Feb. 8, 1966 W. HOLT 3,233,406

INTERNAL COMBUSTION GEAR MOTOR

Filed Oct. 16, 1964 3 Sheets-Sheet 1

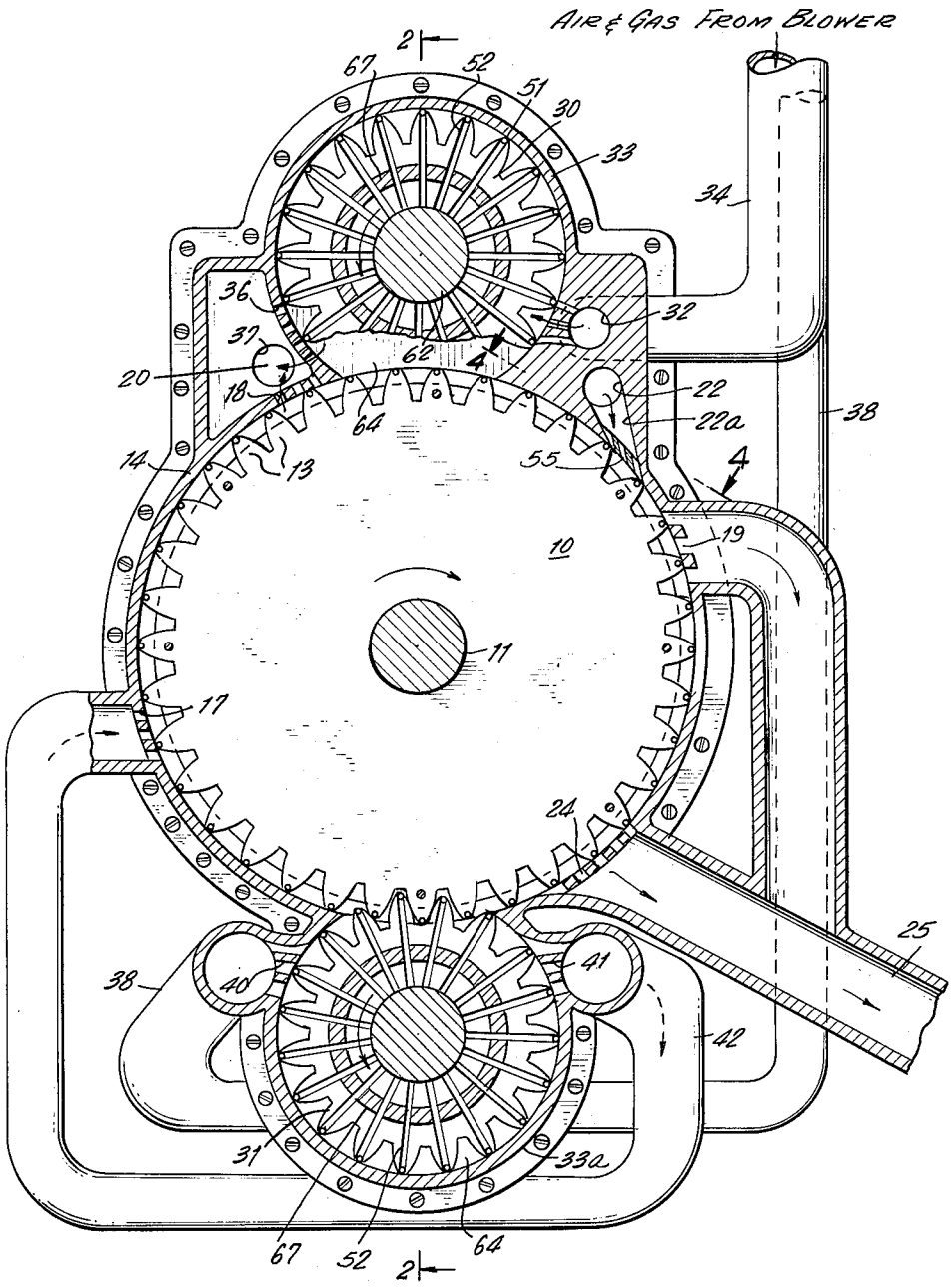

FIG. 1

INVENTOR.
WILLIAM HOLT
BY Albert F. Kornman
ATTORNEY

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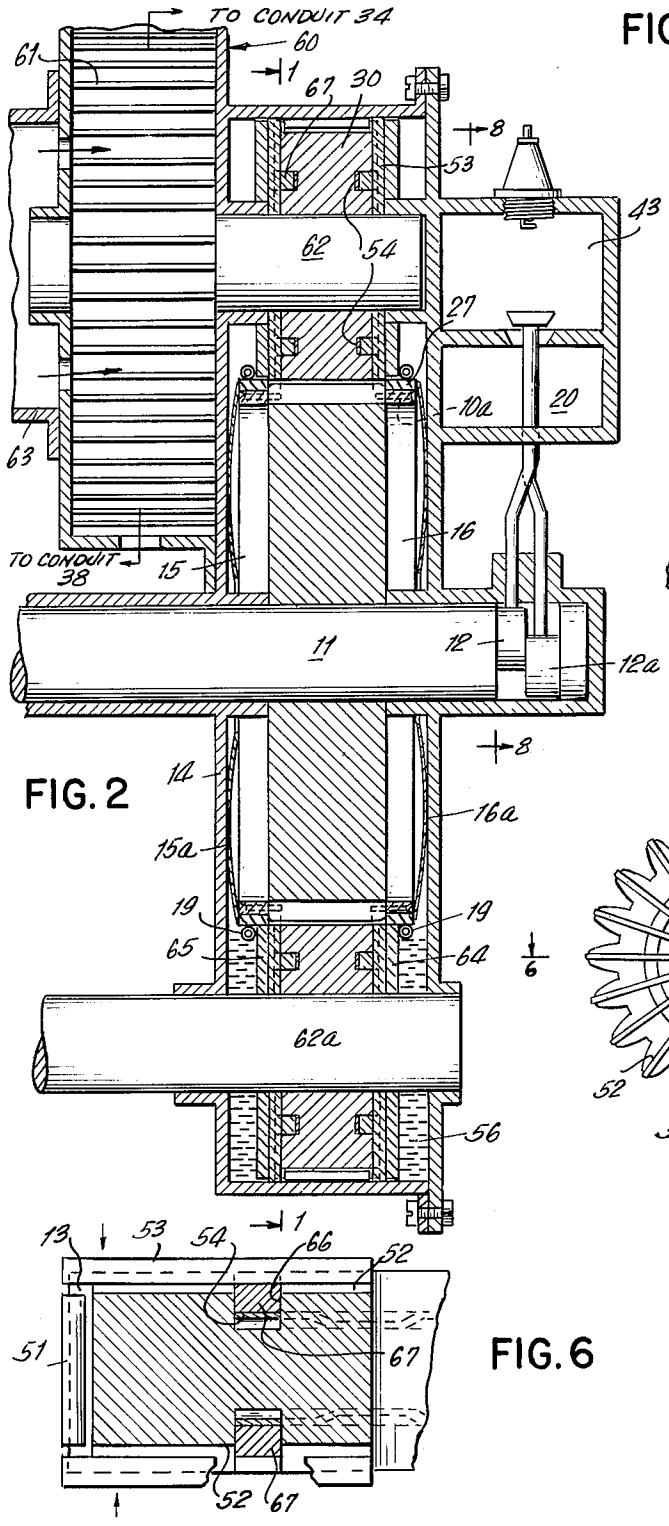

FIG. 2

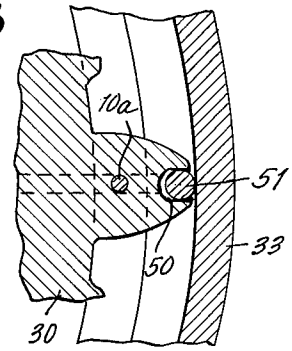

FIG. 3

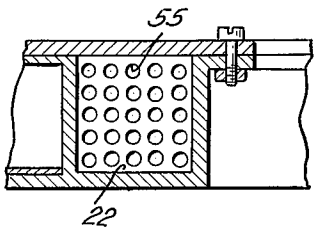

FIG. 4

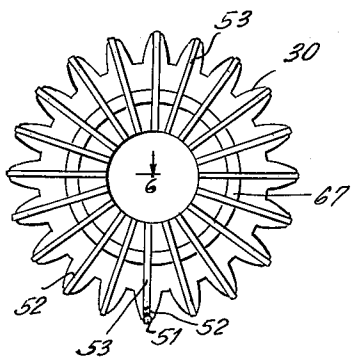

FIG. 5

FIG. 6

INVENTOR.
WILLIAM HOLT
BY Albert H. Kramer
ATTORNEY

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FIG. 7

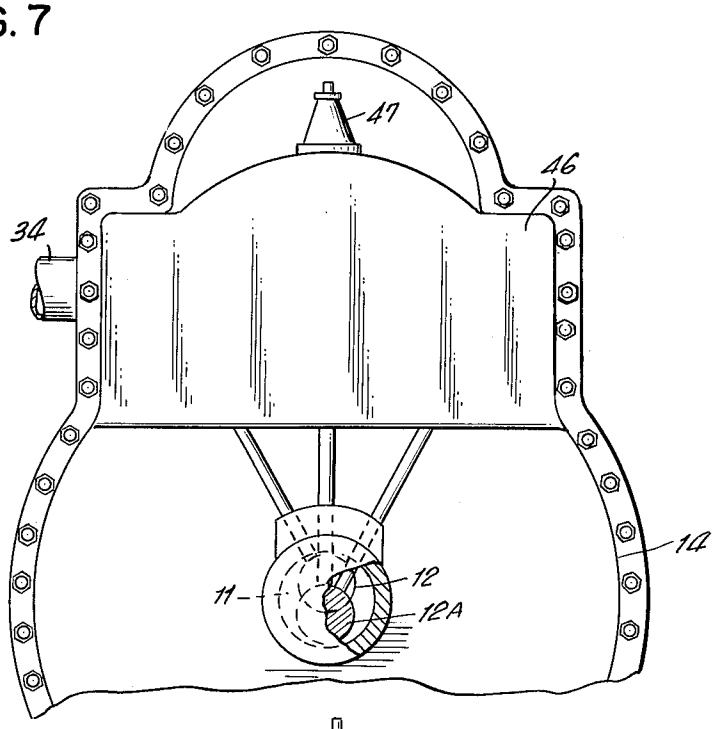
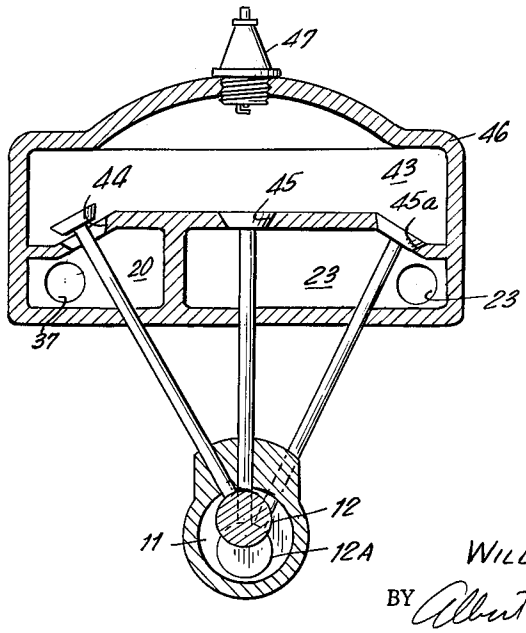


FIG. 8



INVENTOR.
WILLIAM HOLT
BY Albert H. Kronman
ATTORNEY

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3,233,406

INTERNAL COMBUSTION GEAR MOTOR

William Holt, 701 Passaic Ave., Arlington, N.J.

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2 Claims. (Cl. 60—39.43)

This invention relates to an internal combustion engine which is a continuation-in-part of an application for patent entitled: Internal Combustion Gear Motor, filed by William Holt on July 17, 1961, Serial No. 124,428 now abandoned. The invention has particular reference to gear means for sealing portions of the power gear so that there will be no gas leakage between the ends of the teeth and an enclosing casing.

Many attempts have been made to utilize the pumping action of two or more gears as applied to an internal combustion engine. Generally these attempts have been unsuccessful for several reasons. First, a separate set of gears was employed to pump the gas to the place of combustion, and then a second set of gears was employed to convert the exploded gases into mechanical power. The double pump arrangement produced excessive leakage around the ends of the gear teeth and along the sides of the gear and generally resulted in an inefficient engine. The present invention uses a single power gear both for pumping the gas and for utilizing the power of the exploded mixture.

The invention will be described in connection with the use of two supply conduits, each for providing a combustible mixture from a charge blower and carburetor. One conduit is connected directly to the power gear while the other conduit applies the combustible mixture to parts of two pumping gears,. While this double conduit system is the preferred form and is high in efficiency, it is to be understood that either one of the conduits may be eliminated.

One of the objects of this invention is to provide an improved internal combustion gear motor which avoids one or more of the disadvantages and limitations of prior art motors.

Another object of the invention is to provide an internal combustion motor in which all the major parts rotate, there being no heavy reciprocating components.

Another object of the invention is to increase the efficiency of internal combustion motors by employing a double gear pump to convey the combustible gas mixture.

Another object of the invention is to reduce the gas leakage around the gear teeth by a novel sealing means.

Another object of the invention is to reduce the size of internal combustion motors.

Another object of the inventon is to reduce the wear on component parts and surfaces by equalizing the pressure on rotating parts and by providing tangential forces for driving the power gear.

The invention comprises an internal combustion motor having a single power gear rotatably mounted between two flat sealing plates and having gear teeth for conveying a combustible mixture on one side and for receiving and utilizing exploded gas on its other side. An explosion chamber is mounted adjoining the power gear with means for electrically igniting the combustible gas. A casing surrounds most of the periphery of the gear and prevents gas leakage around the ends of the gear teeth. A first entrance port is provided for applying combustible gas to one side of the gear and a first exit port is provided for sending combustible gas to the explosion chamber. A second entrance port is provided for sending the exploded gas to the other side of the power gear and a second exit port is provided for sending the exploding gas to the atmosphere. A first pumping gear meshes with the power gear between the first exit port and the second entrance port while a second pumping gear meshes with the power gear between the first entrance port and the second exit port. Valve means controlled by the power gear are provided for sequentially admitting unburned gas to the explosion chamber and applying the exploded gas to the other side of the power gear.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings.

FIGURE 1 is a cross sectional view, with some parts in elevation, of the entire motor taken generally along line 1—1 of FIGURE 2.

FIGURE 2 is a cross sectional view of the motor shown in FIGURE 1 and is taken along line 2—2 of that figure. In FIGURE 2 the conduit manifolds have been omitted for the sake of clarity.

FIGURE 3 is a cross sectional view to an enlarged scale of one of the teeth of the power gear.

FIGURE 4 is a cross sectional view of a portion of the motor shown in FIGURE 1 and is taken along 4—4 of that figure. This view shows the construction of the entrance and exit ports.

FIGURE 5 is a side view of one of the sealing gears showing the side sealing means.

FIGURE 6 is a cross sectional view of the tooth shown in FIGURE 5 and is taken along line 6—6 of that figure.

FIGURE 7 is a side view of the upper portion of the motor viewed from the side containing the combustion chamber.

FIGURE 8 is a cross sectional view of a portion of the motor shown in FIGURE 2 and is taken along line 8—8 of that figure.

Referring now to the figures, the motor includes a power gear 10 supported on a shaft 11 which may be connected to a mechanical load (not shown). A portion of the shaft 11 extends through the gear 10 and a part of this shaft is cut in the form of cams 12 and 12A which operate poppet valves to be described later. The power gear 10 includes a plurality of teeth 13 which move adjacent to the inside surface of a circular casing 14. The sides of the power gear teeth are sealed by two rings 15 and 16 (see FIGURE 2) which are fastened to the gear by bolts 10A, a split ring 27 is slipped around each gear ring 15, 16 and held by flat springs 15A and 16A to cut down the gas leakage. Garter springs 19 slipped over the split rings maintain the ring pressure on the gear rings 15, 16. The casing 14, as shown in FIGURE 1, contains a first entrance port 17, and a first exit port 18, these two ports being positioned adjacent to the bottom and the top of one side of the power gear 10 respectively for the purpose of receiving a combustible mixture at the entrance port 17, conveying the mixture, and then discharging it through the exit port 18 into a storage chamber 20. The entrance port 17 receives gas from one of the gear pumps including gear 31.

On the other side of the power gear 10, casing 14 is provided with a drive entrance port 23 which is for the admission of exploded gases from a second storage chamber 23 (see FIGURE 8). This side of the casing also contains a second exit port 19 and third exit port 24 which expells the burned gas into an exhaust pipe 25 which is open to the atmosphere.

Portions of the gears 30, 31 are used as pumps in conjunction with the power gear 10 and for this purpose an entrance port 32 is provided in casing 33. The entrance port 32 is connected by means of a conduit 34 to the carburetors and mixes air with vaporized fuel as is well known in the art.

The combustible mixture from conduit 34 enters the entrance port 32 and travels around the upper portion

of pumping gear 30 to an exit port 36 and conduit 37. Exit port 36 and conduit 37 are connected directly to the storage chamber 20. In a similar manner combustible gas from the carburetor is sent through conduit 38 to entrance port 40 in the casing 33*a* which surrounds the lower sealing gear 31. The gas supplied through this entrance is carried by the teeth of pumping gear 31 around through the lower half of the gear and is then discharged through an exit port 41 into a conduit 42. This conduit is connected to the first entrance port 17 in the main casing 14. From the above description, it will be evident that the two pumping gears 30 and 31 act as pumps for pumping combustible gas to the entrance port 17 and to the storage chamber 20.

The cross sectional view shown in FIGURE 2 shows the combustion chamber 43 behind the upper pumping gear 30. This combustion chamber is connected to storage chambers 20 and 23 (FIGURE 8) by an entrance poppet valve 44 and by two exit poppet valves 45 and 45A which are opened and closed in a sequential manner by cams 12 and 12A connected to the main shaft 11. During the pumping part of the cycle, valve 44 is open and gas is pumped through the first exit port 18 into the storage chamber 20 and the combustion chamber 43. Both chambers 20, 43 are surrounded by an enclosing casing 46. At a predetermined time interval, valve 44 is closed and valves 45 and 45A start to open. At this instant the combustible gas in chamber 43 is ignited by a spark plug 47 which is connected to an ignition system (not shown). Valves 45 and 45A now open all the way and the exploded gas expands passing through chamber 23, through entrance port 22. The expanding gas is directed against the teeth of the gear 10 through duct 22*a* to move the power gear 10 during its power stroke. The power gear 10 rotates under impulse from the exploded gases, which then go to the exit ports 19 and 24 and to the exhaust pipe 25. Soon after the exploded gases have expanded through valves 45 and 45A, the valves are closed and valve 44 is opened, immediately permitting an additional charge of scavenging air from a second blower (not shown) to clear the combustion chamber. During this portion of the cycle the exhaust valve remains open. Thereafter a new charge of combustible gas is permitted to enter the combustion chamber 43 to start another cycle of operations.

It has been found that the efficiency of the motor can be increased by providing an ignitable mixture under pressure to the manifold 34. For this purpose a blower 60 (see FIGURE 2) having rotatable vanes 61 is mounted on shaft 62 on which is secured the upper sealing gear 30. The blower contains an intake manifold 63 through which the air-gas vapor is drawn from the carburetor. On one side of the blower, connection is made to conduit 34. As soon as the motor is started the rotation of the vanes 61 forces the mixture under considerable pressure to entrance ports 17, 32 and 40 thereby aiding the production of greater pressure within the combustion chamber 43 and increasing both the power and the efficiency of the motor.

Without the force applied to the combustible mixture by the blower 60, the centrifugal forces built up by the rotating gears would prevent a charge from entering the motor.

The detailed drawing shown in FIGURE 3, illustrates the method of sealing the extremities of the teeth 13 in gears 10, 30 and 31 from gas leakage. The ends of the teeth are formed with a circular slot 50 whose axis is parallel to the ends of the teeth 13 and to shafts 11, 62 and 62*a*. Slot 50 contains a portion which extends through the ends of the teeth so that a cylindrical roller 51 when inserted into the slot can protrude enough to make a sealing contact with the inside surface of casing 14, 33, 33*a*. Rollers 51 are urged by the centrifugal force of rotation of gears 10, 30 and 31 against the casing surface to prevent gas leakage around the ends of the gear teeth 13. As the gears mesh, the rollers are retained from jumping entirely out of the slots by well known means.

The leakage of gas out of the ends of the grooves 50 and around the flat faces of the gears 30, 31 is prevented by the sealing vanes 53 and the plates 64, 65 shown in FIGURES 2, 5 and 6. The gears 30, 31 are formed with radial slots 52 on each side which extend from the shafts 62, 62*a* to the extremities of each tooth 13. A vane 53 (see FIGURE 6) is positioned in each slot and presses against one of the plates 64 or 65. When rollers 51 and vanes 53 are employed with all the teeth 13 of the gears 30, 31 the leakage is reduced to a minimum and high pressures can be maintained. An annular groove 66 is cut in each face of the gears 30, 31 and a ring 67 disposed therein below the vanes 53. The ring 67 further serves to limit the travel of gases from the teeth down the sides of gears 30, 31, a wave spring 54 is disposed in the groove below the ring 67 to force the ring 67 and the vanes 53 outwardly.

The various exit and entrance ports could be constructed with single port cavities but this might interfere with the travel of the rollers 51. In order to retain the rollers in their desired position, all the ports are constructed with a plurality of holes 55 as shown in FIGURE 4. These holes reduce the gas flow by only a small amount and permit the rollers to move in their circular path without deviation.

In order to insure proper lubrication of all the moving parts in the motor, the casings 14, 33 and 33*a*, are filled with a suitable lubricant such as oil 56. The oil 56 may be circulated through a suitable heat exchange unit (not shown) to reduce the temperature of the oil during motor operation. It is also desirable to mix oil or a lubricant with the fuel in the manner used for two cycle internal combustion engines to provide lubrication.

Having thus fully described the invention what is claimed as new and desired to be secured by Letters Patent of the United States, is:

1. An internal combustion motor comprising, a casing, a power gear rotatably mounted within the casing, a plurality of gear teeth in the power gear, sealing means comprising a roller carried by the gear teeth and, responsive to the centrifugal force of the rotating power gear to bear against the inside of the casing, spaced first and second pumping gears in mesh with the power gear and rotatably carried within the casing to form with said casing and power gear a combustion chamber and an expansion chamber adjacent the power gear teeth, sealing means comprising a roller carried in the periphery of the teeth of each pumping gear and adapted to ride upon the inner surface of the casing adjacent the pumping gears, a conduit for a source of combustible gas, means comprising a first entrance port in the casing to introduce the combustible gas into the compression chamber, means comprising a first exit port in the casing to lead the combustible gas from the pumping gear into the combustion chamber, electrical means for igniting the combustible gas within the combustion chamber, means comprising a second entrance port in the casing to lead the exploding gases from the combustion chamber into the expansion chamber to drive the power gear, said expansion chamber compressing at least one exhaust port in the casing to exhaust the spent gases.

2. An internal combustion motor comprising, a casing, an output shaft journaled within the casing, a power gear rotatably mounted within the casing, and secured to the output shaft, a plurality of gear teeth in the power gear sealing means comprising a roller carried by the gear teeth and, responsive to the centrifugal force of the rotating power gear to bear against the inside of the casing, spaced first and second pumping gears in mesh with the power gear and rotatably carried within the casing to form with said casing and power gear a storage chamber and an expansion chamber adjacent the power gear teeth, sealing

means comprising a roller carried in the periphery of the teeth of each pumping gear and adapted to ride upon the inner surface of the casing adjacent the pumping gears, a conduit for a source of combustible gas, a blower to receive the combustible gas from the conduit, means comprising a first entrance port in the casing to introduce the combustible gas under pressure from the blower into the storage chamber, means to introduce additional combustible gas between the casing and at least one of the pumping gears, a combustion chamber in communication with the storage chamber and expansion chamber, means comprising a first exit port in the casing and valves controlled by the output shaft to lead the gas from the storage chamber into the combustion chamber, electrical means for igniting the combustible gas within the combustion chamber, means comprising a second entrance port in the casing to lead the exploding gases from the combustion chamber into the expansion chamber to drive the power gear, said expansion chamber comprising at least one exhaust port in the casing adjacent the expansion chamber to exhaust the spent gases.

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MARK NEWMAN, *Primary Examiner.*

SAMUEL LEVINE, *Examiner.*