No. 856,517. PATENTED JUNE 11, 1907.

C. DAWE.

OSCILLATING STEAM OR AIR ENGINE.

APPLICATION FILED FEB. 12, 1906.

3 SHEETS—SHEET 1.

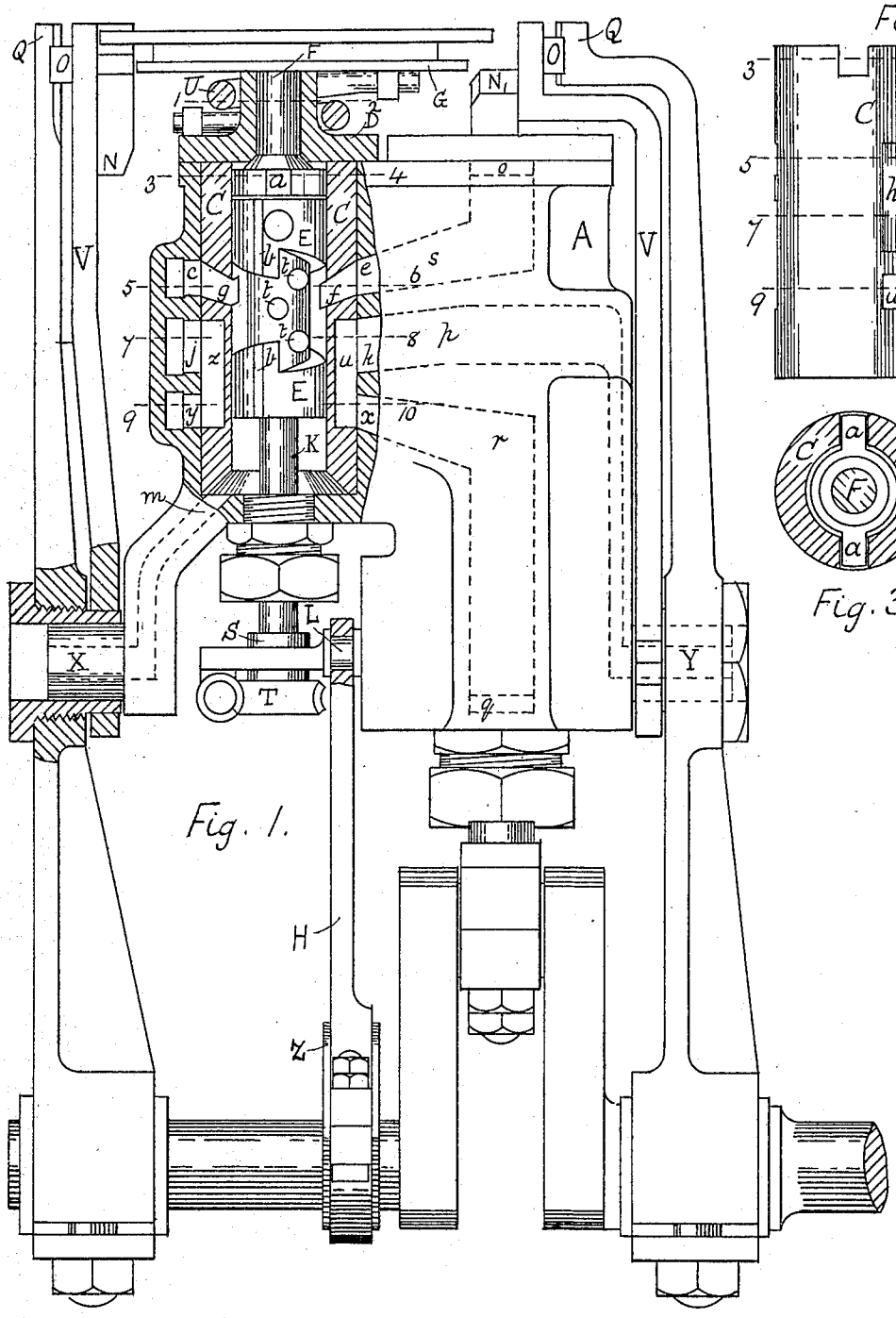


Fig. 1.

Fig. 2.

Fig. 3.

Witnesses.
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Richard Southwell Pearce.

Inventor
Charles Dawe.

THE NORRIS PETERS CO., WASHINGTON, D. C.

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3 SHEETS—SHEET 2.

Fig. 4.

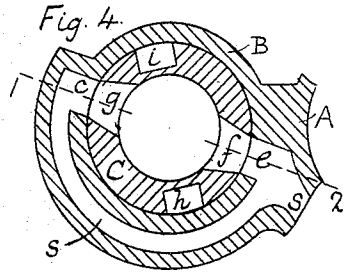


Fig. 5.

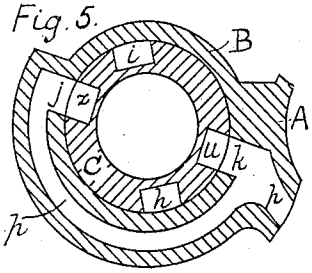
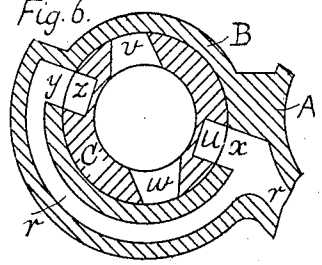


Fig. 6.



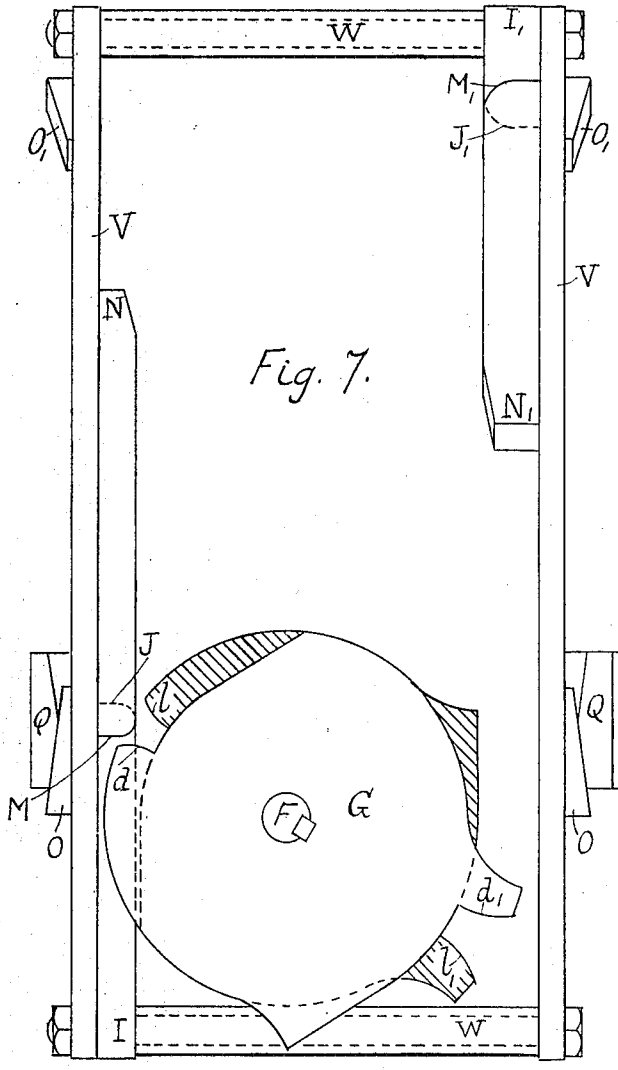


Fig. 7.

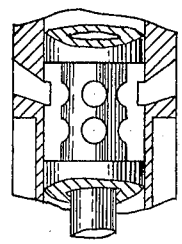


Fig. 8.

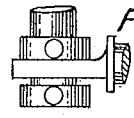


Fig. 9.

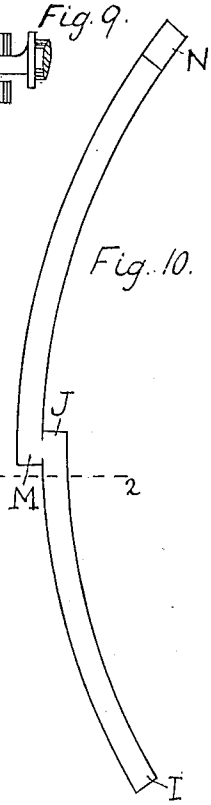


Fig. 10.

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3 SHEETS—SHEET 3.

Fig. 11.

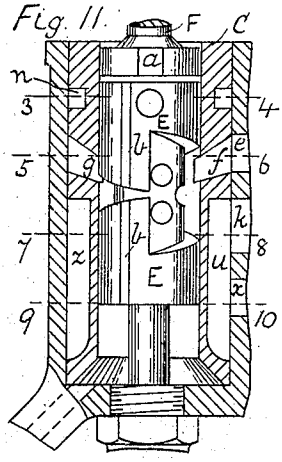


Fig. 12.

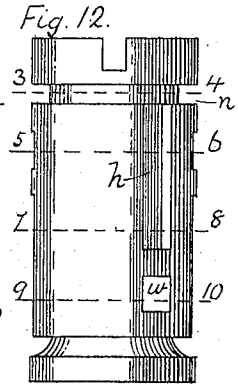


Fig. 17.

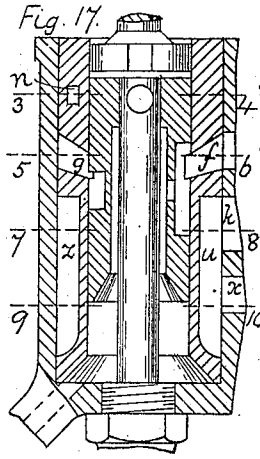


Fig. 18

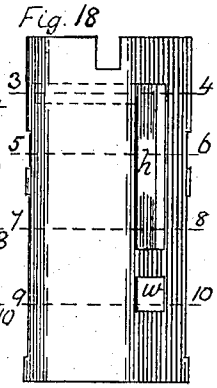


Fig. 13.

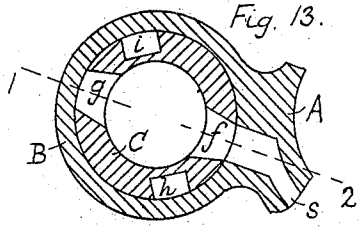


Fig. 19.

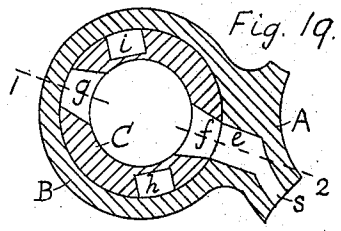


Fig. 14.

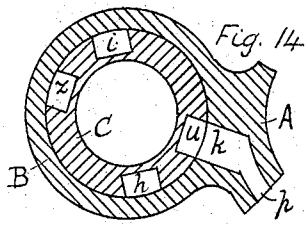


Fig. 20.

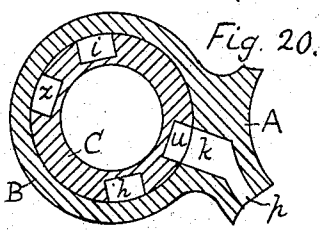


Fig. 15

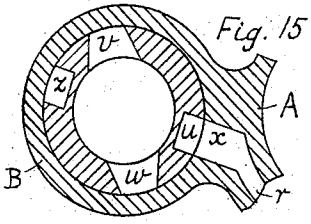


Fig. 21.

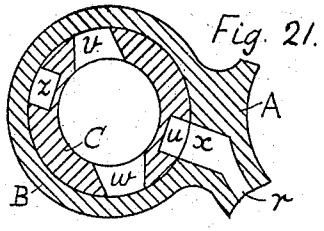


Fig. 16.

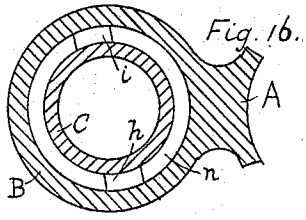
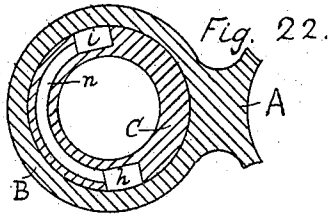


Fig. 22.



Witnesses.
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UNITED STATES PATENT OFFICE.

CHARLES DAWE, OF PLYMOUTH, ENGLAND.

OSCILLATING STEAM OR AIR ENGINE.

No. 856,517. Specification of Letters Patent. Patented June 11, 1907.

Application filed February 12, 1906. Serial No. 300,815.

To all whom it may concern:

Be it known that I, CHARLES DAWE, a subject of King Edward VII of the United Kingdom of Great Britain and Ireland, residing at 27 Ford Park road, in the town of Plymouth, in the county of Devon, England, have invented a new and useful Improvement in Oscillating Steam or Air Engines, of which the following is a specification.

My invention relates to those cases where an engine with an oscillating cylinder driven by steam or compressed air is used to turn a shaft or spindle, and the objects of my improvement are first to combine a wide range of expansion with great freedom of exhaust, and second to use fewer bearings and fewer working parts. I attain these objects by the mechanism illustrated in the accompanying three sheets of drawings in which—

Figure 1. is a front elevation showing certain parts in section. Figs. 2. and 3. are views of the sleeve piece. Figs. 4. 5. 6 are transverse sections of slide casing. Fig. 7 is a plan showing part of the top. Figs. 8 and 9 are to illustrate a peculiar case. Fig. 10. is a view of one of the cam guide bars, and Figs. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22 are illustrations showing alternative methods of constructing slide valve, sleeve piece and cylinder ports.

The cylinder A is oscillating being supported on trunnions, one of which X is shown, the supporting bush being drawn in section. The other trunnion Y is hidden in its bearing in the engine frame. These two trunnions X and Y are hollow, and serve respectively as supply and exhaust passages.

The slide valve casing B is cylindrical, its axis is parallel to the axis of the cylinder, it is at the end of the cylinder away from the trunnions and in the drawings it is shown cast in one with the cylinder. The slide valve casing B is bored out cylindrical, and an internal sleeve piece C fits steam tight in it. This internal sleeve piece cannot move lengthwise being stopped at the bottom end by the body of the slide valve casing and at its top end by the slide valve casing cover D. It is bored parallel with the same axis as the exterior surface and is free to rotate on its axis to and fro through an angle determined by a cam and guide bars as will be described. The sleeve piece at its upper end has two slots made in it, and a spindle F passing through the valve cover is fitted with two corresponding projections *a* so that the spindle and sleeve turn together, but are not secured to each other. The arrangement is shown in Fig. 3 where the sleeve is shown in section through a line 3, 4 Fig. 1, and the spindle through line 1, 2, Fig. 1.

The spindle F is kept steam tight in its passage through the slide valve cover by a miter being formed on the spindle, and a corresponding recess on the under side of the cover. At the top of the spindle a cam G is fixed and the oscillation of the cylinder on its trunnions is used to turn this cam, and consequently the sleeve piece C into required positions for up and down strokes of the engine.

In the description of the construction of the engine reference will be made at first only to Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Figs, 1, 4, 5, 6 show the way in which steam or air is distributed both for supply and exhaust. Fig. 4 shows a transverse section of slide casing and sleeve piece through a line 5, 6, Fig. 1. Fig. 5 shows a transverse section of slide casing and sleeve piece through a line 7, 8, Fig. 1. Fig. 6 shows a transverse section of slide casing and sleeve piece through line 9, 10 Fig. 1. Fig. 1 shows a longitudinal section through line 1, 2 Fig. 4.

e and *c* are two ports in the slide casing; a passage *s* connects these ports with each other and with a port *o* at the top end of the cylinder.

f and *g* are two supply ports through the sleeve piece, and *h* and *i* are two exhaust ports in the thickness of the sleeve piece.

x and *y* are two ports in the slide casing. A passage *r* connects these ports with each other, and with a port *q* at the bottom end of the cylinder.

w and *v* are two supply ports through the sleeve piece, and *u* and *z* are two exhaust ports in the thickness of the sleeve piece.

k and *j* are two ports in the slide casing. A passage *p* connects these ports with each other, and passes away from the engine through the middle of Y the exhaust trunnion.

In the Figs. 1, 4, 5, 6 the sleeve piece is in such a position that steam or air is entering the top of cylinder through ports *f g* and *e c* passage *s* and port *o* and exhaust from bottom of cylinder is taking place through port *q* passage *r* and ports *x y* and *u z* and ports *k j* and passage *p* to exhaust trunnion Y. The side pressure due to port *f* is balanced by that due to port *g* and the side pressure due to port *u* is balanced by that due to port *z*.

This is the position of sleeve piece for down stroke of engine. For the upstroke the sleeve piece is turned around so that the ports *h* and *i* come opposite *e* and *c* in Fig. 4 *h* and *i* come opposite *k* and *j* in Fig. 5, and *w* and *v* come opposite *x* and *y* in Fig. 6. In this position steam or air will enter the bottom of cylinder through ports *w v* and *x y*, passage *r* and port *q* and exhaust from the top of cylinder will take place through port *o* passage *s* and ports *e c* and *h i* and *k j* and passage *p* to exhaust trunnion Y. A similar balancing of side pressures takes place in this new position of the sleeve piece. A passage *m* is constructed between the interior of the supply trunnion and the bottom of the slide valve casing. The bottom of the interior of the sleeve is coned out as shown to receive this passage.

Fig. 1 shows the construction of the slide valve. It consists of two cylinders E fitting steam tight in the sleeve piece connected by a smaller cylinder. The interior of the slide valve is bored larger than the spindle K and holes *t* are drilled in the smaller part of the slide valve. The spindle is passed through longitudinal hole in valve and secured at its top end by a transverse pin. The lower edge of the top cylinder E is a left handed double helix, and the upper edge of the bottom part is a right handed double helix. Between these top and bottom parts of the slide valve is a space in free communication with steam or air supply. The top part of the slide valve cuts off steam or air supply to the top of the cylinder by passing in front of the ports *f. g.* the double helix being so formed that the right hand portion of the valve closes the port *f* at the same instant as the left hand portion of the valve closes the port *g*. The bottom part of the slide valve cuts off steam or air supply to the bottom of the cylinder by passing in front of the ports *w. v.* the double helix insuring that these two ports are shut at the same time. Provision is made as will be shown later for turning around the slide valve on its axis so that the cutting off edges of the slide valve are approached to or receded from each other, and so the cut off of steam or air is thereby made earlier or later. The ports *f. g.* and *w. v.* are where they meet the internal surface of the sleeve piece shaped so as to be parallel to the cutting off edges of the slide valve,—to give suddenness of cut off.

Fig. 1 shows how the motion of the slide valve is obtained from the crank shaft. An eccentric sheave Z is so fitted on the crank shaft that its axis shall be between the axis of the crank shaft and the axis of the crank pin. An eccentric rod H conveys up and down motion to a pin L formed in one with a guide block sliding in a guide groove made in the exterior of the cylinder. This eccentric pin L is prolonged and a boss formed on it, the boss being bored to receive the bottom end of the slide valve rod K. Above this boss a washer S is fixed to the rod K and below it a toothed wheel T is fixed to the valve rod. The effect of this arrangement is that the motion of the slide valve coincides with the motion of the piston, that is to say, when the piston is at the top of its stroke the slide valve is at the top of its stroke, when the piston is at the bottom of its stroke the slide valve is at the bottom of its stroke, and when the piston is at half stroke the slide valve is approximately at half stroke. The slide valve is turned into the position to give any required cut off by a worm mounted in bearings formed on the boss of L engaging with the toothed wheel T. This worm may be connected by a flexible shaft with the driving platform of the engine. If desired the slide valve may be made so that when turned around into one position it gives little or no opening for steam or air at any part of the stroke, and then narrow shallow grooves *b* may be cut on valve so that steam or air in small quantities shall pass into the cylinder throughout the entire length of its stroke. In this position of the slide valve the engine runs slowly but is less likely to stop. For some purposes an alterable degree of expansion will be an unnecessary refinement, and in such a case the toothed wheel T and its worm will not be required, and the cutting off edges of the slide valve will be flat and parallel to its ends. Such an arrangement is shown in Figs. 8 and 9. In Fig. 9 the slide spindle is allowed a little end play to give a sharper cut off.

Fig. 7 shows the method of turning the cam and sleeve piece into the required positions for up and down strokes. The cam G may be regarded as a top and bottom plate connected by a distance piece. In Fig. 7 the bottom plate is where visible from above crossed by sectional lines to make the figure more clear. I, J. M. N. is a guide bar shown in elevation in Fig. 10. in plan in Fig. 7 and Fig. 1. shows a section of it through line 1. 2. Fig. 10. This guide bar is so made and so placed that the part M N serves as a guide to the top plate of the cam, the part J I serves as a guide to the bottom plate of the cam and so that the middle part M J is opposite to the spindle F when the cylinder is in the middle of its arc of oscillation.

In Fig. 1. U is a helical spring. One end of it is placed between two pins screwed into the slide valve cover and the other end is placed between two pins screwed into the lower surface of the cam G and the spring is so fitted that there is no torsion on it when the cam is in its central position.

In Fig. 7. as the engine approaches the dead point with the tooth shaped surface *l* kept sliding along the bar J I by torsion of the spring U, the surface *l* reaches the end J of the bar J I and the tooth shaped surface *d*

at the same time engages with the end M of the bar M N and the motion of the engine being continued turns around the cam until the surface *d* begins to slide along the bar M N being kept in contact with it by the torsion of the spring U. While the engine is completing its stroke the surface *d* slides along the guide bar M N a certain distance toward N and then returns. When the crank is approaching its other dead center the surface *d* reaches the end M of the bar M N and the surface *l* at the same time engages with the end J of the bar J I and the motion of the engine being continued turns around the cam until the surface *l* begins to slide along the face of the bar J I. While the engine is completing its return stroke the surface *l* slides along the bar J I a certain distance and then returns. In this manner the cam and consequently the sleeve piece are turned into a second position as the engine is passing over its top center and back into its original position as it passes over the bottom center. The turning of the cam may be made as gradual as desired by suitably shaping the ends M and J and the surfaces *d* and *l* and the distribution of steam or air both for supply and exhaust will be somewhat affected thereby.

For reversing purposes the bar I J M N is fixed on a reversing frame V capable of motion only around the axis of the cylinder trunnions and on this same frame a reversing bar I_1 J_1 M_1 N_1 similar in every respect to the bar I J M N is fixed. This reversing frame V is preferably built up. Two separate plates are bolted together by bolts W, and ferrules are placed on the bolts to keep the two plates the required distance apart. The parts of these plates which fit on the bushes supporting the trunnions are made with detachable caps to facilitate construction. This reversing guide bar is so made and so fixed on the reversing frame that when the movement of the reversing frame has brought the middle part M_1 J_1 opposite to spindle F when the cylinder is in the middle of its arc of oscillation, the part M_1 N_1 serves as a guide to the top plate of the cam, and the part I_1 J_1 serves as a guide to the bottom plate of the cam. The engine is then in backward gear, and the action of the bar I_1 J_1 M_1 N_1 on the cam G becomes similar to that of the bar I J M N previously described.

In Fig. 7 if the reversing frame be moved around the axis of the trunnions in direction N I so far that as the surface *d* slides along the bar M N the oscillation of the cylinder fails to bring the surface *l* of the cam into contact with the end J of the guide bar the valve gear is inoperative. This is the stop position of the reversing frame. The position of the bar I_1 J_1 M_1 N_1 on the reversing frame must be such that in this stop position of the reversing frame as the cylinder oscillates with the surface *d* sliding along the bar M N and the surface d_1 sliding along the bar M_1 N_1 the oscillation of the cylinder just fails to bring the surface l_1 into contact with the end J_1 of the guide bar. The guide bars M N and M_1 N_1 must be made so long that the cam slides along M_1 N_1 before leaving M N. The points N and N_1 are beveled as shown to facilitate transference of the cam from forward to backward motion, and from backward to forward motion. For small engines convenient of access the reversing frame may be moved to forward and backward positions by a handle made in one with the frame. For larger engines or engines more difficult of access it will be more convenient to fit a pin in the frame and use a connecting rod to connect this pin with a reversing lever convenient to the driver. O. O. are two wedges formed on the back of the reversing frame. These on being pushed into shaped portions Q Q of the engine framing steady the reversing frame for forward motion. Two wedges O_1 O_1 in a similar way steady the reversing frame for backward motion. For non-reversing engines the guide bar I J M N is made in one with the engine framing.

In Fig. 1 the trunnions X and Y are placed very low on the cylinder body, the idea being to increase the moment of inertia of the oscillating cylinder and so to help the engine over its dead points. If considered preferable these trunnions may be placed nearer the middle of the length of the cylinder and the side stresses on the engine framing will be thereby reduced.

Figs. 11, 12, 13, 14, 15, 16 show an alternative method of constructing the sleeve piece slide valve and cylinder ports. Fig. 11 gives a longitudinal section through line 1, 2 Fig. 13. Fig. 12 shows an elevation of sleeve piece perpendicular to line 1, 2 Fig. 13. Fig. 13 shows a transverse section of slide casing and sleeve piece through line 5, 6 Fig. 11. Fig. 14 shows a transverse section of slide casing and sleeve piece through line 7, 8 Fig. 11. Fig. 15 shows a transverse section of slide casing and sleeve piece through line 9,10 Fig. 11. Fig. 16 shows a transverse section of slide casing and sleeve piece through line 3, 4, Fig. 11. In this alternative method of construction it will be seen that the ports *g* and *v* do not act as passages for steam or air, but balance the side pressures on sleeve piece due to ports *f* and *w*. A groove *n* is turned out of the sleeve near its top end, and this groove connects the two ports *h* and *i*. A groove R is turned out of the sleeve near its bottom end, and this groove connects the two ports *u* and *z*. In this alternative method of construction the lower edge of the top cylinder E of the slide valve is a left-handed single helix, and the upper edge of the bottom part is a right handed double helix. This alternative method of construction is shown inasmuch as

it gives the same balanced sleeve piece with a less complicated cylinder casting.

Figs. 17, 18, 19, 20, 21, 22 show a second alternative method of constructing the sleeve piece slide valve and cylinder ports. Fig. 17 gives a longitudinal section through line 1, 2 Fig. 19. Fig. 18 shows an elevation of sleeve piece perpendicular to line 1, 2 Fig. 19. Fig. 19 shows a transverse section of slide casing and sleeve piece through line 5, 6 Fig. 17. Fig. 20 shows a transverse section of slide casing and sleeve piece through line 7. 8. Fig. 17. Fig. 21 shows a transverse section of slide casing and sleeve piece through line 9. 10 Fig. 17. Fig. 22 shows a transverse section of slide casing and sleeve piece through line 3. 4. Fig. 17. This second alternative method of construction differs from the first alternative method in the fact that the passage *n* connecting the ports *h* and *i* is cast in the thickness of the sleeve piece and extends over half the circumference and that the passage R connecting the ports *u* and *z* is cast in the thickness of the sleeve piece and also extends over half the circumference.

What I claim as my invention and desire to secure by Letters Patent is—

1. An oscillating steam or air engine comprising a cylindrical slide casing, a balanced sleeve piece, a combination of cam spring and guide bar whereby the oscillation of the cylinder on its trunnions oscillates this sleeve piece as required for forward motion of the engine, a hollow cut off valve mounted to vibrate lengthwise within the sleeve piece, a pin controlled by an eccentric on the engine shaft to vibrate the same cut off valve, a worm wheel on the cut off valve spindle for altering grade of expansion, a combination of cam and spring with a second cam guide bar whereby the sleeve piece may be so oscillated as to work the engine in a reverse direction, and a reversing frame movable around the cylinder trunnions carrying both those guide bars so arranged that movement of the frame into one position insures one bar working correctly with the cam, movement of the frame into a second position insures the second bar working correctly with the cam, and movement of the frame into a third and intermediate position allows the cylinder to oscillate without turning the cam, substantially as shown and described.

2. The combination of a sleeve piece C with an internal cut off valve E, the said sleeve piece being open at its top and bottom ends, formed with side openings diametrically opposite to each other, one or both of which side openings are used for supply passages to end of cylinder, and formed with ports in its exterior surface diametrically opposite to each other, one or both of which are used for exhaust ports from end of cylinder, and these diametrically opposite exhaust ports connected with each other either directly and always by a circumferential passage or groove in the sleeve piece or indirectly at such times as the port is open to exhaust by a passage formed in the cylinder body, the said sleeve piece being placed in a slide valve casing so constructed that steam or air enters the slide casing through the center of the sleeve piece, and the said internal cut off valve being hollow, provided with radial holes in the middle of its length, and being so formed and so placed in the sleeve piece that all steam or air supply takes place through the annular space between the valve spindle and valve body, and being so mounted as to cut off steam or air supply by the solid part of the valve sliding lengthwise over the port in sleeve piece, substantially as shown and described.

3. A combination comprising a cam a spring and a cam guide bar, the said cam being fixed on a spindle which is furnished with projections fitting into grooves in the sleeve piece, the said spring having one end attached to the cam and the other end attached to the slide valve cover and being so fitted that there is no strain on the spring when the sleeve piece is in the middle of its arc of oscillation, and the said cam guide bar being so shaped and so placed as to transmit the oscillation of the cylinder on its trunnions into the required degree of oscillation of the sleeve piece in the slide casing, substantially as shown and described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES DAWE.

Witnesses:
CHARLES HENRY PELLOW,
RICHARD SOUTHWELL PEARCE.