M. E. TOBELER.

EXPLOSIVE ENGINE.

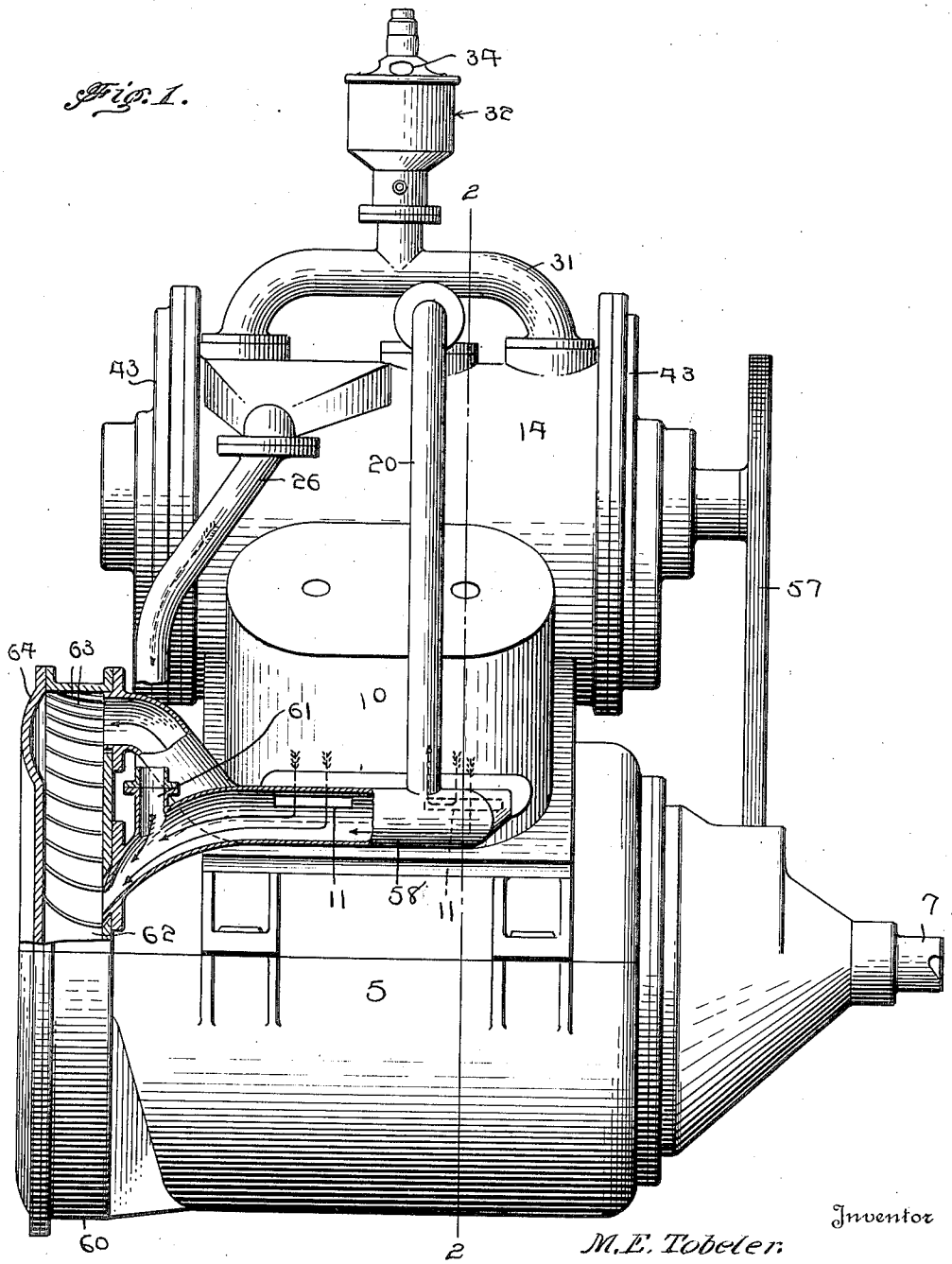
APPLICATION FILED NOV. 27, 1920.

1,438,877.

Patented Dec. 12, 1922.

4 SHEETS—SHEET 1.

Fig. 1.



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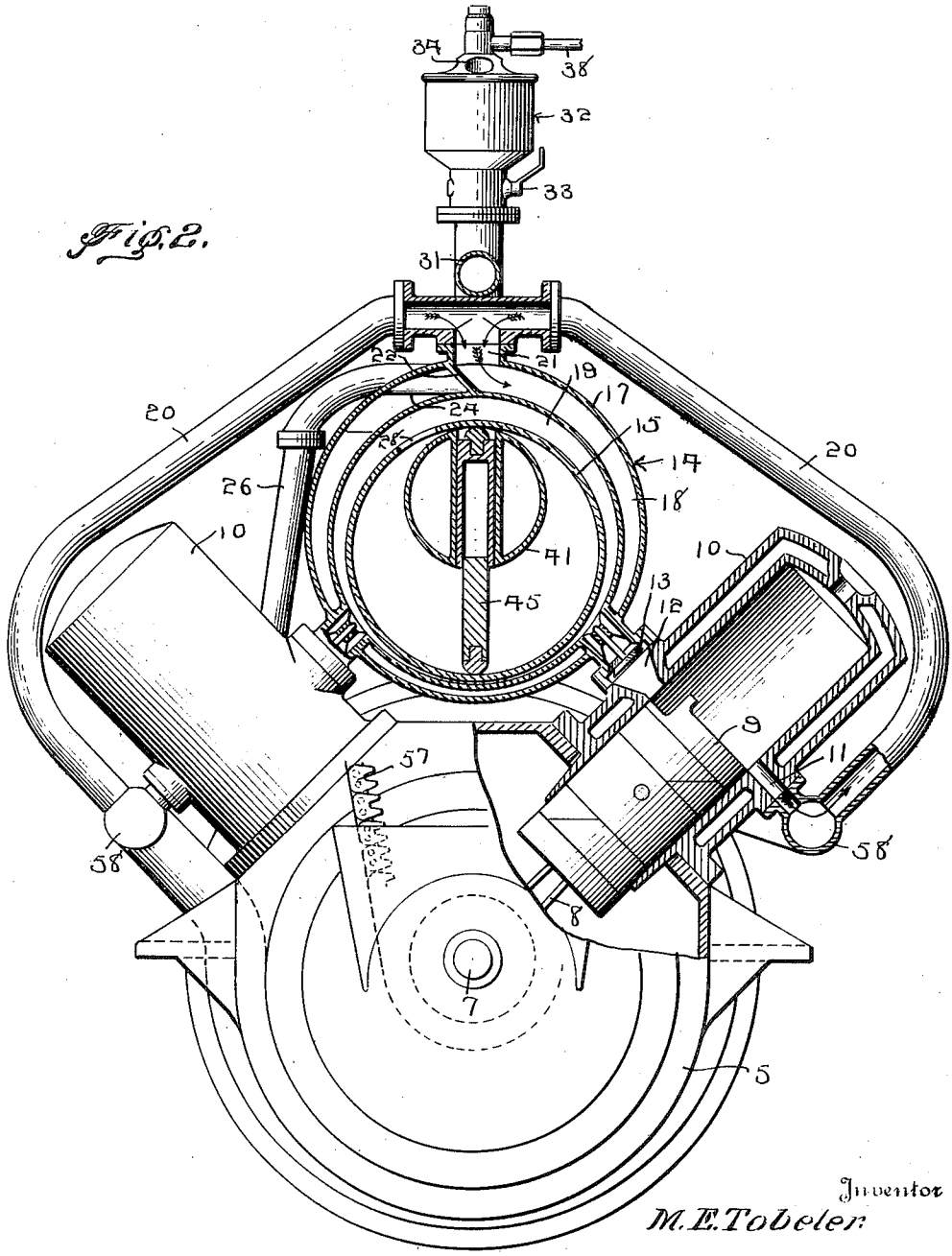
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4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

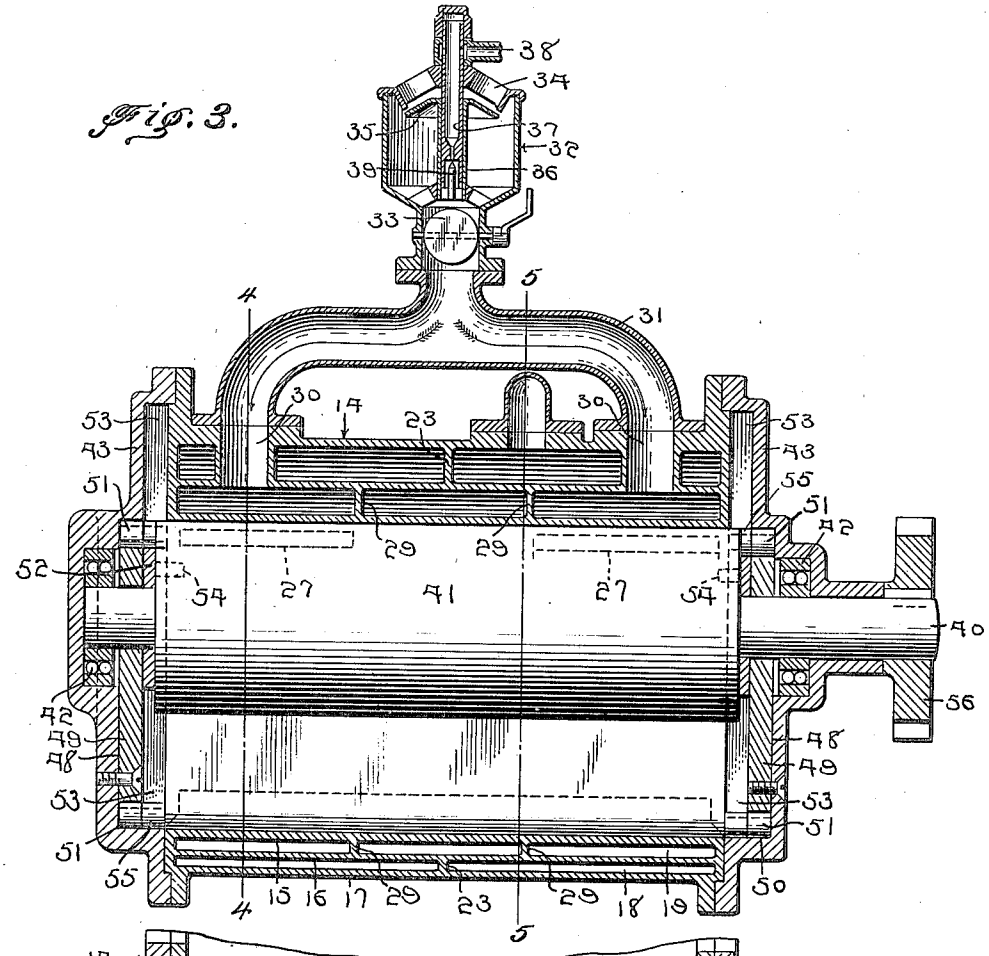
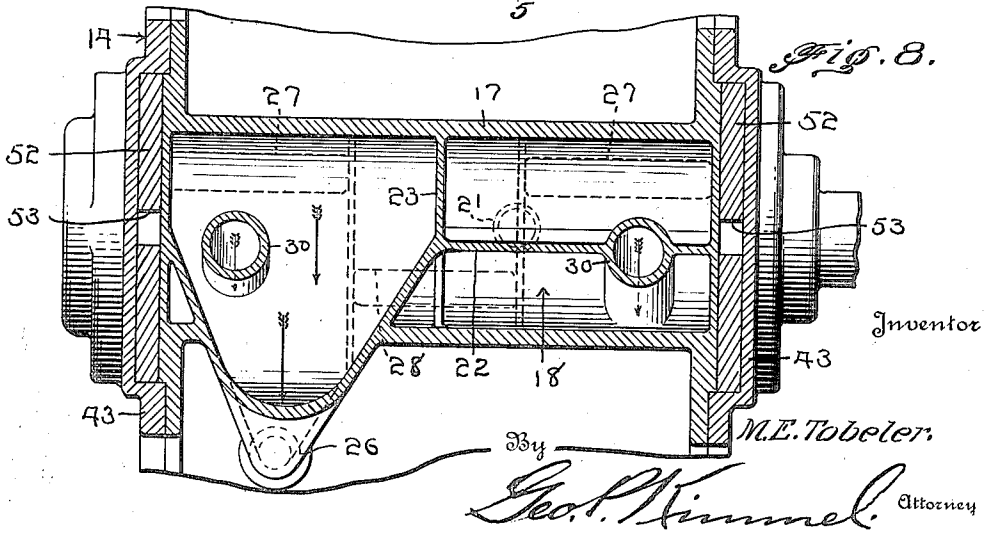


Fig. 8.



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4 SHEETS—SHEET 4.

Fig. 4.

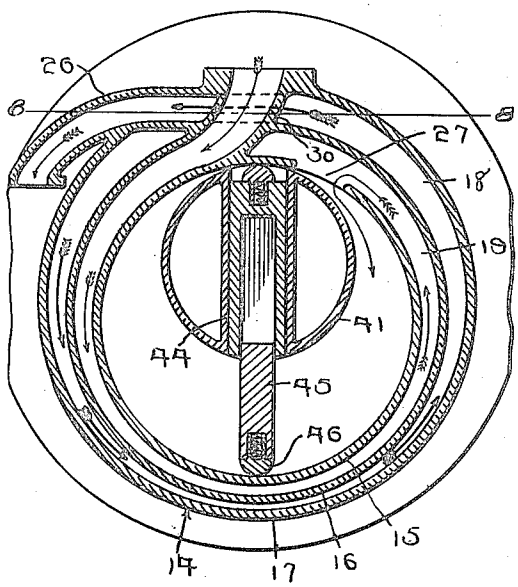


Fig. 5.

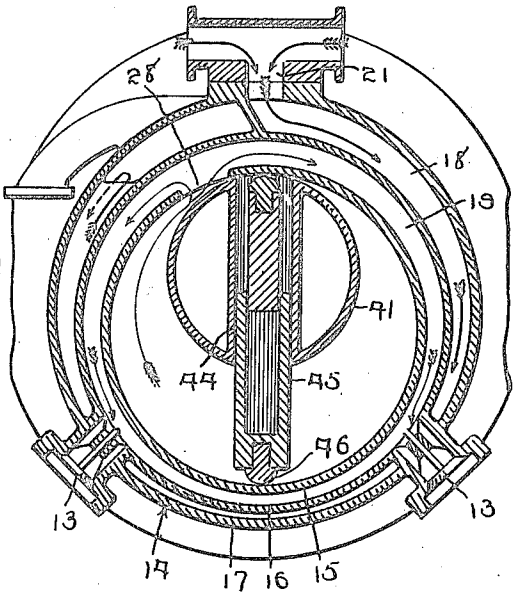


Fig. 6.

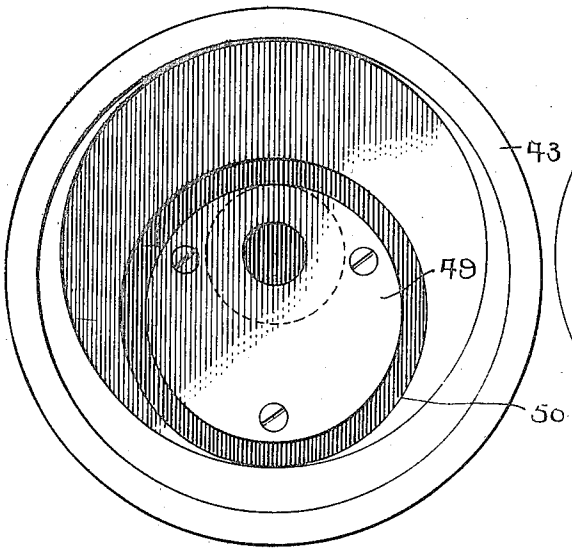
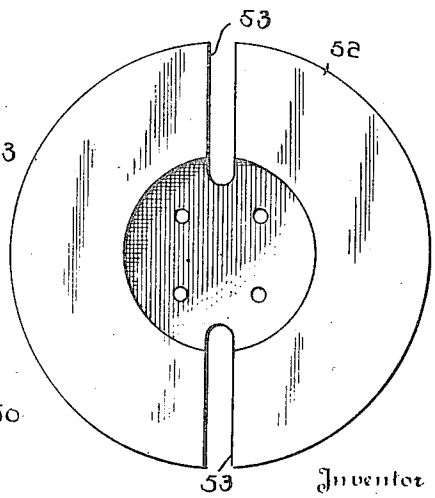


Fig. 7.



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Patented Dec. 12, 1922. 1,438,877

UNITED STATES PATENT OFFICE.

MAX EMIL TOBELER, OF DETROIT, MICHIGAN.

EXPLOSIVE ENGINE.

Application filed November 27, 1920. Serial No. 426,821.

To all whom it may concern:

Be it known that I, MAX EMIL TOBELER, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in an Explosive Engine, of which the following is a specification.

This invention relates to improvements in explosive engines of the two cycle type and has for its principal object to provide for the compact assembly of the engine, gaseous fuel compressor, gaseous fuel distributing system and arrangement of exhaust pipes for conducting the products of combustion from the engine cylinders.

A further object is the provision of an improved gaseous fuel compressor of the rotary type having internal circuitous fuel conducting passages completely enclosed by heating chambers through which the exhaust products of combustion are conducted immediately subsequent to their discharge from the engine cylinders to effectively heat the incoming fuel mixture and ensure complete vaporization of the liquid fuel.

A still further object resides in the final utilization of the products of combustion in the operation of a turbine wheel mounted upon the crank shaft.

A still further object resides in the close arrangement of the fuel compressor relative to the inlet ports of the engine cylinders whereby to minimize in the loss of heat of the fuel mixture incident to its passage from the compressor to the explosion chambers of the engine cylinders.

With these and other objects in view, the invention consists in certain novel features of construction as hereinafter shown and described, and specificially pointed out in the claims.

In the accompanying drawings:

Figure 1 is a side elevation of the explosive engine, portions of the exhaust pipes and turbine casing being shown in section.

Fig. 2 is a front elevation of the engine, partly in section, the plane of the section being indicated by the section line 2—2 in Fig. 1.

Fig. 3 is a vertical longitudinal sectional view through the rotary compressor dismounted from the cylinders of the engine.

Figure 4 is a transverse vertical sectional view through the rotary compressor on the line 4—4 of Fig. 3.

Fig. 5 is a similar view of the rotary compressor on the line 5—5 of Fig. 3.

Fig. 6 is an interior elevation of one of the end plates or cylinder heads of the cylinder of the rotary compressor removed.

Fig. 7 represents an elevation of one of the rotary guides for the sliding abutments of the rotary compressor.

Fig. 8 is a fragmental horizontal sectional view on the line 8—8 of Fig. 4.

Referring to the drawings in detail, wherein similar reference numerals designate corresponding parts throughout the several views, the numeral 5 indicates the crank case of the improved engine in which a crank shaft 7 is journaled having connection with the connecting rods 8 attached to the pistons 9 reciprocably mounted in the cylinders 10. In the embodiment of the invention illustrated in the accompanying drawing, the cylinders are arranged as in the V-type engines and, if preferred, the cylinders may be arranged in banks of any desired number.

The opposed portions of the cylinders 10 are formed with exhaust ports 11 which are uncovered by the pistons 9 when the latter approach the limit of their power strokes permitting the products of combustion to exhaust from the combustion chambers of the cylinders. The adjacent portions of the walls of the cylinders 10 are provided with inlet ports 12 through which the gaseous fuel is conducted to the cylinders during the change of motion of the pistons 9, the inlet ports 12 having inwardly opening check valves 13 arranged therein and being connected with the rotary compressor designated generally by the numeral 14.

The rotary compressor is of the cylindrical type being compactly assembled between the banks of cylinders 10 and having its axis disposed horizontally. The cylindrical body portion of the compressor is composed of three eccentric spaced walls namely, the inner wall 15, the intermediate wall 16 and the outer wall or casing 17. The chamber 18 between the intermediate and outer walls 16 and 17 constitutes a heating jacket for the inner chamber 19, a portion of the products of combustion from the engine cylinders 10 being conducted to

the chamber 18 through exhaust branch pipes 20 and a port 21 formed in the upper portion of the chamber 18. To ensure thorough circulation of the heated products or combustion through the chamber 18, a transverse baffle 22 is interposed between the walls 16 and 17 at a point adjacent the port 21. The chamber 18 is also divided by a circular radiating disposed partition 23 arranged centrally between the ends of the rotor cylinder and having a portion thereof adjacent the baffle 22 cut away as indicated at 24 to permit the heated products of combustion to enter the portion of the chamber 18 on the opposite side of the partition 23. Subsequent to circulating about the terminal portion of the chamber 18 opposite the port 21, the products of combustion are finally conducted from the rotor casing or cylinder by the exhaust pipe 26.

The terminal portions of the inner wall 15 of the rotor cylinder are provided with elongated inlet ports 27 communicating with the bore of the cylinder whereas the medial portion of the inner cylinder wall 15 lying intermediate the ports 27 and spaced circumferentially therefrom is provided with an outlet port 28. The chamber 19 is divided by a plurality of equidistant circular and radially disposed partitions 29 into three circular passages communicating respectively with the ports 27 and 28.

The terminal passages of the chamber 19 communicate with short pipe sections 30 extending through the outer or heating chamber 18 and connected with the forked terminals of an intake manifold 31. The inlet terminal of the manifold 31 is connected with a carbureter 32 equipped with a throttle valve 33 and air intake ports 34 controlled by a frusto-conical valve 35 having a sleeve portion 36 connected therewith and mounted for sliding movement upon the nozzle 37. A liquid fuel supply pipe 38 is connected with the nozzle 37 and the discharge of fuel from the discharge port of the latter is controlled by a valve 39 mounted internally of the sleeve 36 and movable therewith. As clearly shown in Fig. 4, portions of the short pipe sections 30 are extended across the terminal passages of the inner or fuel conducting passage 19 for ensuring circulation of the incoming gaseous fuel about the end passages prior to their admission to the rotor inlet ports 27.

The stub axles 40 carried by the terminals of the rotor 41 are journaled in bearings 42 provided in the cylinder heads or end plates 43. The rotor 41 is eccentrically mounted in the bore of the compressor cylinder 14 and is provided with a diametrical slot 44 receiving the sliding abutment 45. The active edges of the abutment 45 are provided with spring pressed sealing strips 46 movable across the inlet and outlet ports 27 and 28 of the compressor and over the inner face of the bore of the compressor cylinder whereby suction is created in the portion of the gaseous fuel conducting system lying intermediate the inlet port 27 and the carbureter 32 and ejecting the gaseous fuel under pressure through the outlet port 28 and intermediate passage of the gaseous fuel connecting chamber 19. As indicated in Figures 2 and 5, the housings of the check valves 13 are extended into and communicate with the intermediate passage of the chamber 19 whereby gaseous fuel is admitted to the explosive chambers of the cylinders 10 under pressure during operation of the engine.

Compressor cylinder heads 43 are provided with circular depressions 48 concentric with the bore of the compressor cylinder and receiving relatively thin circular disks 49 disposed in spaced concentric relation to the side wall of the cavities formed by the depressions 49 thereby defining circular channels 50 in which the guide rollers 51 secured to the terminals of the abutments 45 travel. By so arranging the rollers 51 to travel in the circular channels 50, the sealing strips 46 of the abutment are maintained in sliding contact with the wall of the bore of the compressor cylinder. Supplemental guide disks 52 having opposed radial slots 53 are interposed between the compressor cylinder 14 and its heads 43 and are connected with the terminals of the rotor 41 by pins 54. Additional guide rollers 55 arranged adjacent the rollers 50 are mounted to travel in the slots 53 of the supplemental guide disks 52 whereby the sliding abutment is maintained in diametrical position relative to the rotor 41.

One of the stub shafts 40 of the rotor is extended exteriorly of the compressor cylinder 14 and is provided with a gear wheel 56 receiving the drive chain 57 which also extends over a similar gear wheel secured upon the crank shaft 7 of the explosive engine, whereby rotary movement of the crank shaft during operation of the explosive engine is transmitted to the rotor 41 of the gaseous fuel compressor 14.

The exhaust ports 11 in each bank of cylinders 10 communicate with an exhaust manifold 58 which extends alongside of the banks of cylinders and which communicates with the branch exhaust ports 20 through which a portion of the products of combustion is conducted to the compressor cylinder 14 for heating the external jacket of the latter incident to the operation of the engine. The exhaust manifolds 58 extend to a point adjacent the terminal of the crank shaft 7 opposite the drive chain 57 and communicate with the outer portion of a tur-

bine casing 60. The final exhaust pipe 26 for the heating chamber 18 of the compressor cylinder is connected with one of the exhaust manifolds as indicated at 61 in Fig. 1 in order to utilize the entire pressure of the burnt gases in the operation of the turbine wheel 62 mounted in the turbine casing 60.

The turbine wheel 62 is non-rotatably mounted upon the crank shaft 7 and is provided with a series of pitched blades 63 which are so arranged that the products of combustion discharged from the terminals of the manifolds 58 impinging thereon effects rotary movement of the turbine wheel in the direction of rotation of the crank shaft of the engine. The end wall of the casing 60 opposite the crank case 5 is formed with a circular depression 64 providing a circular passage for the products of combustion and permitting their discharge from a suitable port formed in any desired location in the turbine casing.

During operation of the improved explosive engine, the rotary compressor 14 is constantly driven through the drive chain 57 and the sliding abutment 45 working in the eccentric bore of the cylinder produces suction through the inlet port 27 causing the gaseous fuel to be drawn from the carbureter 32 through the intake manifold 31 and pipes 30 to the chamber 19, it being understood that the incoming gaseous fuel is confined to the opposite extremities of the chamber 19 by the circular partitions 29. The air control valve 35 and needle valve 39 of the carbureter are automatically controlled and correspondingly with the opening and closing movements of a throttle valve 33, by the suction effects created in the carbureter 32 upon the rotation of the rotor 41, the air valve 35 being moved downwardly to uncover the air inlet ports 34 of the carbureter as the throttle valve 33 is moved to open position and the movement of the air valve 35 being transmitted to the liquid fuel controlling valve 39 through the sleeve 37 whereby the proper proportion of air and liquid fuel is maintained. During continued rotation of the rotor 41, the gaseous fuel which is drawn into the bore of the compressor cylinder behind the moving abutment 45 is compressed and discharged through the outlet port 28 and, subsequent to circulating about the intermediate compartment of the inner chamber 19 is conducted to the explosion chambers of the cylinders 10 as the ports 12 thereof are uncovered by the pistons 9. During the compression stroke of each piston, the gaseous fuel is compressed in the usual manner and is subsequently ignited by the sparks from an electrical ignition system (not shown) and the resulting combustion of the fuel effects downward movement of the piston, such movement being transmitted to the crank shaft 7 through the connecting rod 8. As the piston approaches the limit of its power stroke, the exhaust port 11 is uncovered, simultaneously with the uncovering of the inlet port 12 and the products of combustion are admitted to the exhaust manifolds 58 by which they are conducted to the turbine casing 60 and, acting upon the blades 62 of the turbine wheel tend to turn the latter and thus utilize the products of combustion in assisting to drive the crank shaft 7. A portion of the products of combustion passing through the exhaust manifolds 58 is conducted to the chamber 18 forming a jacket about the compressor cylinder, the products of combustion entering the chamber 18 at one side of the centrally disposed partition 23 and traveling in a circular path at one side of the partition finally enter the chamber at the opposite side of the partition through the port 24, being exhausted therefrom to the final exhaust pipe 26. By thus causing the heated products of combustion to circulate about the internal chamber 19 of the compressor cylinder, the products of combustion circulating through the chamber 19 are effectively heated preliminary to their admission to the bore of the compressor cylinder and during their passage from the bore of the compressor cylinder to the engine cylinders 10. In this manner, the incoming charge is heated to such extent, preliminary to its admission to the cylinders of the engine as to ensure thorough vaporization of the liquid fuel and consequent maximum efficiency of the engine.

What is claimed is:

1. In an explosive engine, a cylinder provided with inlet and exhaust ports, a piston reciprocably mounted in the cylinder adapted to uncover said ports, a crank shaft operatively connected with the piston, a rotary compressor operated from the crank shaft having gaseous fuel inlet and outlet ports, the outlet port of the compressor having communication with the inlet port of the cylinder, carbureting means connected with the compressor inlet port, and means for directing the products of combustion discharged from the cylinder exhaust port against the rotary compressor to heat the gaseous fuel preliminary to its admission to the engine cylinder.

2. In an explosive engine, a cylinder provided with inlet and exhaust ports, a piston reciprocably mounted in the cylinder adapted to uncover the ports, a rotary compressor having gaseous fuel inlet and outlet ports, the outlet port of the compressor being connected with the inlet port of the cylinder, carbureting means connected with the inlet port of the compressor, a heating chamber enclosing the rotary compressor,

and means connecting the exhaust port of the cylinder with the heating chamber for conducting the heated products of combustion thereto to heat the gaseous fuel preliminary to its admission to the engine cylinder.

3. In an explosive engine, an engine cylinder having inlet and exhaust ports therein, a rotary compressor connected with the cylinder inlet port, a heating chamber enclosing the compressor, means connecting the cylinder exhaust port with the heating chamber for conducting products of combustion thereto, and deflecting means arranged in the chamber for causing the products of combustion to have a circuitous course through the chamber.

4. In an explosive engine, a gaseous fuel compressor including a double walled cylinder having an internal bore, an inner fuel receiving chamber and an outer heating chamber, circumferentially spaced inlet and outlet ports formed in the inner wall of the cylinder, partitions arranged in the chamber between the inner and intermediate cylinder walls and between the inlet and outlet ports, gaseous fuel conducting means communicating with the inner chamber at remote points and on opposite sides of the partition, a rotor mounted in the cylinder, end plates supporting said rotor, a sliding abutment mounted in the rotor, and means for conducting the products of combustion from the engine to the chamber lying intermediate the intermediate and outer walls of the cylinder.

5. In an explosive engine, a rotary gaseous fuel compressor including a double walled cylinder having an internal bore, and inner and outer chambers provided between the inner, intermediate and outer walls thereof, the inner wall of the cylinder having circumferentially and longitudinally spaced inlet and outlet ports therein, a partition arranged in the inner chamber separating the inlet and outlet ports, gaseous fuel conducting means communicating with the inner chamber, extending exteriorly of the cylinder and remotely located whereby to cause circulation of the gaseous fuel through the chamber during its passage through the cylinder, means for conducting the products of combustion from the engine to the outer chamber, and means for ensuring circulation of the products of combustion through the outer chamber.

In testimony whereof, I affix my signature hereto.

MAX EMIL TOBELER.