April 5, 1927.

J. R. KINNEY

1,623,315

VACUUM PUMP

Filed April 14, 1926 3 Sheets-Sheet 1

Fig. 1.

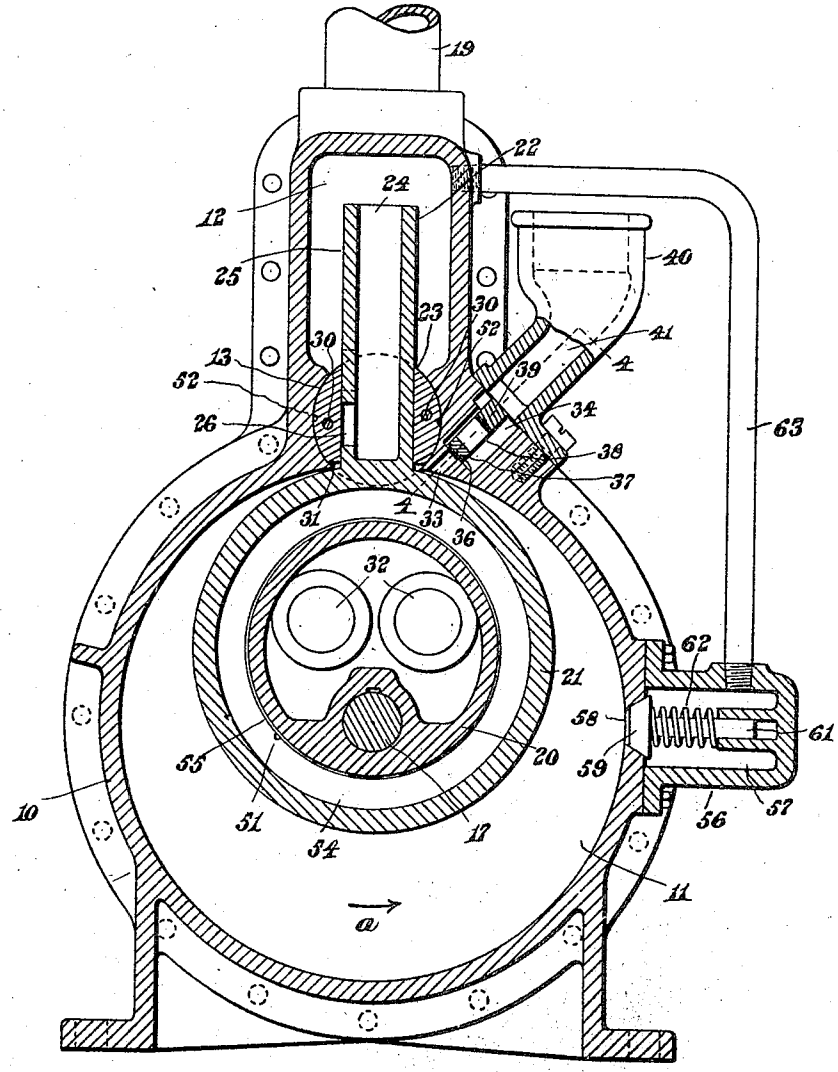
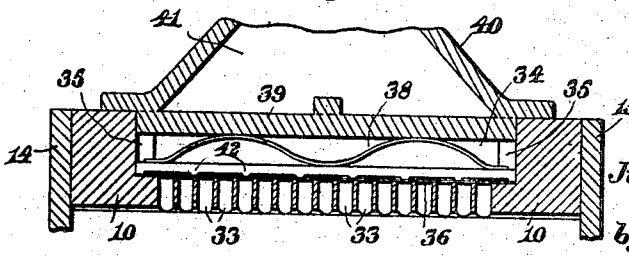


Fig. 4.



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Fig. 2.

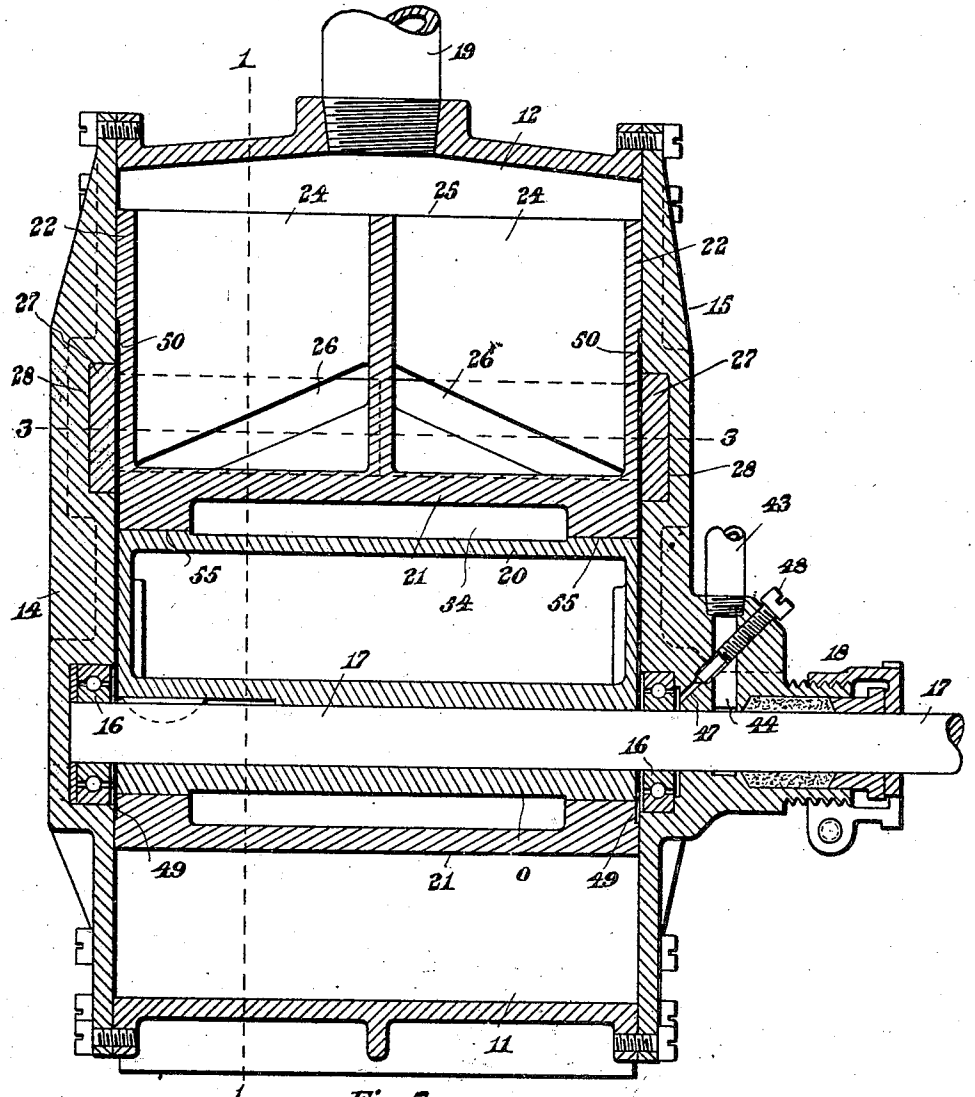
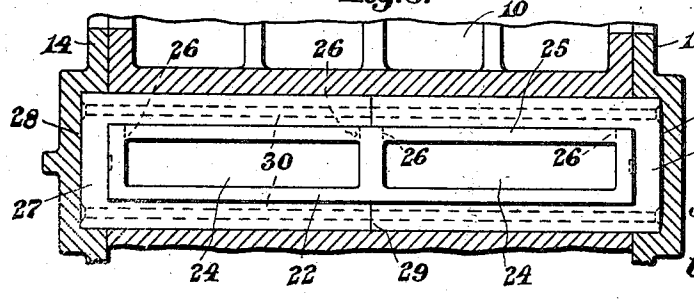


Fig. 3.



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Fig. 5.

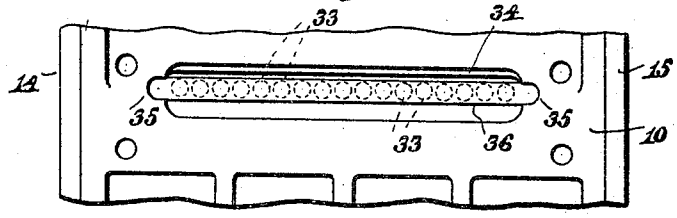


Fig. 6.

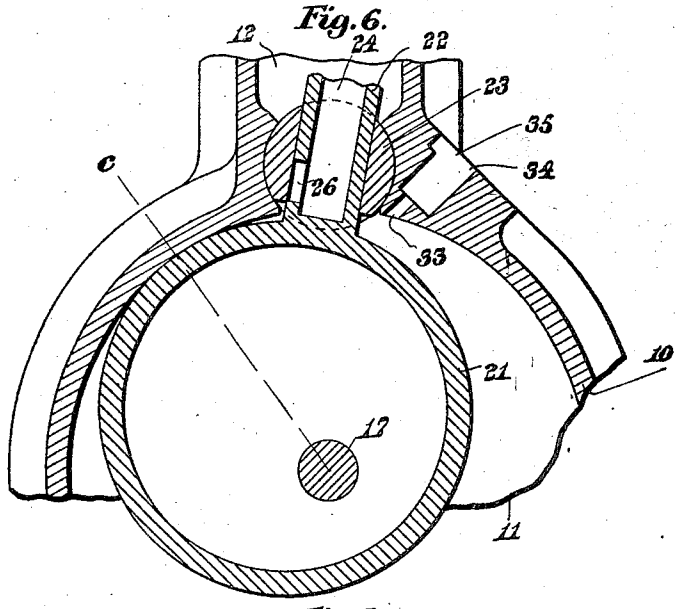
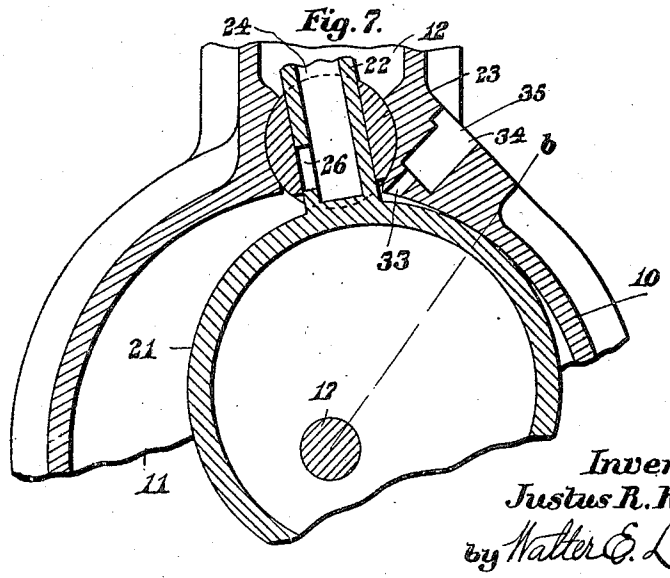


Fig. 7.



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Patented Apr. 5, 1927. 1,623,315

UNITED STATES PATENT OFFICE.

JUSTUS R. KINNEY, OF JAMAICA PLAIN, MASSACHUSETTS, ASSIGNOR TO KINNEY MANUFACTURING CO., OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

VACUUM PUMP.

Application filed April 14, 1926. Serial No. 101,932.

This invention relates to vacuum pumps and has for its object the production of a rotary pump of this character which will be simple and inexpensive to construct and very effectual in operation.

This object is attained by the mechanism illustrated in the accompanying drawings.

For the purpose of illustrating the invention, one preferred form thereof is illustrated in the drawings, this form having been found to give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized, and the invention is not limited to the precise arrangement and organization of these instrumentalities as herein shown and described except as required by the scope of the appended claims.

Of the drawings:

Figure 1 represents a vertical section of a pump embodying the principles of the present invention, the cutting plane being on line 1, 1, on Fig. 2.

Figure 2 represents a transverse vertical section of same on line 2, 2, on Fig. 1.

Figure 3 represents a section on line 3, 3, on Fig. 2.

Figure 4 represents a section on line 4, 4, on Fig. 1.

Figure 5 represents a plan of a portion of the casing showing the discharge openings.

Figure 6 represents a diagram showing the position of the piston and blade when gas is about to be admitted to the piston chamber, and

Figure 7 represents a similar diagram showing the same elements when admission of gas has just been completed.

Similar characters indicate like parts throughout the several figures of the drawings.

In the drawings, 10 is a casing having extending laterally therethrough a cylindrical chamber 11 and a compartment 12 located above the chamber 11 and communicating therewith by means of a semi-cylindrical passage 13.

The casing 10 has secured to its opposite ends closing plates 14, 15 each of which is provided with anti-friction bearings 16 in which is disposed a rotatable shaft 17, one end of which bears against an inner wall of the closing plate 14, while the opposite end extends through a stuffing box 18 on the closing plate 15.

An inlet pipe 19 communicates with the upper end of the compartment 12.

The shaft 17 extends through the center of the chamber 11 and has keyed thereto a cam member 20 which is surrounded by an annular piston 21 having a laterally extending blade 22 which extends through a slot formed in an oscillating pin 23 disposed in and fitting the passage 13.

The shaft 17 extends through the cam member 20 at one side of its center forming an eccentric, thereby causing the piston 21 to contact at one point with the cylindrical wall of the chamber 11 during the entire rotation of the shaft 17.

The blade 22 has two pockets 24 extending inwardly from is outer end, one wall 25 of which is provided with the oppositely inclined ports 26 through which gas is admitted to the chamber 11 from compartment 12 at stated times during the rotation of the shaft 17.

The lower ends of the ports 26 are considerably removed from the periphery of the piston so that during a part of the revolution of the piston 21 the said ports 26 are closed and no gas can pass through the same.

The slotted blade-receiving pin 23 extends beyond the ends of the casing 10 with cylindrical ends 27 disposed in cylindrical recesses 28 formed in the end closing plates 14, 15.

This pin 23 is made in two parts abutting at 29, said parts being connected together by the headed rods 30 extending from end to end thereof.

The lower side of the pin 23 has a flat face as indicated at 31.

The cam member 20 is preferably cored out with openings at the ends in which are disposed closing plugs 32.

Closely adjacent one side of the passage 13 on the discharge side of the pump, the casing 10 is provided with a plurality of discharge ports 33 extending into a pocket 34, the opposite ends of which have narrow extensions 35 in which are positioned the opposite ends of the valve 36 of thin spring metal.

This valve 36 normally closes the ports 33 and has superimposed thereon a follower 37 forced downwardly by a spring 38, the

curved upper portions of which bear against a rib 39 forming a part of the discharge nozzle 40.

As will be noted in Fig. 1 this rib 39 is narrower than the passage 41 extending from the bottom of said nozzle.

The lower face of the follower 37 has a plurality of cross ribs 42 which bear on the valve 36 leaving space between these ribs through which the gas may freely pass.

The shaft 17 is lubricated by oil admitted through a pipe 43 communicating with a passage 44 in the hub 45 of the end plate 15, the inner end of said passage communicating with an annular recess 46 surrounding the shaft 17.

From the passage 44 extends a branch passage 47 to one of the anti-friction bearings 16 and the flow of oil through this branch passage 47 is regulated by a needle valve 48.

The outer ends of the piston 21 have recesses 49 therein which communicate with oil passages 50 extending along the ends of the blade 22 and these recesses are connected by a groove 51 in the inner cylindrical wall of the piston 21.

The oil admitted through the branch passage 47 enters all these recesses and grooves and not only thoroughly lubricates the moving parts of the pump but also makes a perfect seal preventing the escape of gas.

The slotted pin 23 has oil grooves 52 upon opposite sides and extending lengthwise thereof to assist in lubricating the contacting surfaces of said pin and the passage 13 in which said pin is positioned.

During the operation of the pump the shaft 17 rotates in the direction of arrow *a* on Fig. 1 and when the piston 21 is in the position shown in said Fig. 1 both the inlet 26 and outlet 33 from the chamber 11 are closed.

As the piston 21 commences to revolve in direction of arrow *a* all gas in advance of said piston will be forced toward the outlet ports 33 and through said ports into the discharge nozzle 40.

During this forward movement the blade 22 will commence to tilt, moving the slotted pin 23 about its axis and as the piston continues to move forward said blade 22 will commence to move downwardly until the piston reaches the position shown in Fig. 6 in which position the lower end of the ports 26 will register with the flat face 31 of the slotted pin 23.

Further rotation of the piston will uncover the ports 26 and permit gas to be drawn from the pockets 24 into the chamber 11 where it will be forced ahead of the piston to the discharge outlet ports 33, in the next cycle of the piston.

The ports 26 will remain open until the piston 21 reaches the position indicated in Fig. 7 when the ports 26 will be closed and remain closed until the piston again reaches the position indicated in Fig. 6.

While the contacting point of the piston 21 is travelling from *b* (Fig. 7) to *c* (Fig. 6) the supply of gas to the chamber 11 is entirely cut off and as the piston continues to rotate in the direction of arrow *a* the gas in advance of said piston 21 will be compressed, this increased pressure forcing the valve plate 36 from its seat and permitting the gas to be discharged through the openings 33 into the pocket 34 and then through the outlet 40.

When the last of the gas in advance of the piston is about to be forced through the openings 33, the ports 26 will be closed and no new supply of gas will be admitted until the piston attains the position indicated in Fig. 6.

The ports 26 are made inclined in order to provide a better bearing surface on the port side wall of the blade 22 as it reciprocates in the slot in the oscillating pin 23.

The piston 21 is chambered out at 54 as indicated in Fig. 2 and has bearing portions 55 at its opposite ends and the grooves 51 extend transversely of these bearing portions 55.

The cam 20 is slightly shorter than the space between the inner faces of the end plates 14, 15 and consequently the lubricant admitted through the passage 47 forms a film at each end of the cam 20, said lubricant passing from one end to the other through the grooves 51.

This film of lubricant also enters the recesses 49 in the ends of the piston 21 and flows into the oil grooves 50 at the opposite ends of the blade 22.

The grooves 50 do not extend to the outer end of the blade 22 and therefore the oil in these grooves cannot escape therefrom.

It is obvious, therefore, that all the moving parts of the pump will be thoroughly lubricated by the lubricant admitted through the passage 47 and the amount of oil or lubricant can be regulated by means of the needle valve 48.

To the outlet side of the casing 10 is secured a housing 56 having a chamber 57 therein communicating with the main chamber 11 by a cone-shaped opening 58 to which the valve 59 is fitted.

The valve 59 has a stem 60, the end of which extends into a cylindrical pocket 61 which serves as a guide for said stem 60 when the valve 59 is forced from its seat.

A spring 62 normally retains the valve on its seat and may be compressed when the pressure of gas within the main chamber 11 reaches a predetermined limit.

At any lower pressure the opening 58 is closed and there is no escape for the gas therethrough.

From the housing 56 extends a pipe 63, the other end of which communicates with the compartment 12.

The object of this by-pass 63 is to make the pump run more easily when it is first operated thereby greatly reducing the power required of the motor which actuates the driving shaft 17.

When the pump is first actuated the chamber 11 is filled with gas under atmospheric pressure and this pressure offers considerable resistance to the rotation of the piston 21.

By providing the by-pass 63 this gas in advance of the rotating piston will pass through the by-pass into the compartment 12 until the contacting point on the piston passes the opening 58 from which point the gas in advance of the piston will be forced from the chamber 11 through the openings 33, the spring 38 yielding sufficiently to permit free discharge of the gas.

As only a portion of the gas in the chamber passes through the pipe 63 and the remainder passes through the discharge openings 33 and escapes, the pressure in the chamber 11 will be gradually decreased to a point where it will be insufficient to move the valve 59 from its seat.

When this limit has been reached the gas remaining in the chamber will all be discharged through the openings 33 until a perfect vacuum is created in the chamber 11, and at this time very little power is required to rotate the piston 21, as there remains in the chamber no gas to retard its movement.

When the gas escapes through the openings 33 with some little pressure the valve 36 may be lifted from its seat above the openings 33, but when this pressure decreases so that it is insufficient to offset the tension of spring 38, the pressure will cause the thin flexible valve 36 to curve slightly between the ribs 42 and pass noiselessly into the pocket 34 and thence through the outlet 40, 41.

This makes a most effective vacuum pump which will be noiseless in operation and which requires very little power to actuate it.

It is believed that the operation and many advantages of the invention will be understood without further description.

Having thus described my invention, I claim:

1. In a device of the class described, a piston rotatable in a cylindrical chamber with one point thereof always in contact with the wall of said chamber, said chamber having an outlet therefrom open to atmosphere at its outer end and said piston having a radial blade extending therefrom with an inlet passage therein terminating in a port in a side wall of said blade farthest from said outlet and spaced from the periphery of said piston; and an oscillating pin having a transverse slot through which said blade extends, one wall of said slot closing said port until the contacting point of said piston in its rotation has advanced considerably beyond said slotted pin and said oscillating pin being at one side of and slightly removed from said outlet.

2. In a device of the class described, a piston rotatable in a cylindrical chamber with one point thereof always in contact with the wall of said chamber, said chamber having an outlet therefrom open to atmosphere at its outer end and said piston having a radial blade extending therefrom with an inlet passage therein terminating in a port in a side wall of said blade farthest from said outlet and spaced from the periphery of said piston; an oscillating pin having a transverse slot through which said blade extends, one wall of said slot closing said port until the contacting point of said piston in its rotation has advanced considerably beyond said slotted pin and said oscillating pin being at one side of and slightly removed from said outlet; and an automatic valve for closing said outlet.

3. In a device of the class described, a piston rotatable in a cylindrical chamber with one point thereof always in contact with the wall of said chamber, said chamber having an outlet therefrom open to atmosphere at its outer end and said piston having a radial blade extending therefrom with an inlet passage therein terminating in a port in a side wall of said blade farthest from said outlet and spaced from the periphery of said piston; an oscillating pin having a transverse slot through which said blade extends, one wall of said slot closing said port until the contacting point of said piston in its rotation has advanced considerably beyond said slotted pin and said oscillating pin being at one side of and slightly removed from said outlet; and a spring-pressed valve for closing said outlet.

4. In a device of the class described, a piston rotatable in a cylindrical chamber with one point thereof always in contact with the wall of said chamber, said chamber having an outlet therefrom open to atmosphere at its outer end and consisting in part of a plurality of alined discharge openings and said piston having a radial blade extending therefrom with an inlet passage therein terminating in a port in a side wall of said blade farthest from said outlet and spaced from the periphery of said piston; an oscillating pin having a transverse slot through which said blade extends, one wall of said slot closing said port until the contacting point of said piston in its rotation has advanced considerably beyond said slotted pin; a thin plate normally covering

said openings; a follower thereon provided with transverse ribs resting on said plate; and a spring forcing said follower against said plate causing the latter to close said openings.

5. In a device of the class described, a casing having a closed cylindrical chamber, an inlet compartment, and a communicating passage between the chamber and compartment, said passage having cylindrical walls; a pin adapted to oscillate in said passage and having a transverse slot therein; a rotatable shaft centrally disposed in said chamber; an eccentric cam thereon; an annular piston mounted on the periphery of said cam with one peripheral point always in contact with the wall of said chamber and provided with a radial blade extending through the transverse slot of said pin, said blade having an inlet passage communicating with said compartment and terminating in ports in one wall of said blade and spaced from the periphery of said piston; outlet openings from said chamber adjacent but slightly removed from the closed wall of said blade; and a thin flexible plate normally closing said openings.

6. In a device of the class described, a casing having a closed cylindrical chamber, an inlet compartment, and a communicating passage between the chamber and compartment, said passage having cylindrical walls; a pin adapted to oscillate in said passage and having a transverse slot therein; a rotatable shaft centrally disposed in said chamber; an eccentric cam thereon; an annular piston mounted on the periphery of said cam with one peripheral point always in contact with the wall of said chamber and provided with a radial blade extending through the transverse slot of said pin, said blade having an inlet passage communicating with said compartment and terminating in inclined ports in one wall of said blade spaced from the periphery of said piston; openings from said chamber adjacent but slightly removed from the closed wall of said blade and communicating at their opposite ends with an outlet open to atmosphere; and means within said outlet for closing said openings.

7. In a device of the class described, a casing having a closed cylindrical chamber, an inlet compartment, and a communicating passage between the chamber and compartment, said passage having cylindrical walls; a pin adapted to oscillate in said passage and having a transverse slot therein; a rotatable shaft centrally disposed in said chamber; an eccentric cam thereon; an annular piston mounted on the periphery of said cam with one peripheral point always in contact with the wall of said chamber and provided with a radial blade extending through the transverse slot of said pin, said blade having an inlet passage communicating with said compartment and terminating in ports in one wall of said blade, the lower ends of which are considerably removed from the periphery of said piston; and valved openings from said chamber adjacent but slightly removed from the closed wall of said blade communicating with an outlet open to atmosphere.

8. In a device of the class described, a casing having a closed cylindrical chamber, an inlet compartment, and a communicating passage between the chamber and compartment, said passage having cylindrical walls; a pin adapted to oscillate in said passage and having a transverse slot therein and a flat lower side perpendicular to the side walls of said slot; a rotatable shaft centrally disposed in said chamber; an eccentric cam thereon; an annular piston mounted on the periphery of said cam with one peripheral point always in contact with the wall of said chamber and provided with a radial blade extending through the transverse slot of said pin, said blade having an inlet passage communicating with said compartment and terminating in ports in one wall of said blade spaced from the periphery of said piston; and valved outlet openings from said chamber adjacent but slightly removed from the closed wall of said blade communicating with an outlet open to atmosphere.

9. In a device of the class described, a piston ring having a radial blade provided with pockets extending from the outer end thereof with ports from the inner end of said pockets through one wall of the blade.

10. In a device of the class described, a piston ring having a radial blade provided with pockets extending from the outer end thereof with inclined ports from the inner end of said pockets through one wall of the blade.

11. In a device of the class described, a casing having a cylindrical chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere; a piston revoluble therein and contacting at one point with the cylindrical wall of said chamber; and means coacting with said piston for cutting off the supply of gas to said chamber while the contacting part of said piston is travelling from a point at one side of said outlet to a point a considerable distance beyond said inlet.

12. In a device of the class described, a casing having a cylindrical chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere; a piston revoluble therein and contacting at one point with the cylindrical wall of said chamber; means coacting with said piston for cutting off the supply of gas to said chamber while the contacting part of said piston is travelling from a point at one side of said out-

let to a point a considerable distance beyond said inlet; and an automatic valve for closing said outlet under normal conditions and adapted to be opened by increased pressure created in said chamber by the rotation of said piston.

13. In a device of the class described, a casing having a cylindrical chamber therein provided with an inlet passage and a closely adjacent outlet open to atmosphere; an oscillating pin in the inlet passage; a piston revoluble in said chamber with one point always contacting with the cylindrical wall of said chamber and having a hollow radial blade extending through said slot, said blade having a port in one wall thereof for the admission of gas to said chamber and said port being spaced from the periphery of said piston; and means for closing said inlet port while the contact point of the piston is travelling from a point a considerable distance at one side of the outlet to a point beyond the inlet passage.

14. In a device of the class described, a revoluble piston having a radial blade; and an oscillating pin provided with a slot through which said blade extends, said pin being made in two abutting parts retained together by headed rods extending through both parts.

15. In a device of the class described, a casing having a cylindrical chamber; and an eccentric revoluble piston therein provided with means cutting off the supply of gas to said chamber during a portion of the cycle of rotation of said piston.

16. In a device of the class described, a casing having a cylindrical chamber and an outlet therefrom open to atmosphere; a valve closing said outlet under normal conditions; and an eccentric revoluble piston therein adapted during only the latter part of its rotation to compress the gas in advance thereof and eject it through said outlet.

17. In a device of the class described, a casing having a cylindrical chamber and an outlet therefrom open to atmosphere; and an eccentric revoluble piston therein provided with means operable during a part of the cycle of said piston to create an increased pressure of the gas in said chamber in advance of said piston; and an outlet valve normally closed but adapted to be opened by the increased pressure created in said cylinder.

18. In a device of the class described, a casing having a cylindrical chamber provided with an outlet open to atmosphere and a plurality of alined discharge openings communicating with said outlet; a flat yielding plate covering said openings; a follower therefor having transverse ribs resting thereon; and a spring bearing on said follower.

19. In a device of the class described, a casing having a cylindrical chamber provided with an outlet open to atmosphere and a plurality of alined discharge openings communicating with a wide pocket in said casing having narrow recesses at the ends thereof; a flat yielding plate covering said openings with its ends in said recesses; a follower therefor having transverse ribs resting thereon, the ends of said follower being disposed in said recesses; and a spring bearing on said follower.

20. In a device of the class described, a casing having a cylindrical chamber provided with a member having an outlet open to atmosphere and a plurality of alined discharge openings communicating with a wide pocket in said casing having narrow recesses at the ends thereof; a flat yielding plate covering said openings with its ends in said recesses; a follower therefor having transverse ribs resting thereon, the ends of said follower being disposed in said recesses; a spring bearing on said follower; and a longitudinal bar on the outlet member forming a bearing surface for said spring.

21. In a device of the class described, a casing having a cylindrical chamber; an eccentric piston therein provided with a radial blade having oil grooves at its opposite ends, an oscillating pin having a slot through which said blade extends; and means for admitting a lubricant to said grooves.

22. In a device of the class described, a casing having a cylindrical chamber; an eccentric piston therein provided with a radial blade having oil grooves at its opposite ends; an oscillating pin having a slot through which said blade extends; and adjustable means for admitting a lubricant to said grooves.

23. In a device of the class described, a casing having a cylindrical chamber; an eccentric piston therein provided with a radial blade having oil grooves at its opposite ends; an oscillating pin having a slot through which said blade extends, said pin being positioned in a semi-cylindrical passage and having peripheral oil grooves extending lengthwise thereof opposite the walls of said passage; and means for admitting a lubricant to said oil grooves.

24. In a device of the class described, a casing having a cylindrical chamber; an eccentric cam revoluble therein; an annular piston surrounding said cam and having bearing portions at opposite ends thereof contacting with the periphery of said cam, each bearing portion having an oil groove extending transversely thereof; and means for admitting a lubricant to said oil grooves.

25. In a device of the class described, a casing having a cylindrical chamber; an annular piston provided with a radial blade;

an oscillating pin having a slot through which said blade extends; an eccentric cam on which said annular piston is mounted and which is revoluble in said chamber; end plates at the opposite ends of said casing one of which is provided with an oil passage to admit a lubricant to said chamber and to grooves formed in the moving parts therein; and means for regulating the admission of lubricant through said passage.

26. In a device of the class described, a casing having a cylindrical piston chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere; a piston revoluble therein and contacting at one point with the cylindrical wall of said chamber; a by-pass in the outer wall of said chamber adjacent the outlet and extending to the inlet side thereof; a valve closing said by-pass and adapted to be opened when the pressure within said chamber exceeds a predetermined limit; and valve mechanism for closing said outlet under normal conditions.

27. In a device of the class described; a casing having a cylindrical piston chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere; a piston revoluble therein and contacting at one point with the cylindrical wall of said chamber; a housing secured to the outer wall of said casing adjacent the outlet and having a chamber therein communicating with the piston chamber of said casing by an opening; a valve for closing said opening and adapted to be opened under a predetermined pressure; a pipe leading from said housing to the inlet side of said piston chamber; and valve mechanism for closing said outlet under normal conditions and adapted to be opened only when the contacting portion of the piston has passed said by-pass.

28. In a device of the class described, a casing having a cylindrical piston chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere; a piston revoluble therein and contacting at one point with the cylindrical wall of said chamber; a housing secured to the outer wall of said casing adjacent the outlet and having a chamber therein communicating with the piston chamber of said casing by a cone-shaped opening; a spring-pressed valve for closing said opening and adapted to be opened under a predetermined pressure; a pipe leading from said housing to the inlet side of said piston chamber; and a valve controlling the escape of gas through said outlet adapted to be opened only when the contacting portion of the piston has passed said by-pass.

29. In a device of the class described, a casing having a cylindrical piston chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere and a compartment communicating with said piston chamber by a cylindrical passage; an oscillating pin in said passage having a transverse slot therein; a piston revoluble in said piston chamber and contacting at one point with the cylindrical wall thereof; a blade extending from said piston through said slot and having an inlet passage therethrough; a by-pass through the outer wall of the casing adjacent the outlet from said chamber and extending to said compartment; a valve closing said by-pass and adapted to be opened when the pressure within the piston chamber exceeds a predetermined limit; and a valve in said outlet normally closed but adapted to be opened when the contacting portion of the piston has passed said by-pass.

30. In a device of the class described, a casing having a cylindrical piston chamber therein provided with an inlet thereto and an outlet therefrom open to atmosphere and a compartment communicating with said piston chamber by a cylindrical passage; an oscillating pin in said passage having a transverse slot therein; a piston revoluble in said piston chamber and contacting at one point with the cylindrical wall thereof; a blade extending from said piston through said slot and having an inlet passage therethrough; a housing secured to the outer side of said casing adjacent the outlet and having a chamber therein communicating with the piston chamber of said casing by an opening; a valve for closing said opening and adapted to be opened under a predetermined pressure; a pipe leading from said housing to the inlet side of said piston chamber; and a valve in said outlet normally closed but adapted to be opened when the contacting portion of the piston has passed said by-pass.

Signed by me at 746 Old South Bldg., Boston, Mass., this 9th day of April, 1926.

JUSTUS R. KINNEY.