_1 and S_2.

Obviously the retardation π—z is a function of the initial pressure P_o of the gas contained in the cylinder **3**; hence it is possible to regulate one of these values by conveniently adjusting the other. It is important to make the retardation as great as possible without varying the total duration of the cycle.

So far as the resilient cushion between the fore part of the percussor and the posterior part of the tool **5** is concerned, this cushion in the present instance is simply formed by two loaded springs **7** and **8**, which bear at one end against the opposite side of a ring **6**, which is provided at the foot of the tool **5**, and at the other end against shoulders **9** and **10** provided in the prolongation of the casing N, which carries the tool. These two springs work against one another and continually bring the casing back into the same position relative to the tool, as the tool, when it receives the shock from the percussor M, acts by means of its ring **6** upon the spring, and thus takes the casing along in the same direction. In this way the casing, at the beginning of the counter-effect which the gas exerts during the following return stroke, will always find itself in the same initial position. By conveniently choosing the dimensions and the initial charge of the respective springs in relation to the moving means, the effect of the spring can be made absolutely perfect.

In the example of embodiment shown in Figs. 5 to 7, three single masses have been employed, namely a mass m_1 in the middle and two masses m' respectively above and below the middle one, whereby all the axes of rotation are parallel to one another and at right angles to the percussion axis. The masses are connected with one another by means of the toothed wheels i_1 and j_1, one of which is driven by means of a flexible shaft **14**. Here, moreover, means are provided for obtaining a turning motion of the percussor, namely by means of helical grooves **11**, which act upon a muff **12**. This latter, in its turn, acts in a known manner only in one direction upon a tool rest **13**. In this case the head 5_1 of the tool is not circular but rather of a polygonal form.

The compressed gas is admitted into the chamber 4_1 through a conduit **15**, which opens into the chamber through a duct **16**. This latter is controlled by a valve **17**. The duct **15** has a branch **18**, which leads to a chamber **19**, within which the percussor T runs. The cross-section of the branch conduit **18** can be regulated by control means, e. g., a screw **20**. The degree of compression produced in the chamber 4_1 depends on the cross-section of the conduit **18**. In effect, when this cross-section is large the gas arriving through conduit **15** can easily escape through conduit **18** and consequently the pressure of the gas in conduit **15** decreases and the gas is admitted under reduced pressure into chamber **4**. If on the other hand the cross-section of conduit **18** is small the gas arriving through conduit **15** can hardly escape through conduit **18** and consequently the pressure in conduit **15** increases and the gas is admitted under high pressure into chamber **4**.

The gas which passes through the duct **18** can be employed for cleaning the point of the tool. For this purpose holes **21** are provided in the percussor, through which holes the gas passes from the chamber **19** to the interior of the percussor, and from there, through a duct **22** in the

helical grooves 1_1 and the head 5_1 of the tool, to the point of the tool.

The chamber 4_1 in which the piston 2_1 slides is arranged as in the previous case in the rear end 3_1 of the casing N_1 of the apparatus.

What I claim is:

1. A percussion implement comprising in combination a casing; a percussor slidable axially in said casing; eccentric weights rotatably mounted on said percussor and adapted to impart a reciprocatory motion to said percussor by their centrifugal forces; a tool axially slidable in the front part of said casing and actuated by said percussor; and means comprising: a hollow cylinder at the rear part of said casing, a piston secured to the rear end of said percussor and adapted to slide in said cylinder and means for supplying gas to said cylinder so that the gas in said cylinder always has the same pressure at the beginning of every compression stroke, and resilient means connecting said tool to said front part of the casing; whereby the energy of said percussor in its backward stroke is momentarily stored and then returned to said percussor in the next, forward stroke of the latter to supplement the energy imparted to said percussor by said weights, the total energy is transmitted to said tool by said percussor at the impact and part of said total energy is expended by said tool through said resilient means in order to return said casing to its initial position.

2. A percussion implement comprising in combination a casing; a percussor slidable axially in said casing; eccentric weights rotatably mounted on said percussor and adapted to impart a reciprocatory motion to said percussor by their centrifugal forces; a tool axially slidable in the front part of said casing and actuated by said percussor; and means comprising: a hollow cylinder at the rear part of said casing, a piston secured to the rear end of said percussor and adapted to slide in said cylinder and means for supplying gas to said cylinder so that the gas in said cylinder always has the same pressure at the beginning of every compression stroke, and resilient means connecting said tool to said front part of the casing and constantly tending to return said tool and said front part of the casing to the same relative positions; whereby the energy of said percussor in its backward stroke is momentarily stored and then returned to said percussor in the next, forward stroke of the latter to supplement the energy imparted to said percussor by said weights, the total energy is transmitted to said tool by said percussor at the impact and part of said total energy is expended by said tool through said resilient means in order to return said casing to its initial position.

3. A percussion implement comprising in combination a casing; a percussor slidable axially in said casing; eccentric weights rotatably mounted on said percussor and adapted to impart a reciprocatory motion to said percussor by their centrifugal forces; a tool axially slidable in the front part of said casing and actuated by said percussor; and means comprising: a hollow cylinder at the rear part of said casing, a piston secured to the rear end of said percussor and adapted to slide in said cylinder and means for supplying gas to said cylinder so that the gas in said cylinder always has the same pressure at the beginning of every compression stroke, and resilient means connecting said tool to said front part of the casing, said resilient means consisting of two loaded counter-acting springs; whereby the energy of said percussor in its backward stroke is momentarily stored and then returned to said percussor in the next, forward stroke of the latter to supplement the energy imparted to said percussor by said weights, the total energy is transmitted to said tool by said percussor at the impact and part of said total energy is expended by said tool through said resilient means in order to return said casing to its initial position.

4. A percussion implement comprising in combination a casing; a percussor slidable axially in said casing; eccentric weights rotatably mounted on said percussor and adapted to impart a reciprocatory motion to said percussor by their centrifugal forces; a tool axially slidable in the front part of said casing and actuated by said percussor; resilient means connecting said tool to said front part of the casing; a hollow cylinder at the rear part of said casing; a piston secured to the rear end of said percussor and working in said cylinder; means for supplying gas under pressure to said cylinder; means for supplying the gas under pressure to said tool for cleaning purposes; and means for regulating the pressure at which gas is admitted in the said cylinder consisting of means for controlling the cross-section for the passage of the compressed gas to the said tool; said resilient means so co-operating with said piston and said cylinder that the energy of said percussor in its backward stroke is momentarily stored and then returned to said percussor in the next, forward stroke of the latter to supplement the energy imparted to said percussor by said weights, the total energy is transmitted to said tool by said percussor at the impact and part of said total energy is expended by said tool through said resilient means in order to return said casing to its initial position.

GIOSUÈ PINAZZA.