Dec. 21, 1937. G. PINAZZA 2,102,603

PERCUSSION APPARATUS

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Fig. 1.

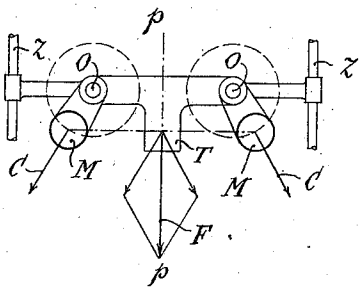


Fig. 2.

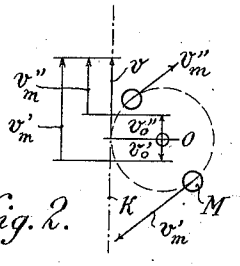


Fig. 9.

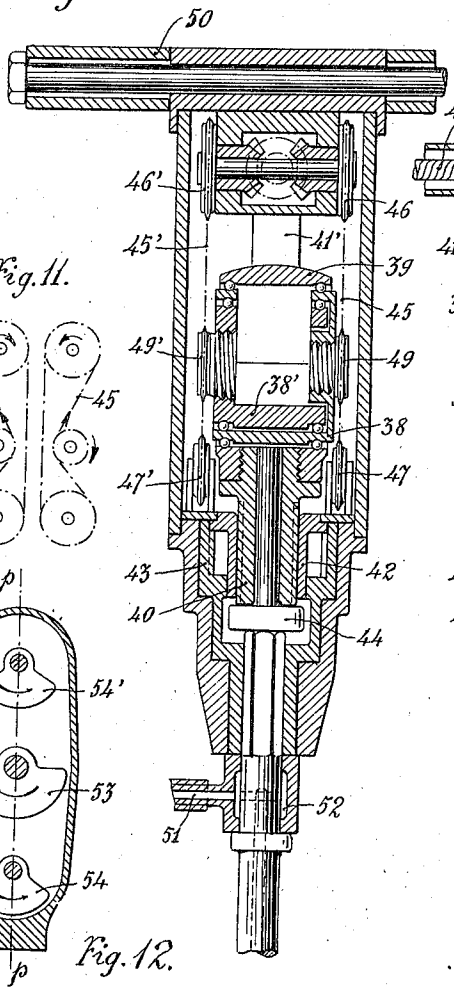


Fig. 10.

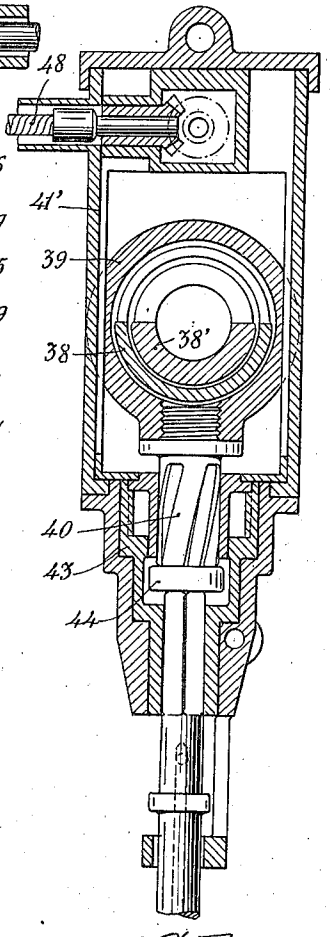


Fig. 11.

Fig. 12.

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Fig. 3.

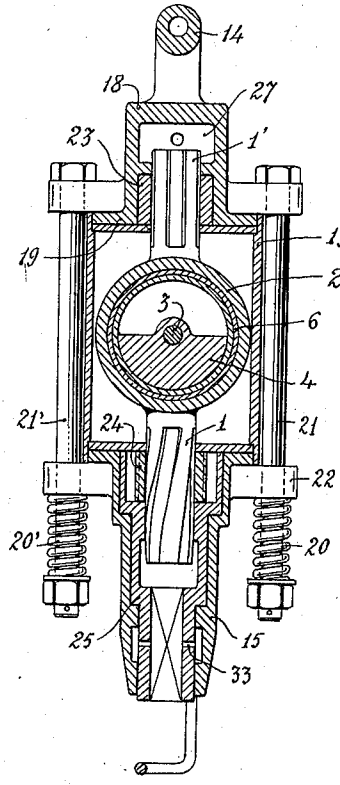


Fig. 4.

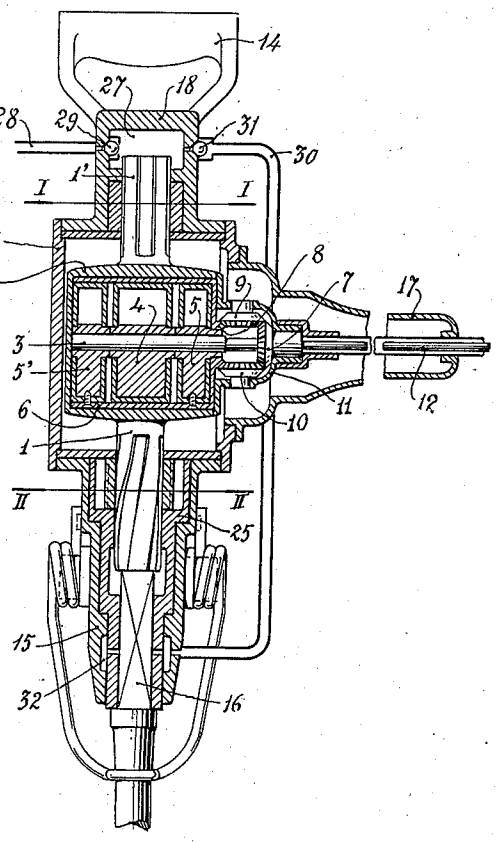


Fig. 7.

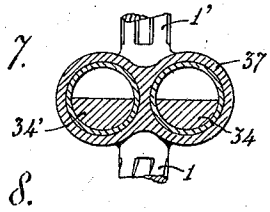


Fig. 8.

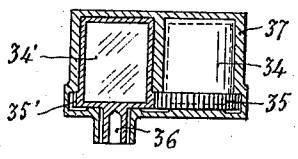


Fig. 5.

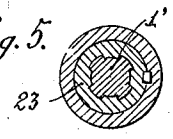
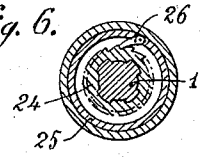


Fig. 6.



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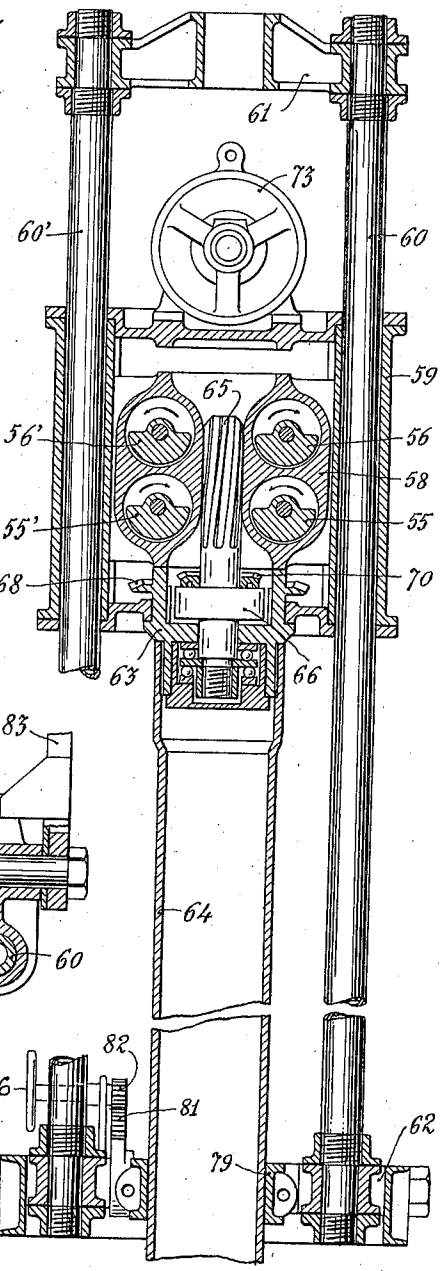
By: Mascock Downing & Seebold ATTYS.

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Fig. 13.



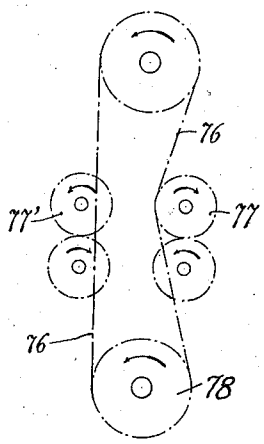


Fig. 16.

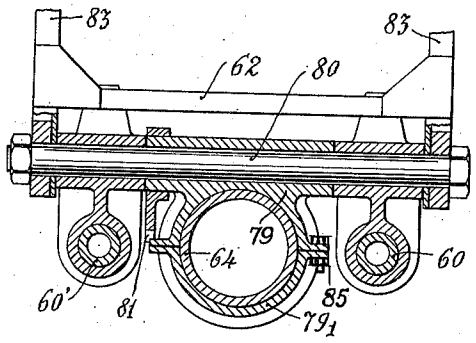


Fig. 15.

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Fig. 17

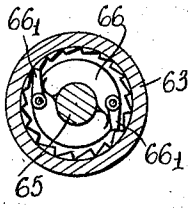
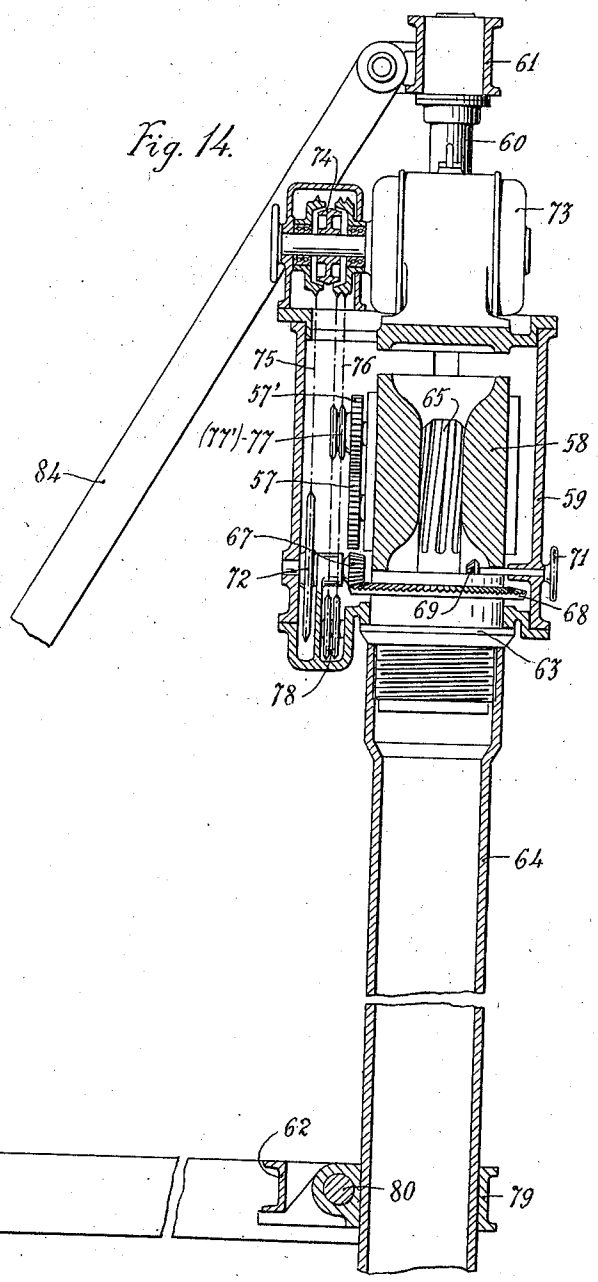


Fig. 14.



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UNITED STATES PATENT OFFICE

2,102,603

PERCUSSION APPARATUS

Giosuè Pinazza, Milan, Italy

Application February 8, 1936, Serial No. 63,035
In Italy February 16, 1935

6 Claims. (Cl. 255—42)

This invention relates to improvement in percussive apparatus (such as mechanical hammers, chipping and perforating hammers, riveters, rams for pile driving or boring) of the type in which a striking element of the apparatus is oscillated by the centrifugal action of eccentric weights revolubly mounted on the striking element.

The present invention has the object of supplying by equality of weight and mean speed of rotation, a better utilization of the energy supplied to the apparatus, by eliminating or at least reducing to a minimum all disturbance in the constituent parts, that is to say all efforts as well as all movements which are not essentially necessary.

According to the invention the desired effect is obtained by arranging the eccentric weights in such a way that their centres of gravity all move in the same plane, the actual plane of the percussion axis, whereby no bending or twisting tendencies act upon the parts, and simultaneously giving to the eccentric weights a periodic variable rotation during each revolution, in such a manner that the striking element possesses a small kinetic energy at the end of the return stroke and a large kinetic energy at the end of the active stroke.

In order that the invention may be more clearly understood, reference is hereinafter made to the accompanying drawings, wherein:

Figure 1 shows diagrammatically the arrangement of the weights in the apparatus according to the invention and their mode of operation.

Figure 2 shows diagrammatically the mode of operation of a detail of the invention.

Figure 3 represents a first embodiment of the invention in longitudinal section.

Figure 4 represents the same form of embodiment in longitudinal section at right angles to that of Figure 3.

Figure 5 is a section of the same embodiment along the line I—I of Figure 4.

Figure 6 is a section of the same embodiment along the line II—II of Figure 4.

Figure 7 represents a modification of the examples of Figures 3–6 in section similar to that of Figure 3.

Figure 8 represents the same modification in plan and partly in horizontal section.

Figure 9 represents another form of the invention in longitudinal section.

Figure 10 represents the same form of embodiment in longitudinal section at right angles to that of Figure 9.

Figure 11 shows diagrammatically a detail of the form of embodiment of Figures 9 and 10.

Figure 12 represents a modification of the embodiment of Figures 9 and 10, in diagrammatic and longitudinal section similar to that of Figure 10.

Figure 13 represents another form of embodiment of the invention in elevation and partly in section.

Figure 14 represents the same example also in elevational section with a view at right angles to that of Figure 13.

Figure 15 represents a horizontal section of the same example.

Figure 16 shows diagrammatically a detail of the same embodiment.

Figure 17 shows another detail of the same embodiment.

The devices shown in Figures 3 to 12 are given as examples of small tools or hammers; those of Figures 13 to 17 as examples of large machines; the whole to show the vast field of application of the invention.

Referring to Figure 1, *p—p* represents the percussion axis which coincides with the direction of oscillation. The invention provides essentially two weights M, M (true weights or resultants of an aggregation of weights), which rotate eccentrically in one and the same plane containing the axis of oscillation *p—p*, around the axes O, O which connect with a striker T adapted to freely slide in guides Z—Z parallel to the direction of oscillation *p—p*. The weights M, M rotate with the same instantaneous speed symmetrically with respect to the axis *p—p* and have the same moment about the respective axes. Their centrifugal forces combine to form a resultant F which coincides with the direction of oscillation *p—p*. The fact of the trajectories traversed by the masses being in the same plane, eliminates all bending and twisting, which, not occasioning any useless tendency in the parts, permits the best possible utilization of the material thereof.

To obtain the desired effect it is not necessary that the masses should be actually two in number, they may be of any greater number, provided they form the two resultant masses complying with the conditions defined above. In the embodiments illustrated there are various arrangements but other arrangements can obviously be devised within the scope of the invention.

In the example of the hammer illustrated in Figures 3 to 6, the striker comprises a shaft 1—1'

sliding, but prevented from rotating, and a hollow body **2** in which is mounted a transverse spindle **3**, forming the axis of rotation of the masses, the latter being two in number: the one **4** in the centre, and the other divided into two halves **5**, **5'**, placed on either side of the first but rigidly connected together with a cylindrical casing **6**. These masses all have the same profile, but that in the middle **4** has a thickness double that of each of the two lateral halves **5**, **5'**. The central mass is fixed on the shaft **3**, while the other mass **5—6—5'** rotates idly on this shaft. The centre of gravity of the mass **4** and that of the mass **5—6—5'** rotate in a single plane in opposite directions with the same angular speed, and the masses are driven in such a way that the said centres of gravity are at every instant in the symmetrical positions referred to above. The equal and opposite rotation of the masses is obtained by means of bevel-gears **7**, **8**, **9**, **10** mounted on the hub **11** of the body **2**. Spindle **3** is coupled directly to a flexible driving shaft **12**. Said shaft can also be coupled to one of the planet-gears **9**, **10**.

The striking member moves axially within a frame **13** closed by end covers. One of these is provided with a grip handle **14** and the other having a sleeve **15** for guiding the bit **16**. A shroud **17** protects the gears and the shaft chuck **12**.

In the forward stroke, the striker strikes the bit; in the return stroke it strikes a bottom end of cover **19**; these blows are attenuated by the springs **20**, **20'** mounted on the rods **21**, **21'** fixed to the cover **19** and bearing against a cross bar **22** of the sleeve **15** and respective cover.

Part **1'** of the striker is provided (see Figure 5 which is a section along I—I of Figure 4) with longitudnally straight slots which slide in corresponding ones in the fixed hub **23**, preventing the striker turning about its axis.

This embodiment of a hammer provides also for the rotation of the bit. To this object part **1** is provided with helical screw threads of large pitch with which co-operates a corresponding screw-threaded part on a bushing **24**. The bushing **24** is provided externally with ratchet teeth in which engages a pawl **26** carried by a second bushing **25** surrounding the bushing **24**, which is prevented from being axially displaced; the tool or bit is fixed in the bushing **25**. When the part **1** oscillates axially, the bushing **24** rotates alternatively due to the screw threads in opposite directions: in one direction it has no action on the pawl **26** and therefore the bushing **25** and the tool remain stationary, while in the opposite direction of rotation it acts on the pawl and drives the bushing **25** and the tool in its rotation.

The return stroke can also be utilized to provide for the circulation of a washing and/or lubricating fluid. In the example given it is a matter of providing a stream of fluid flowing through the bit to expel all dust from the hole. Part **1'** of the striker acts as a piston for pumping into a chamber **27** of the cover **18**: the liquid enters by duct **28** through a valve **29** and passes to the bit by a pipe **30** through valve **31**. The water enters the bit through a chamber **32** and radial ducts **33** of bushing **25**. The pipe **30** can be incorporated in the housing.

According to the alternative shown in Figures 7 and 8, the masses **34**, **34'**, exactly equal moments, rotate on parallel axes, arranged crossways to the centre line **1—1'** and at equal distance from the same. The two masses revolve symmetrically, being coupled together by gears **35**, **35'**, the latter being the driving element from the flexible driving shaft **36**. The housing for the two masses being of bi-lobular shape.

The example of Figures 9–11 shows another arrangement of the masses according to the invention, and further a specially designed mechanism provided in the apparatus for obtaining the variable rotation of the masses according to the invention, in such a way that the return stroke may have little or no energy and therefore occasion no loss of energy. This feature is obtained by actuating the weights by means of one or more chains which move with a uniform movement upon toothed wheels fixed to the frame and which mesh with toothed wheels fixed to the weights. The direction of movement of these chains is the same at the point where it meshes with the toothed wheels of the weights, as the direction of translation of the return stroke of the striker. As will be seen from the diagram in Figure 2 if v is the constant speed of the chain K, the peripheral speed of the mass, and consequently the centrifugal force, is greater (v'_m) or less (v''_m) than v, accordingly as the centre O is displaced with a speed having a contrary direction (v'_o) or the same direction (v''_o) respectively as v.

In the embodiment illustrated in Figures 9 to 11, the weights are arranged coaxially and the one within the other in a supporting body **39** forming the striker and therefore provided with a stem **40**. The common axis of rotation is at right angles to the striker's centre-line. The body **39** is prevented from rotating by the uprights **41**, **41'** of the frame, whilst the striker **40** causes the bit to rotate in a similar way as in the preceding embodiment with reference to Figures 3 and 4, by means of the helically slotted arrangement, bushing **42** is provided with the pawl and counter-bushing **43** is provided with the ratchet teeth. The head of the striker is interchangeable and eventually is shaped as a mushroom **44** whose stem is inserted in the axial bore of the striker.

The motion is impressed to the masses by chains **45**, **45'** (Figures 9 to 11), which mesh with toothed driving wheels **46**, **46'**, and **47**, **47'** and a self chain-tightener of known construction, all fixed to the frame. The wheels **46**, **46'** are controlled by a driving shaft **48**, through bevel-gears or other means. With said chains are meshing respectively two toothed wheels **49**, **49'**, one fixed to mass **38** and the other to mass **38'** to which they impress the oppositely rotating motion.

The device is provided with a handle **50**. The washing away of the bit's work is obtained through a separate feed-pipe **51** which enters a chamber **52** around the bit.

In the embodiment Figure 12, the masses are three in number, **53**, **54**, **54'**, arranged on parallel axes at right angles with the striking centre-line p—p. The centre mass **53** with regard to the rotational axis has a turning moment double that of one of the other two masses **54**, **54'**, (which are equal to one another) and revolves in opposite direction to the latter, by means of a gear or chain drive.

The embodiment according to Figures 13 to 16 shows a large ram for driving in the ground piles or hollow bits or pipes for casting directly in concrete, to build piles in the ground.

In this machine the masses are four in number

and are indicated at 55, 55', 56, 56', all equal and arranged in pairs in two stages and connected by gears 57, 57'. The two masses of each set rotate symmetrically in opposite directions with respect to the axis of percussion. Each mass of the lower set has a direction of rotation which is contrary to that of the mass located above it in the upper set. During rotation the masses of the upper set produce an axial force which is identical at any instant with that produced by the two masses of the lower set; for this purpose all the masses simultaneously reach the lowest position shown and then the highest position at 180° with respect to this position. Said masses are mounted in a striking body 58 axially slidable but incapable of rotating, in a body 59 sliding in its turn on two upright guides 60, 60' in the shape of columns, frame-connected by a bolster-bar 61 at the top and a similar bar 62 at the bottom.

The striking body 58 strikes a head 63 going through the bottom of body 59 which is rotatable in opposite directions: said head has an outer worm to engage with the mouth piece of the bit 64, solid or hollow to be driven in the ground.

Whilst being driven in, the bit is also moved rotatively, by similar means to those specified above, viz. an axially rotatable shaft 65 is provided with the male thread and the cylindrical body 58 with the female thread; the alternating movement without rotation of the body 58 impresses on the shaft 65, due to the threaded arrangement, alternating rotation. The shaft 65 carries rigidly a bushing 66 (Figure 17) provided with pawls 66, which engage with ratchet teeth of a second bushing 63 surrounding the first. In one direction of rotation the bushing 66 drives, by means of the pawls, the bushing 63 and the tool 64 connected to it. In the opposite direction the pawls slide over the ratchet teeth and the bushing 63 does not rotate.

The screwing and unscrewing are operated by means of a gear 67 engaging a circular-rack 68 of the head 63, whilst a gear 69, engaging circular-rack 70 of body 66, dis-engages the pawls. Gear 69 is controlled by hand wheel 71, whilst gear 67 is driven by a chain wheel 72.

A motor 73 provides the power to the mechanism. It is mounted over the body 59. By means of a double clutch 74 said motor can control alternatively either gear wheel 72 by means of chain 75, or by chain 76 on wheel 77 driving the masses. This chain can be arranged as shown in Figure 16 and is tightened by automatic tighteners provided with wheels 78.

The bit 64 is guided at the bottom by a sleeve formed in two halves 79 and 79_1 held together with bolts 85 and adapted to be opened when desired, which sleeve is rotatably mounted on the shaft 80. This sleeve is provided with a toothed sector 81, in which engages a toothed pinion 82 actuated by a fly-wheel 86. By actuating this fly-wheel the sleeve 79—79_1 can be brought into a vertical position or into a horizontal position as shown. Operation is as follows: when brought into vertical position, the half 79_1 is lifted off, the bit 64 is placed horizontally in its interior, the half 79_1 is again applied while gripping the bolts in such a way that the bit may slide. Then it is brought into the horizontal position shown in which it guides the downward movement of the bit. When the latter is almost completely covered, the half 79_1 is again lifted off and the sleeve is again brought into the vertical position; thereby permitting another section of the bit to be mounted.

The frame is kept in an upright position by longitudinal trusses 83 applied to the ground and by uprights 84 which bind them to the upper transverse bar 61.

What I claim is:

1. A percussive apparatus of the character described, comprising a striking element, means for supporting said striking element for alternating oscillatory motion and preventing rotation thereof, eccentric bodies rotatably disposed on said striking element and having their centres of gravity moving in the same plane comprising the axis of percussion in opposite directions symmetrically with respect to said axis of percussion, and means for imparting to said bodies a periodic variable rotation during each revolution, progressively accelerated during the active stroke and progressively retarded during the return stroke of said striking element.

2. A percussive apparatus of the character described, comprising a striking element, means for supporting said striking element for alternating oscillatory motion and preventing rotation thereof, eccentric bodies rotatably disposed on said striking element and having their centres of gravity moving in the same plane comprising the axis of percussion in opposite directions symmetrically with respect to said axis of percussion, and means for imparting to said bodies a periodic variable rotation during each revolution, progressively accelerated during the active stroke and progressively retarded during the return stroke of said striking element, said latter means including toothed wheels rigidly secured to said bodies, toothed wheels carried by said supporting means, motive means imparting a uniform rotation to said latter toothed wheels, chains engaging with said toothed wheels, the direction of motion of the chains at points where they mesh with the toothed wheels secured to the bodies being the same as the direction of motion of the return stroke of the striking element.

3. A percussive apparatus of the character described, comprising a striking element, means for supporting said striking element for alternating oscillatory motion and preventing rotation thereof, two eccentric bodies having equal static moments and rotatably disposed one inside the other around one and the same axis of rotation perpendicular to the axis of percussion in said striking element, and having their centres of gravity moving in the same plane comprising the axis of percussion in opposite directions symmetrically with respect to said axis of percussion, and means for maintaining said bodies in rotation.

4. A percussive apparatus of the character described, comprising a striking element, means for supporting said striking element for alternating oscillatory motion and preventing rotation thereof, two eccentric bodies having equal static moments and rotatably disposed along one and the same axis of rotation perpendicular to the axis of percussion, one of these bodies being divided into two halves rigidly connected together and arranged on both sides of the other body arranged in the centre, and the two bodies having their centres of gravity moving in the same plane comprising the axis of percussion in opposite directions symmetrically with respect to said axis of percussion, and means for maintaining said bodies in rotation.

5. A percussive apparatus of the character described, comprising a striking element, means for

supporting said striking element for alternating oscillatory motion and preventing rotation thereof, three eccentric bodies rotatably disposed about axes parallel to one another and intersecting at right angles the axis of percussion, all such bodies having their centres of gravity moving in the same plane comprising the axis of percussion, the middle component of weight of said bodies having a static moment twice as great as that of each of the other two bodies and revolving symmetrically with respect to the axis of percussion as regards the second component of weight resulting from the other two bodies and means for maintaining said bodies in rotation.

6. A percussive apparatus of the character described, comprising a bit, a striking element, means for supporting said striking element for alternating oscillatory motion and preventing rotation thereof, eccentric bodies rotatably disposed on said striking element and having their centres of gravity moving in the same plane comprising the axis of percussion in opposite directions symmetrically with respect to said axis of percussion, means for maintaining said bodies in rotation, a helically threaded surface pertaining to the said striking element, a member in the form of a sleeve connected to the bit, a second member presenting a surface with helicoidal grooves fitting in the surface with helicoidal grooves pertaining to said striking element, and connecting means between the two said members, said connecting means being constituted by pawls pertaining to one of the said members and a groove pertaining to the other of said members.

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