M. J. BURKEL AND L. P. FOSNOT.

ENGINE OR MOTOR.

APPLICATION FILED JAN. 4, 1918.

1,326,476.

Patented Dec. 30, 1919.

3 SHEETS—SHEET 1.

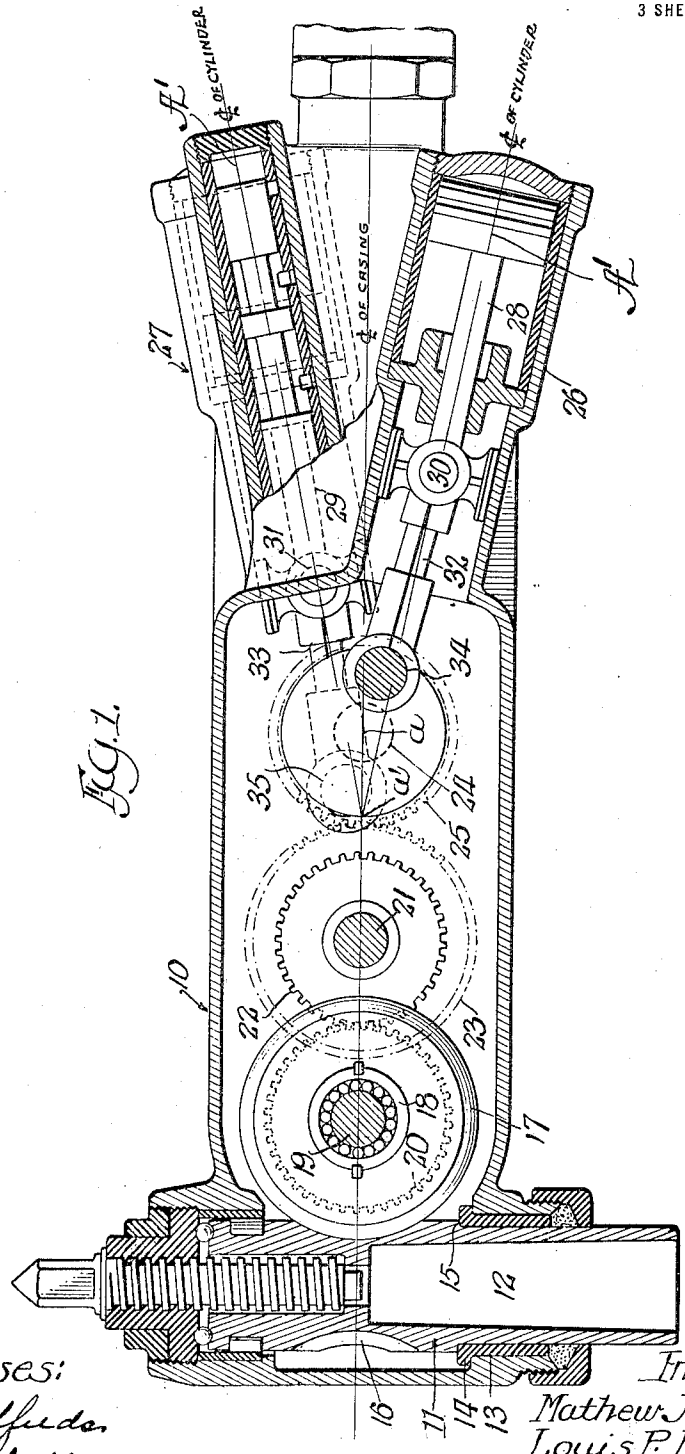


FIG. 1.

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Fig. 2.

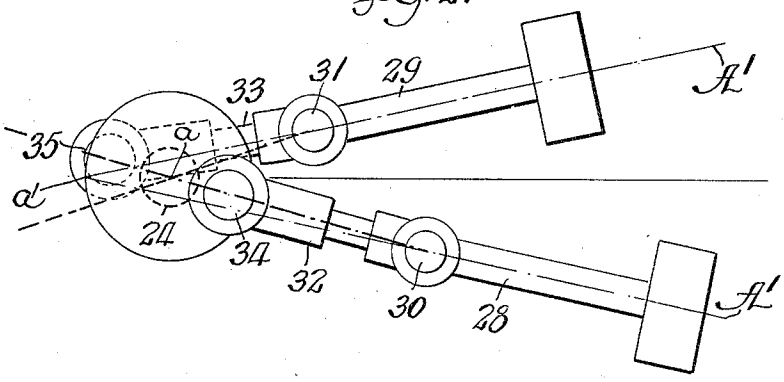


Fig. 3.

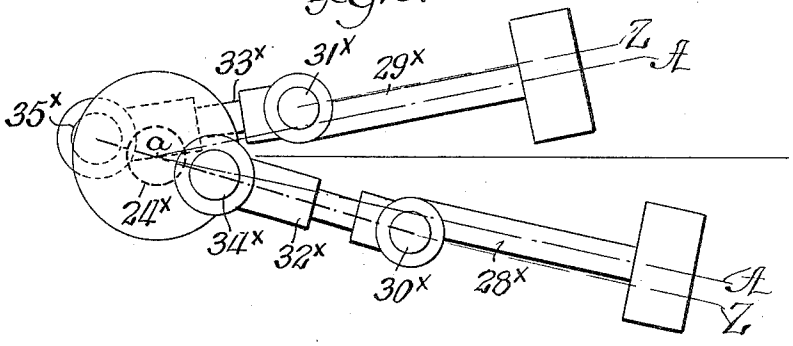
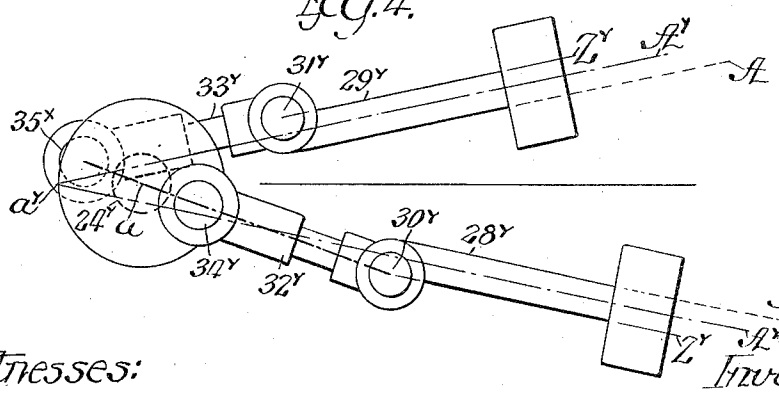


Fig. 4.



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3 SHEETS—SHEET 3.

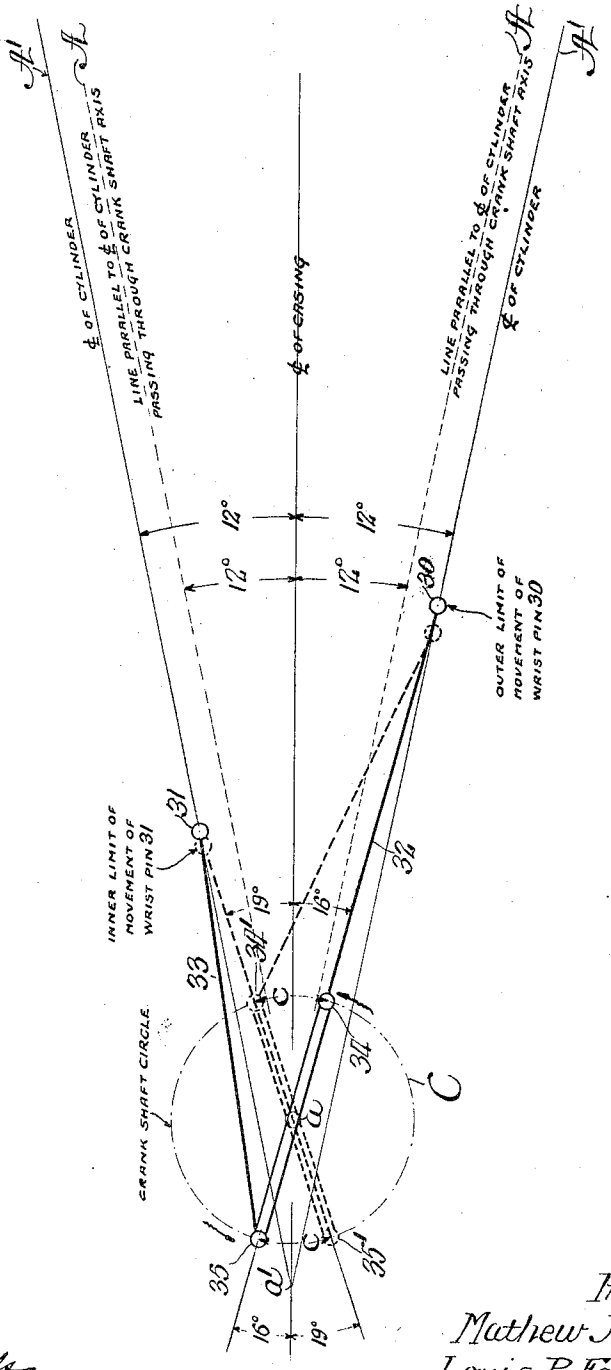


Fig. 5.

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UNITED STATES PATENT OFFICE.

MATHEW J. BURKEL AND LOUIS P. FOSNOT, OF AURORA, ILLINOIS, ASSIGNORS TO CLARENCE E. MEHLHOPE, TRUSTEE, OF WINNETKA, ILLINOIS.

ENGINE OR MOTOR.

1,326,476. Specification of Letters Patent. **Patented Dec. 30, 1919.**

Application filed January 4, 1918. Serial No. 210,292.

To all whom it may concern:

Be it known that we, MATHEW J. BURKEL and LOUIS P. FOSNOT, citizens of the United States, and residents of Aurora, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Engines or Motors; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improvement in engines or motors primarily intended for use with pneumatic drilling machines, but is in no way limited to such use, and consists of the matters hereinafter described and more particularly pointed out in the appended claims.

The improved engine as illustrated herein, is embodied in a pneumatic tool generally known to the trade as a "close quarter drill" and is of the type described in an application filed by Mathew J. Burkel and Paul B. Weis on May 17, 1916, Serial Number 98,017. In consists essentially of a two-cylinder, reciprocatory, engine unit,—the two cylinders having their axes arranged in planes at an acute angle and with their pitmen connected to crank pins placed diametrically opposite to each other.

The object of the invention is to provide a construction in which the angle by which the piston of one cylinder is in advance of the piston of the other cylinder in respect to the dead centers of their respective crank pins, is greatly increased, without increasing the angle between the planes of the cylinders.

The advantages of the invention will appear as we proceed with our specification.

In the drawings:

Figure 1 is a view representing in longitudinal central section, a close quarter drilling machine of the type hereinbefore referred to, provided with a two-cylinder, reciprocating engine unit embodying our invention.

Fig. 2 is a view diagrammatically illustrating the invention as shown in Fig. 1.

Fig. 3 is a similar view illustratng diagrammatically the invention when the construction is somewhat modified.

Fig. 4 is a diagrammatic view illustrating another modified construction.

Fig. 5 is a view representing a diagram illustrating the features of the invention.

In the illustrations of the invention as applied herein,—10 indicates the body of a drilling machine of the type described in the hereinbefore referred to application. 11 indicates a spindle having bearing in one end of the casing with the usual socket 12 to receive the shank of a drill. A sleeve 13, fixed in a socket in the bottom of the casing, provides bearing for the lower length of the spindle and a radial flange 14 at the top of said sleeve provides thrust bearing for a radial shoulder 15 formed on the spindle 11.

Intermediate its length, the spindle 11 is provided with longitudinal teeth 16 which are engaged by a worm 17, mounted in the casing with its axis at right angles to the axis of the spindle and to the axis of the casing. The said worm is of considerably greater diameter than the gear provided by the teeth 16 on the spindle 11 and the thread of the worm approximates a right angle to the rotative axis of said worm. The worm 17 is fixed on a sleeve 18 which is rotatively mounted on a shaft 19 which extends transversely through the casing. On one end of the sleeve 18 is formed an integral spur gear 20.

A second transverse shaft 21 is mounted in bearings in the casing near the first named shaft and in parallel relation thereto. The shaft 21 has a spur gear 22 made integral with it at one end while a spur gear 23 indicated in dotted lines in Fig. 1, is fixed to the shaft 21 near the other side of the casing.

24 indicates a crank shaft arranged parallel to and in the plane of the shaft 21 with its bearing ends journaled in the side walls of the casing. A gear 25 fixed to one end of said crank shaft, meshes with the gear 23 on the shaft 21. Thus it will be apparent that the rotation of the crank shaft through the gears 25, 23, imparts rotative movement to the shaft 21, which in turn, through the gears 22, 20, imparts rotative movement to the worm to drive the spindle 11.

At the rear end of the casing, and preferably made integral therewith, are the two cylinders of a double acting two-cylinder

engine unit. Said cylinders are arranged in planes extending at an acute angle to each other and intersecting in a transverse line of the casing located in the median plane of the casing and extending at right angles to the spindle. 26, 27 indicate the cylinders which are of any suitable construction, preferably such as described in the application referred to; 28, 29 indicate the piston rods; 30, 31, the wrist pins connecting said rods to their respective pitmen 32, 33; and 34, 35 indicate the crank pins of the crank shaft to which said pitmen are in turn connected. The crank pins 34, 35 are placed diametrically opposite each other.

In a construction such as described, with the planes of the cylinders intersecting as heretofore, in the axis of the crank shaft, the angle of advance of the crank pin of one cylinder with respect to the crank pin of the other cylinder as regards dead center, will be equal to the angle between the planes of the cylinder.

In the present invention, however, instead of arranging the cylinders 26, 27 with their axes in planes which intersect in the central axis of the crank shaft, said cylinders are offset from said planes and the planes of the cylinders intersect in a line which is spaced from, or eccentric of the axis of the crank shaft, in a direction remote from the inner ends of the cylinders. The result of this arrangement is to materially increase the angle of advance of the dead center position of the crank pin of one cylinder with reference to the dead center position of the crank pin of the other cylinder. This will be manifest from a consideration of the diagram shown in Fig. 5.

In the diagrammatic view (Fig. 5) A A indicate dotted lines radial to the center of the crank shaft, which lines represent planes intersecting at an acute angle in the axial line of the crank shaft a. The full lines A^1 A^1 represent the planes of the cylinders 26, 27, which planes as above stated, are offset from the planes indicated by the lines A A, so that they intersect in a line of the transverse median plane of the casing indicated at a^1, which is farther removed from the inner ends of the cylinders than the axial line a of the crank shaft.

The full black lines indicating respectively, the wrist pins 30, 31; the pitmen or connecting rods 32, 33; and the crank pins 34, 35:—show said parts in the relative positions similar to those illustrated in Fig. 1, with the crank pin 34 on dead center. In this position of the parts, the piston of the cylinder 26 has reached the outer limit of its movement. The piston of the cylinder 27 is approaching but has not reached the inner limit of its movement.

The heavy dotted lines indicate the relative positions of the same parts enumerated above, when the crank pin 35 is on dead center, with the piston of the cylinder 27 at the inner limit of its movement. In this position of the parts, the piston of the cylinder 26 has started upon its inward path of movement.

The length of arc on the crank pin circle C, between the full line position of the crank pins 34, 35, and the dotted line positions 34^1, 35^1, namely, the arc c, measures the angle by which the dead center position of the crank pin 34 is in advance of the dead center position of the crank pin 35. Manifestly, this angle is in excess of the angle between the planes of the cylinders, since the crank pin 34 must travel through a small arc before it comes to the nearest radial line A and must travel through an even greater arc beyond the other radial line A to come to its position 34^1, corresponding to the dead center position 35^1 of the other crank pin.

Thus with the parts substantially in the proportions shown in Fig. 5, with the planes of the cylinders each at an angle of 12° to the transverse median plane of the casing, or at an angle to each other of 24°, the angular displacement between the dead center positions of the two crank pins will be equal to the sum of 16° and 19°, that is 35°, thus being greater by 11° than the angle between the planes of the cylinders.

As will be understood, the angular displacement between the crank pins of the pistons of the two cylinders when the piston of the cylinder 26 is approaching or at the inner limit of its movement, while the piston of the cylinder 27 is approaching or at the outer limit of its movement, will be the same as shown in the diagram, of Fig. 5, except that the diagram will be reversed, in a manner readily understood.

In Fig. 2 the relative positions of the pistons, pitmen, wrist pins and crank pins of the two cylinders, are shown diagrammatically to correspond with the positions as shown in Fig. 1, and as above outlined in connection with Fig. 5, this figure eliminating the valve chests and cylinders and showing simply the pistons and their connections, as if the pistons moved in a common plane.

The same result, namely, an increase of the angle of displacement between the dead center positions of the two crank pins over and above that of the angle between the planes of the cylinders, may be produced by offsetting the wrist pins instead of offsetting the planes of the cylinders. This construction is shown diagrammatically in Fig. 3. In this figure, A A represent, as before, the lines which indicate the planes intersecting in the axial line a of the crank shaft, while Z Z represent the lines in which the wrist pins 30^x, 31^x connected to the pistons 28^x, 29^x move,—said wrist pins being offset from the planes indicated by the lines A A.

This will be manifest if it will be remembered that it is the path of movement of the wrist pin, which is parallel to the axis of the cylinder, which determines the matter set forth in connection with the description of the diagram in Fig. 5.

By thus offsetting the wrist pins, an increased angle of displacement between the dead center positions of the crank pins of the two cylinders may be obtained without in any way increasing the dimensions of the rear end of such tool as a close quarter drill, namely the type of tool or machine to which the invention is shown as applied, herein.

Again, both expedients may be adopted if a greatly increased angle of displacement between the dead center positions of the two crank pins is required. This may be done by not only offsetting the planes of the cylinders from the planes which intersect in the central axis of the crank shaft, but by in addition, offsetting the wrist pins from said planes in each case. Such a construction is shown in Fig. 4, where the parts are referred to by the same numerals as heretofore, except with the addition of the superfix y. In said figure, A A indicate lines which represent planes intersecting in the central axis of the crank shaft A^y, A^y, indicate lines which represent the planes of the cylinders intersecting in a line a^y remote from the inner ends of the cylinders, and Z^y, Z^y indicate lines which represent the planes in which the crank pins 30^y and 31^y move. Manifestly, the angle of displacement is increased, first by the offsetting of the cylinders, and in addition by the offsetting of the paths of travel of the wrist pins from the axes of the cylinders.

The improvement described herein is of great advantage when applied to a drill construction such as that in connection with which it has been illustrated. In such a tool, compactness is greatly to be desired, and in the construction shown, the same advantages are obtained by offsetting the wrist pins, or by offsetting the cylinders, or by offsetting both the wrist pins and the cylinders, as hereinbefore described, as would be obtained by making the angle between the cylinders greater where the axial planes of the cylinders intersect in the axis of the crank shaft. The greater the angle between the cylinders, of course, the more widely separated the outer ends of said cylinders are, and as it is desirable to bring these ends within as close limits as possible, the advantage of being able to accomplish the desired end, namely, the increase of the angle of displacement between the dead centers of the two crank pins, by simply offsetting the cylinders, offsetting the wrist pins, or offsetting both, thereby increasing the dimensions of the tool merely by the amount of the offset of the cylinders, is manifest, when compared to swinging the outer ends of the cylinders apart a sufficient amount to obtain the desired angle with the planes of the cylinders intersecting in the axis of the crank shaft.

While in describing the invention, we have referred to various details of mechanical construction and arrangement of parts, it is to be understood that the invention is in no way limited thereto, except as may be pointed out in the appended claims.

We claim as our invention:

1. A motor comprising a double acting, two-cylinder, reciprocatory engine unit including a crank shaft having two diametrically opposed crank pins, each cylinder having a piston which is connected by a wrist pin and pitman to an associated crank pin, the cylinders being arranged in planes which extend at an acute angle to each other and which intersect in a line parallel with but spaced beyond the axis of the crank shaft with respect to said cylinders.

2. A motor comprising a double acting, two-cylinder, reciprocatory engine unit including a crank shaft having two diametrically opposed crank pins, each cylinder having a piston which is connected by a wrist pin and pitman to an associated crank pin, the cylinders of the engine unit being arranged in planes extending at an acute angle to each other, the cylinders and their associated parts being so constructed, arranged and connected, that the associated wrist pins travel in planes which intersect in a line parallel with but spaced beyond the axis of the crank shaft with respect to the said cylinders.

In testimony that we claim the foregoing as our invention, we affix our signatures in the presence of two witnesses, this 22 day of December, A. D. 1917.

MATHEW J. BURKEL.
LOUIS P. FOSNOT.

Witnesses.
PETER L. KREITZ,
GEO. DICKINSON.