

April 28, 1953

J. D. MENDEZ LLAMOZAS
DIRECT PUSH PROPULSION UNIT

2,636,340

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2 SHEETS—SHEET 1

Fig. 1.

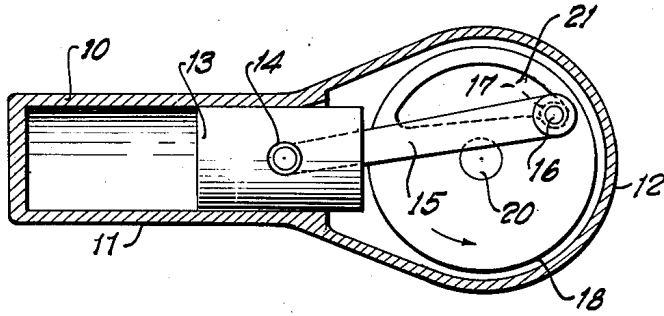


Fig. 2.

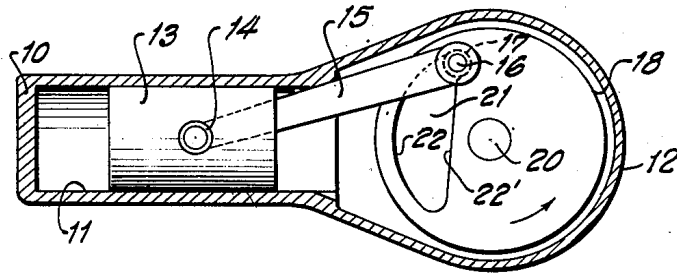


Fig. 3.

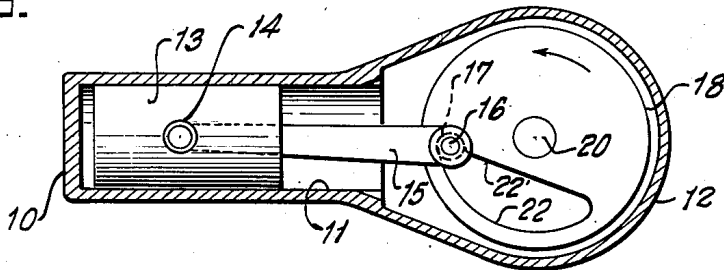
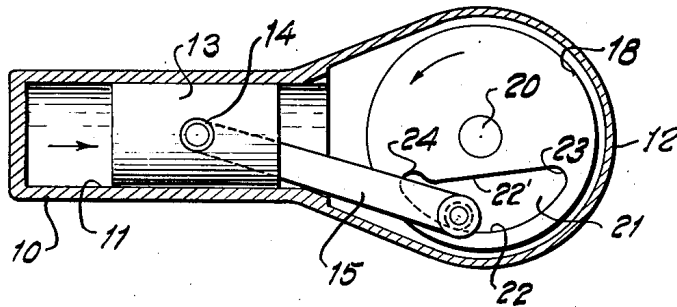


Fig. 4.



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2 SHEETS—SHEET 2

Fig. 5.

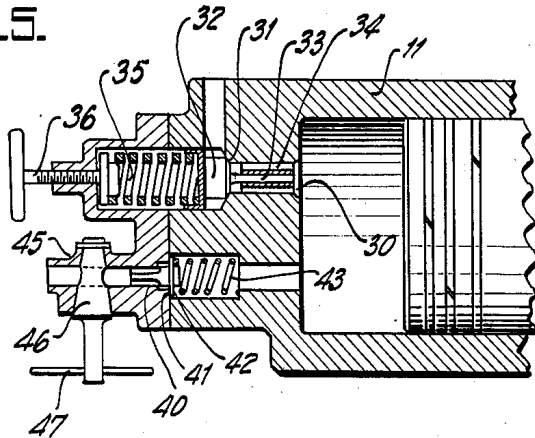


Fig. 6.

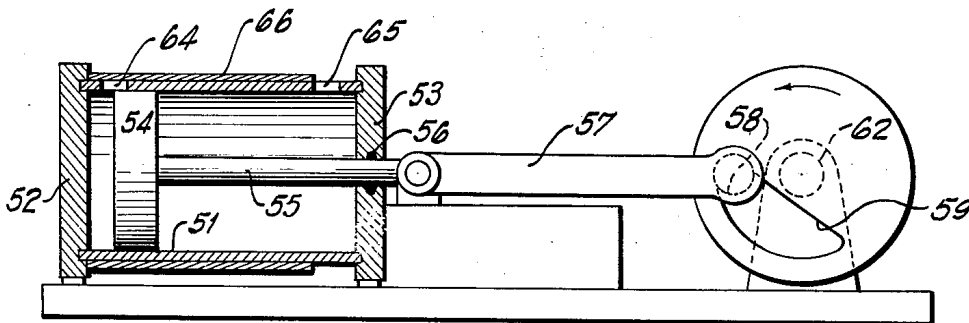
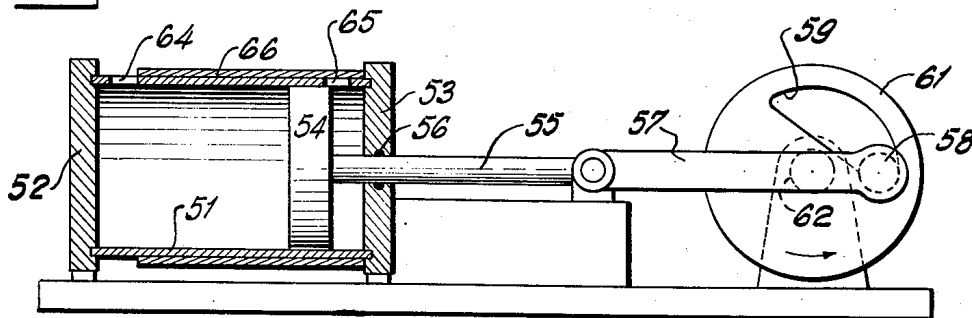


Fig. 7



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DIRECT PUSH PROPULSION UNIT

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5 Claims. (Cl. 60—7)

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The present invention relates to a direct push motor or propulsion unit and, in particular, to a propulsion unit for automotive or self-propelled vehicles. The term "vehicle" is herein used in a broad sense to include aircraft, land craft and water craft, including both surface and sub-surface craft.

The propulsion system in accordance with the present invention is basically different from conventional means for propelling vehicles. Ordinarily, a vehicle is propelled by a force acting against an external medium. This medium is the road surface in the case of automobiles, steel rails in the case of locomotives, water in the case of watercraft and air in the case of aircraft. Propulsion is secured by reaction of the propelling force against such media.

In accordance with the present invention, the reaction for propelling the vehicle is created not in an adjacent or surrounding medium but inside of the propulsion unit itself. For that reason, the apparatus is referred to as a "direct push" motor or propulsion unit, the propelling force being exerted without utilization of conventional means such as wheels, screws, paddles, propellers, etc., acting on an outside medium.

The principle of operation of the direct push propulsion unit in accordance with the present invention is similar to the phenomenon observed in the recoil of a large caliber gun. In the firing of a gun, a high gas pressure is momentarily created in the barrel of the gun behind the projectile. This gas pressure exerts a force on the projectile and an equal and opposite force on the barrel of the gun. Upon the sudden release or discharge of the projectile, the recoil of the gun creates a thrust tending to move the gun carriage in a direction opposite to the direction of movement of the projectile. In the case of a gun, the thrust created by the recoil is an undesirable by-product of the firing of a projectile and is ordinarily dissipated by suitable recoil mechanism. The magnitude of the thrust created by recoil of a gun, even of moderate size, as, for example, a 4-inch gun, is indicated by the size and power of the recoil mechanism provided and by the extent of movement of the gun barrel against the yielding resistance of the recoil mechanism. Calculations have shown that even with a 22 caliber rifle the power developed amounts to more than 20-horse power.

With the direct push propulsion unit of the present invention a thrust created in a similar manner is utilized to propel a vehicle or perform other useful work.

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In the presently preferred form of the direct push propulsion motor in accordance with the present invention, a chamber or cylinder corresponds to the barrel of a gun while a piston corresponds to the projectile. The gas pressure corresponding to that created by the explosion of the propulsive charge is provided by the compression of air or other gas in the cylinder. The piston is moved in one direction by power-driven means to compress the gas in the cylinder. When maximum compression is reached, the piston is suddenly released and moves freely in the opposite direction like the projectile of a gun. The recoil of the cylinder corresponding to the recoil of the gun barrel exerts a thrust on the cylinder in a direction opposite to the direction of movement of the piston. This thrust is transmitted to the vehicle on which the cylinder is mounted and serves as a direct-acting force for propelling the vehicle. This cycle of operation is constantly repeated. Unlike a gun which is fired intermittently or at a relatively low rate, the direct push motor in accordance with the present invention supplies many hundreds or thousands of impulses per minute so that a continual propelling force is exerted on the vehicle.

The invention will be more fully understood from the following description of the embodiments shown by way of example in the accompanying drawings in which

Figs. 1 to 4 are diagrammatic views in longitudinal vertical section of a direct push motor or propulsion unit in accordance with my invention, showing the motor in successive stages of its cycle of operation.

Fig. 5 is a fragmentary longitudinal sectional view corresponding to the left-hand portion of Fig. 1 but on an enlarged scale and showing additional controls for the motor.

Figs. 6 and 7 are views similar to Figs. 1 to 4 but show another embodiment with a reversing control.

The direct push motor or propulsion unit shown diagrammatically in Figs. 1 to 4 comprises a motor block or casing 10 having one or more cylinders 11 and a crank case portion 12. A piston 13, preferably provided with one or more piston rings, is reciprocable in the cylinder 11 and is connected by a wrist pin 14 with one end of a connecting rod 15. The other end of the connecting rod 15 is provided with a crank pin 16 carrying a roller 17 adapted to engage a driving member 18.

The driving member 18 is carried by a power shaft 20 which is rotatably supported by suit-

able bearings in the crank case portion of the motor block and is driven by a suitable power source such, for example, as an internal combustion engine electric motor or turbine. The driving member 18 is hence power-driven. The connecting rod 15, and hence the cylinder 13, are operatively connected with the driving member 18 by providing the driving member with an opening or recess 21 into which the crank pin 16 of the connecting rod 15 projects. As shown in the drawings, the opening 21 is essentially the shape of a segment of a circle having an arcuate side 22 and a straight side 22' which is parallel to, but offset from, a diameter of the driving member 18. One end of the opening 21 is rounded with approximately the same radius as that of the roller 17 on the crank pin 16, as indicated at 23, while at the other end there is provided a curved socket portion 24 which likewise is of approximately the same radius as the roller 17. As will appear more fully from the following description of the cycle of operation of the propulsion unit, the engagement of the crank pin 16 with the opening 21 of the driving member 18 provides a driving connection between the driving member and the piston in certain portions of the cycle while at the same time providing for the quick release and free movement of the piston in other portions of the cycle. The shape of the recess 21 is such as to bring about the release of the piston when it is as near as possible to its position corresponding to the highest compression of the fluid inside the chamber or cylinder in which it operates. In this position of the piston the straight side 22' of the recess 21 should be substantially in line with the connecting rod, so that when the piston is suddenly released its full movement is wholly uninhibited by the driving member. It will be understood that any shape of the recess permitting an independent movement in a given moment between the piston and the driving member is to be considered as included in the claims.

The direct push motor or propulsion unit is mounted in or on the vehicle which it is intended to propel with the axis of the cylinder 11 approximately parallel to the direction of movement of the vehicle. While only one cylinder has been shown, it will be understood that the motor may be provided with any desired number of cylinders to provide the total thrust required.

The cycle of operation of the direct push motor or propulsion unit in accordance with the invention is illustrated in Figs. 1 to 4 of the drawings. The driving member 18 is rotated in a counter-clockwise direction, being driven at the desired speed by a suitable prime mover as indicated above. Fig. 1 shows the beginning of the cycle of operation with the piston 13 at substantially the bottom of its stroke and with the crank pin 16 resting in the socket portion 24 of the opening 21 in the driving member. As the driving member rotates, it acts through the crank pin 16, connecting rod 15 and wrist pin 14 to move the piston 13 to the left towards the top of the cylinder, thereby compressing the air in the cylinder. The compression of air in the cylinder results in a force F_p acting on the top of the piston and an equal and opposite force F_c acting on the head of the cylinder. Fig. 2 shows an intermediate stage in which the driving member has rotated approximately 90 degrees from the position shown in Fig. 1 and

the air in the cylinder is being compressed. The rotation of the driving member and the resulting movement of the piston towards the left continue until the piston has reached the position shown in Fig. 3. At this point, the piston has reached the top of its stroke. The air in the cylinder is, at this point, subjected to maximum compression and, hence, the force F_p acting on the piston and the equal and opposite force F_c acting on the head of the cylinder have been increased to their maximum values. As the forces F_p and F_c are equal and opposite, they are in complete equilibrium.

As the point of full compression is reached, the crank pin 16 passes over the head center position and is suddenly released, thereby severing the driving connection between the driving member 18 and the piston 13. The piston is thereby abruptly freed. The force F_p , up to now, has been transmitted through the connecting rod 15 to the driving member 18 and hence through the shaft 20 to the casing of the motor, thereby balancing the force F_c acting on the piston head. Upon the connection between the piston and the driving member being suddenly broken as, described above, so that the piston is no longer restrained, the force F_p is, in effect, nullified. The equilibrium between F_c and F_p is thereby destroyed, leaving only the force F_c acting on the cylinder head. This reaction produces a thrust in the direction of force F_c which is used for propulsion of the vehicle or other useful work.

Fig. 4 represents the parts after the driving connection between the piston and the driving member has been broken. The crank pin 16 is unrestrained and free to move in the opening 21 of the driving member 18. Its exact position relative to the driving member will depend on the rate of movement of the piston after it has been freed relative to the rate of movement of the driving member. Because of centrifugal force, the crank pin 16 will ordinarily follow the outer arcuate side 22 of the opening 21 although it is unrestrained laterally as well as in a direction lengthwise of the opening. As the piston moving in the direction of the arrow shown in Fig. 4 reaches the end of its stroke, the continued rotation of the driving member 18 causes the crank pin 16 again to be received in the socket portion 24 of the opening 21, whereupon the cycle of operations is repeated. It will be seen that at the point at which driving connection is reestablished between the piston and the driving member 18, the driving member is approximately in, or slightly in advance of, the position shown in Fig. 1 and the direction of movement of the socket 24 is upwards as viewed in this figure and thus substantially at right angles to the direction of reciprocation of the piston. Hence, there can be no substantial amount of shock in the reengagement of the crank pin with the socket, even though there may be some difference in velocity immediately prior to reengagement. Thus, even if the crank pin were momentarily standing still, the only shock would be the small amount attributable to the weight of the crank pin and the adjacent portion of the connecting rod. After the driving connection has been reestablished, the acceleration of the piston is gradual, the curve of acceleration being substantially sinusoidal. It is hence normally unnecessary to make any special provisions for cushioning the contact between the crank pin and the socket 24. How-

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ever, if desired, the socket 24 may be provided with a suitable buffer portion, or the crank pin 16 may be constructed or mounted to provide buffer action.

Comparing the cycle of operation of the direct push motor in accordance with the present invention with the firing of a gun, it will be seen that the compression of air or gas in the cylinder 11, as illustrated in Figs. 1, 2 and 3, corresponds to the loading of the gun. The cylinder 11 may be taken as representing the barrel of a gun while the piston 13 is the projectile. The compressed air provides gas pressure corresponding to that created by the explosive charge. The sudden breaking of the driving connection between the piston and the driving member 18 (Figs. 3 and 4) corresponds to the firing of the gun. The projectile, or piston 13, moves freely in one direction while the recoil exerts a force on the barrel, or cylinder 11, in the opposite direction. It is this recoil which, in accordance with the present invention, is used for propelling the vehicle. There is hence one push on the vehicle for every complete turn of the power shaft 20, one-half of the revolution being utilized for loading and the other half-revolution for explosion with its resulting recoil. When the motor is provided with a plurality of cylinders, it will be understood that the phase relation of the pistons in the respective cylinders can be so arranged as to provide a substantially continuous thrust.

It has been found preferable to drive the driving member 18 at such speed that the socket 24 picks up the crank pin 16 substantially simultaneously with the end of the outward movement of the piston. However, the speed may be regulated as desired.

While the driving member 18 has been shown in the form of a wheel, it will be understood that the invention is not limited to this specific form, as the driving member may be of other shapes. Moreover, the intermittent driving connection between the driving member and the piston so as to compress the gas in the cylinder and then suddenly released the piston, may be provided by other means such, for example, as a cam and cam follower, or a Scotch yoke and pin, instead of by the particular form of driving member and connecting rod illustrated by way of example in the drawings.

The amount of thrust exerted by the direct push propulsion unit in accordance with the invention may be varied by varying the degree of compression of gas in the cylinder and thereby varying the magnitude of the forces F_p and F_c . This can be done in several ways. For example, means may be provided for varying the compression ratio, as by varying the distance between the head of the piston and the power shaft 20 or by otherwise varying the volume of the cylinder when the piston is at the top of its stroke as, for example, by means of a chamber of variable volume communicating with the top portion of the cylinder or by means of a displacement member which is movable a variable amount into the cylinder to decrease its volume. Alternatively, the top pressure of gas in the cylinder can be controlled by means of a valve arrangement permitting a portion of the gas to escape during the compression stroke. One such arrangement is illustrated diagrammatically by way of example in Fig. 5.

In the embodiment illustrated in Fig. 5, the top or closed end of the cylinder 11 is provided with

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an outlet port or orifice 30 shaped to provide a conical seat 31 for a valve member 32. The valve member is movable towards and away from the valve seat 31 and is guided in its movement by a short valve stem 33 slidably held by a spider 34. A spring 35 acts to hold the valve member 32 on its seat; the force of the spring being variable by means of a screw member 36.

The valve member 32 acts as a release valve to control the maximum pressure created in the cylinder. If the pressure becomes great enough to unseat the valve member 32 against the pressure of the spring 35, a portion of the air in the cylinder is permitted to escape. The maximum pressure attained in the cylinder and, hence, the thrust produced by the propulsion unit can be increased by increasing the pressure of the spring 35 on the valve member 32 and, conversely, can be decreased by decreasing the pressure of the spring.

In order to provide for the subsequent replacement of air permitted to escape through the valve 32, the cylinder 11 is also provided with an inlet port or conduit 40 providing a shoulder or seat 41 for a valve disc 42 which is normally held on its seat by a relatively light spring 43. If additional air is needed in the cylinder, it can be drawn in through the port 40. The valve 42 blocks the exit of air thus drawn in.

The inlet valve 42 will ordinarily admit air to the cylinder whenever the pressure inside the cylinder falls below atmospheric pressure. In some instances, however, it may be desirable to limit the amount of air in the cylinder so that the pressure falls below atmospheric for a portion of each stroke. For this purpose, the inlet port 40 is controlled by a second valve 45 which is shown in the form of a plug valve having an apertured conical plug 46 rotatable by a handle 47. When the plug valve 45 is opened by turning the valve plug so as to bring its aperture into alignment with the opposite ports of the valve body, air is admitted to the cylinder 11 under control of the check valve 42, as described above. When the plug valve 45 is closed, the admission of additional air to the cylinder 11 is prevented.

Figs. 6 and 7 illustrate additional controls which permit reversing the direction of the thrust produced by the motor as well as controlling the amount of the thrust. The embodiment shown diagrammatically in Figs. 6 and 7 comprises a cylinder 51 adapted to be mounted on the vehicle and closed at both ends by cylinder heads 52 and 53. A piston 54 is reciprocable in the cylinder by means of a piston rod 55 extending out through a stuffing gland 56 with which one of the cylinder heads 53 is provided. The piston rod 55 is pivotally connected at its outer end to one end of a connecting rod 57, the other end of which is provided with a crank pin 58 adapted to work in an opening 59 in a power-driven driving member 61 carried by a power shaft 62. The arrangement of the connecting rod and driving member is essentially the same as in the embodiment of Figs. 1 to 4.

The cylinder 51 is provided adjacent its opposite ends with one or more outlet ports 64 and 65. A slide valve member 66 is adapted to be moved longitudinally of the cylinder so as to cover either of the ports 64 or 65 or to be in an intermediate position between them so that both ports are left open. With the port 64 closed and the port 65 open, as illustrated in Fig. 6, the motor works exactly the same as that of Figs.

1 to 4. With the sleeve valve 66 in position to close the port 65 while leaving the port 64 open, as illustrated in Fig. 7, the action is the same except that the direction of thrust is reversed since the piston compresses air in the right-hand end of the cylinder as the piston is moved towards the right by the driving member 61 acting through the connecting rod 57 and the piston rod 55. With the slide valve member 66 in an intermediate position, so that both ports 64 and 65 are open, no thrust is produced, the motor thus being in "neutral." By having the port 64 or 65 partially closed instead of fully closed, a reduced thrust is obtained in the manner described in connection with the embodiment of Fig. 5. The amount of thrust, as well as the direction of thrust, can hence be varied as desired.

In place of the slide valve illustrated diagrammatically in Figs. 6 and 7, the openings at the opposite ends of the cylinder 51 may be controlled by other valves of suitable type. For example, a valve arrangement similar to that shown in Fig. 5 may be provided at each end of the cylinder 51.

While the invention and its operation have been described with reference to the embodiments shown by way of example in the drawings, it will be understood that the invention is in no way limited to these particular embodiments. For example, other elastic media, such as springs, may be used in place of the compressible gas. Still other modifications within the scope of the appended claims will be apparent to those skilled in the art.

What I claim and desire to secure by Letters Patent is:

1. A direct push propulsion unit comprising a cylinder, a piston reciprocable in the cylinder, a power driven rotary member having an off-center slot extending in an approximately chordwise direction partway across said member, and a connecting rod connected at one end with the piston and having at the other end a crank pin portion freely movable in the slot in the rotary member and adapted to engage one end of the slot to provide a positive power connection between the power driven rotary member and the piston to drive the piston in one direction to compress an elastic medium in the cylinder and thereby establish a force acting on the cylinder and an equal and opposite force acting on the piston, and, by the free movement of the crank pin in the slot, to release the piston for free movement in the opposite direction upon completion of the compression stroke thereby nullifying the force acting on the piston and leaving unbalanced the force acting on the cylinder to create a unidirectional thrust on the cylinder.

2. A direct push propulsion unit according to claim 1, in which the power driven rotary member is a wheel having therein a slot corresponding in shape to the segment of a circle.

3. A direct push propulsion unit according to claim 1, in which the elastic medium in the cylinder is a compressible gas and in which means is provided for increasing and decreasing the degree of compression.

4. A direct push propulsion unit comprising a block, a piston reciprocable relative to said block, an elastic medium compressible by movement of the piston relative to the block in one direction, said elastic medium, when compressed, tending to move the piston relative to the block in the opposite direction, a power-driven rotary member having an abutment surface disposed at a distance from the axis of rotation of said rotary member, a connecting rod connected at one end with the piston and having at the other end a bearing portion adapted to bear on said abutment surface of the rotary member to provide a positive power connection between the power-driven rotary member and the piston to drive the piston in a direction to compress said elastic medium and to be disengaged from said abutment surface upon completion of said compressive movement to permit free movement of the piston relative to the block in the opposite direction unrestrained by said rotary member and means for guiding the bearing portion of the connecting rod back into engagement with said abutment surface in preparation for a succeeding cycle of operation in like manner.

5. A direct push propulsion unit comprising a block, a piston reciprocable relative to said block, an elastic medium compressible by movement of the piston relative to the block in one direction, said elastic medium, when compressed, tending to move the piston relative to the block in the opposite direction, a power-driven rotary member having a seat disposed at a distance from the axis of rotation of said rotary member, a connecting rod connected at one end to said piston and having at the opposite end a bearing portion adapted to be received in said seat to provide a positive power connection between the power-driven rotary member and the piston to drive the piston in a direction to compress said elastic medium during approximately half a revolution of said rotary member, said bearing portion of the connecting rod being thereupon disengaged from said seat by the reaction of said elastic medium to permit free movement of the piston relative to the block in the opposite direction unrestrained by said rotary member during the remaining half-revolution and means for guiding the bearing portion of the connecting rod back into said seat in preparation for a succeeding cycle of operation in like manner.

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