

Aug. 10, 1948.

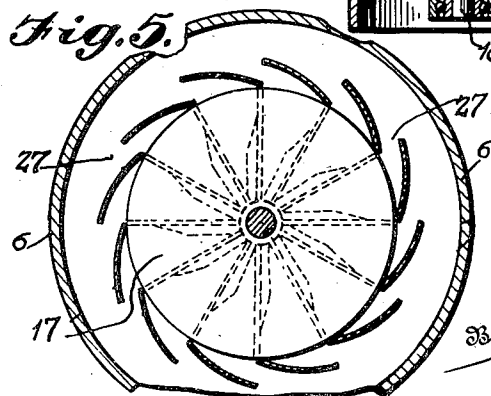
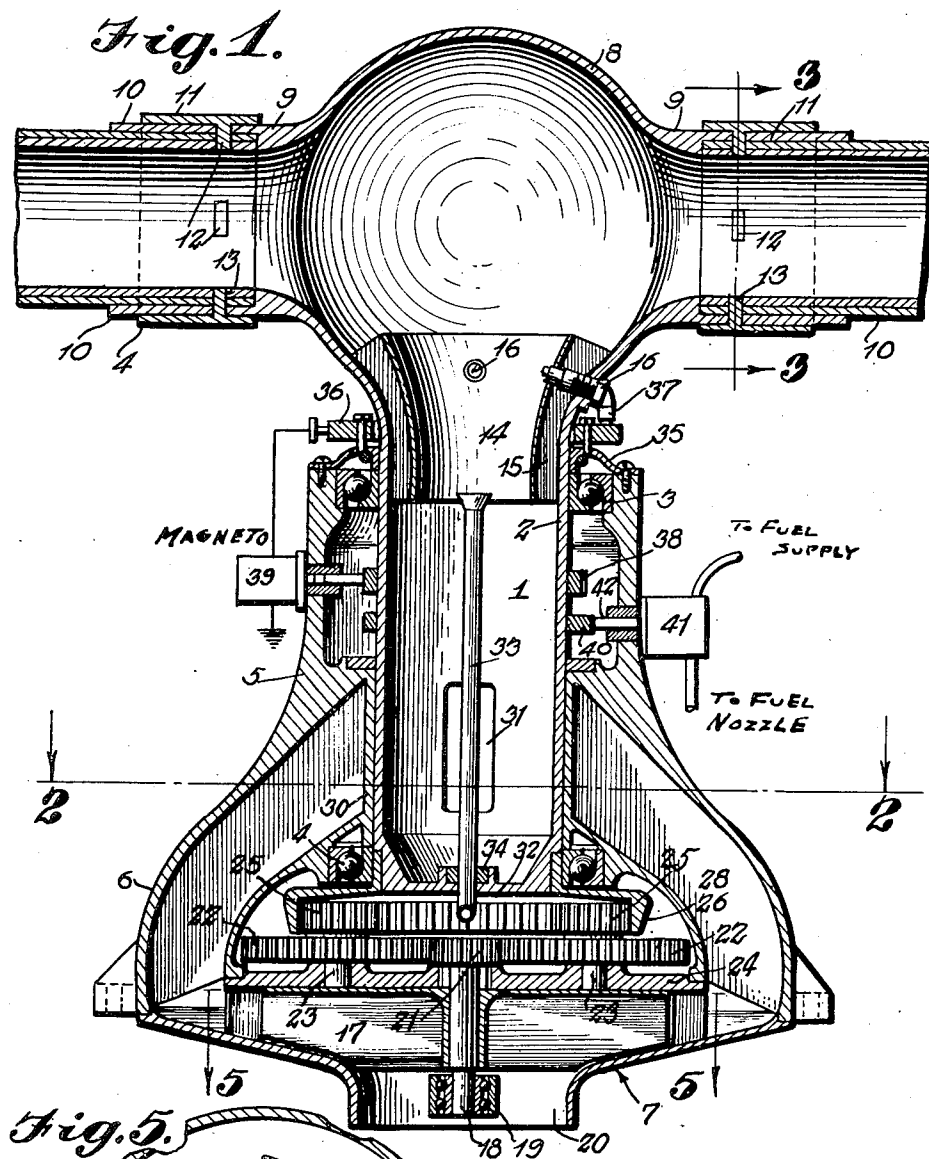
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2,446,785

INTERNAL-COMBUSTION REACTION MOTOR

Filed May 25, 1945

2 Sheets-Sheet 1



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INTERNAL-COMBUSTION REACTION MOTOR

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2 Sheets-Sheet 2

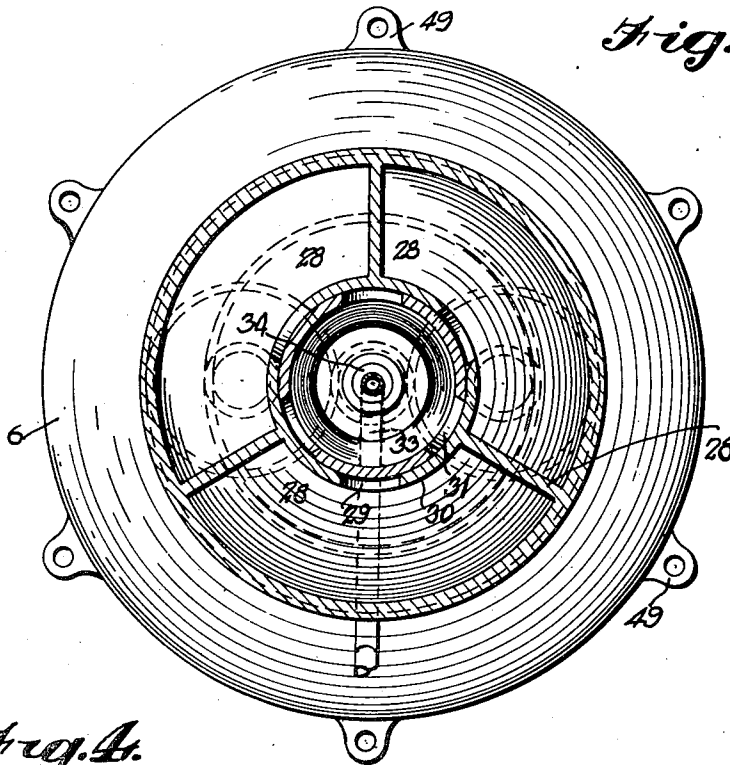


Fig. 2.

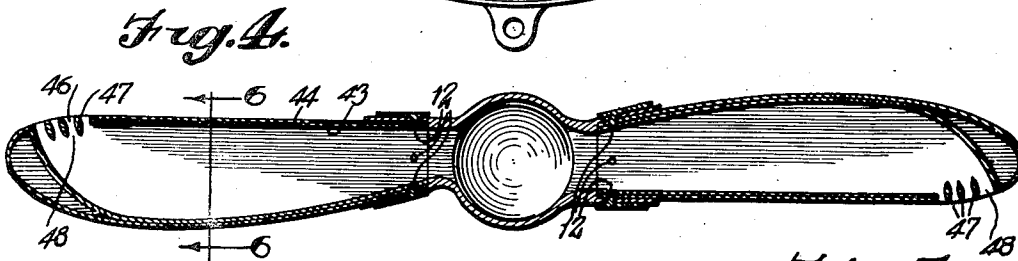


Fig. 4.

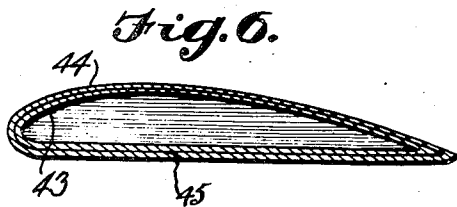


Fig. 6.

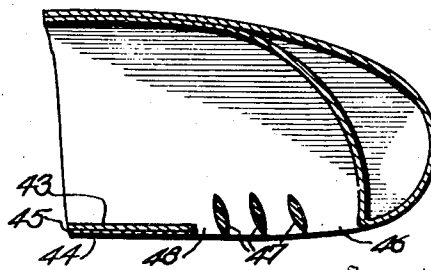


Fig. 7.

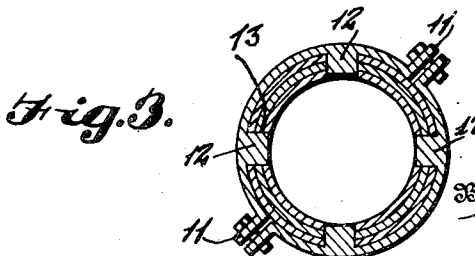


Fig. 3.

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UNITED STATES PATENT OFFICE

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INTERNAL-COMBUSTION REACTION
MOTOR

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12 Claims. (Cl. 60—41)

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This invention relates generally to an internal combustion reaction motor of the type wherein the reaction member is in the form of a screw propeller. More particularly, the invention comprises an internal combustion motor of this type wherein an air compressor is driven by the motor to supply air under pressure as an ingredient of the combustible mixture.

One object of the invention is to provide an internal combustion reaction motor of the character indicated which will be simple and compact in construction, and efficient and economical in operation.

Another object of the invention is to provide in a motor of the character described, means for driving an air compressor, and ignition and fuel accessories, in a manner such that the motor, compressor, and fuel and ignition accessories may be assembled as a complete and compact unit.

Another object of the invention is to provide in a motor of the character described, a rotating combustion chamber together with means for intermittently feeding air under compression and fuel thereto for burning.

Another object of the invention is to provide in a motor of the character described, a rotating combustion chamber which is closed except for the discharge ports in the reaction member, during combustion of the mixture, whereby increased pressures may be realized within the combustion chamber and without imposing such pressures upon the air compressor.

A further object of the invention is to provide an internal combustion reaction motor including an air compressor driven by the motor and supplying air under pressure to the combustion chamber of the motor as an ingredient of a combustible mixture which is burned within the combustion chamber, substantially in accordance with the Brayton cycle of combustion, and the combustion products subsequently delivered to and discharged from a reaction member which is arranged to drive the compressor.

A further object of the invention is to intermittently feed air under compression to the rotating combustion chamber, following each period of fuel ignition therein, whereby the products of combustion may be discharged by the incoming air and fuel and whereby loss of pressure during such periods is minimized by the absorption of heat from the walls of the combustion chamber and reaction member.

These and other objects of the invention will become apparent from a consideration of the fol-

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lowing specification read in the light of the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of the motor with parts of the reaction propeller broken away.

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a transverse sectional view on the line 3—3 of Fig. 1.

Fig. 4 is a transverse sectional view of the reaction propeller.

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 1.

Fig. 6 is a transverse sectional view on the line 6—6 of Fig. 4.

Fig. 7 is an enlarged detail view of a discharge port in the reaction propeller.

Referring more particularly to the accompanying drawings wherein like reference numerals are used to designate like parts throughout, the motor of the present invention comprises a combustion chamber 1 which, in the form shown, is an elongated tubular member 2 mounted for rotation within bearings 3 and 4. The bearing members 3 and 4 are mounted within a casing member 5, the lower portion of which is belled outwardly as shown at 6 to provide means for housing and supporting an air compressor and drive means therefor indicated generally in Fig. 1 by the reference numeral 7.

The elongated tubular member 2 which forms the combustion chamber, is enlarged at its upper end to form a hollow head 8 having diametrically disposed blade attaching portions 9, 9. Attached to each of the portions 9, 9 is a screw propeller blade 10, the respective shanks of which are connected to the members 9, 9 by any suitable means such as split collars 11 which carry lugs 12 arranged to engage in aligned apertures 13 of the blade shanks 10 and blade attaching members 9, as clearly shown in Figs. 1 and 3. A combustion tube or cone 14 is mounted substantially at the point of juncture between the tubular member 2 and the head 8, said combustion cone being concentrically disposed within the tube 2 and secured thereto by means of radial web members 15. The combustion tube 14 forms in effect a mixing chamber within which an ignitable mixture of fuel and air is initially formed and which is fired by one or more ignition devices 16 mounted in the wall of the tube 2 and extending into the tube 14, as clearly shown in Fig. 1.

The compressor unit 7 is shown mounted within the bell-shaped portion 6 of the casing 5 in the lower end thereof, and comprises a rotor 17

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mounted upon a shaft 18, which shaft is journaled in a bearing 19 supported by a spider disposed within the open inlet end 20 of the casing 6. The shaft 18 carries at its upper end a gear 21 which meshes with gears 22, which in turn are carried by stub shafts 23 carried in the upper inner wall 24 of the rotor chamber. Each of the stub shafts 23 above the gears 22, carries pinions 25 which in turn mesh with a ring gear 26 secured to the lower end of the tube 2. By this arrangement, the rotor 17 is rotated through the chain of gears 21, 22, 25 and 26 directly from the tubular chamber. The rotor chamber, as shown in Fig. 5, communicates peripherally through a set of vaned discharge passages 27, with the air discharge manifold 28, which communicates at the upper end thereof with the combustion chamber 1 through ports 29 in a cylindrical wall 30, which circumscribes the lower end of the combustion chamber. The circumscribed portion of the combustion tube 2 is ported at 31 so that, as the combustion tube 2 rotates, air under pressure from the compressor is delivered intermittently to the combustion chamber through alignment of ports 29 and 31.

The combustion tube 2 is closed at its lower end by a wall 32 through which passes a fuel injection pipe 33. The fuel injection pipe 33 extends upwardly through the combustion chamber 1 and terminates within the lower end of the combustion or mixing tube 14, as clearly shown in Fig. 1. The wall 32, surrounding the fuel pipe 33, is provided with a heat resistant fluid-tight packing 34 to prevent leakage of combustion products and loss of pressure at this point.

The casing member 5, adjacent its upper end, is provided with a bearing shield 35 which protects the bearing 3 and is also utilized to support a slip ring 36 by which current is supplied to the ignition devices 16 through brushes 37.

The combustion tube 2 carries intermediate its length a gear 38 which may be arranged to drive a magneto unit 39 mounted on said casing 5, as shown in Fig. 1, and electrically connected to the slip ring as shown diagrammatically in Fig. 1. Also, the combustion tube 2 may be provided with a cam 40 which may be arranged to actuate a fuel injection pump 41 mounted on said casing 5 and having an actuating plunger 42 extending through the casing into operative relation with the cam. Fuel from the injection device 41 may be supplied to the fuel pipe 33 within the tubular chamber, as clearly indicated in Fig. 1.

The reaction member in the form of an aerial screw is shown more clearly in Figs. 4, 6 and 7. Each propeller blade is hollow and formed of at least two laminations of metal, an inner lamination 43 of heat-resistant, non-corrosive metal, and an outer lamination 44 of high strength steel such as chromium nickel steel alloy. Intermediate the two laminations is provided a heat-insulating layer or coating 45 to prevent excessive loss of heat through the walls of the blade. Each propeller blade is provided with a discharge port 46 in the trailing edge thereof and near the outer extremity of the blade, each such port being provided with a plurality of vane members 47 shaped to provide a plurality of nozzle-like discharge apertures 48 shown clearly in Fig. 7. The motor as a unit may be mounted upon any desired supporting structure by means of a plurality of apertured lugs 49 carried by the casing 5.

In operation, fuel from the injection device 41 is intermittently supplied to the fuel pipe 33 at such time as the ports 29 and 31 are in regis-

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tration. The air admitted through the ports 29 and 31 from the compressor, passes longitudinally through the combustion chamber, part of the air mixing with the fuel escaping from the pipe 33 within the mixing tube 14 where it is ignited by the ignition devices 16 and burned, and the remainder of said air passing around the tube 14, mixing with the burning gases beyond the tube, the products of combustion passing through the hollow head 8 and out through the propeller blades 10 for discharge through the ports 48 of the blades, which blades are driven about the axis of the tube 2 by the reaction forces of such discharge. The fuel and air are intermittently delivered to the combustion chamber and following each admission period are burned, with the ports 29 and 31 closed. This intermittent delivery of a combustible mixture to the chamber, followed by closure of the ports 29 and 31 and subsequent burning of the fuel with the ports closed, relieves the compressor 7 of all back-pressure developed within the combustion chamber during periods of burning, whereas the subsequent admission of air and fuel following a burning cycle, flushes the combustion chamber and blades clear of combustion products, while at the same time, absorbing heat from the walls of the chamber and blades to thus minimize pressure losses during periods when fuel and air are being admitted.

It will be understood that the lower portion of the combustion tube 2 carrying the ports 31, in connection with the ported circumscribing wall 30 bearing the ports 29, function as a rotary valve for intermittently admitting air under compression to the combustion chamber. Each charge of fuel thus admitted is subsequently burned during the period while the ports 29 and 31 are closed, and this cycle is repeated as the combustion tube 2 is rotated under the force of reaction of the discharged products of combustion.

It should be noted that the combustion cycle as performed in the present motor closely approximates that of the Brayton cycle of combustion in that the ignition and burning of the fuel within the combustion chamber with the ports 29-31 closed, builds up relatively high pressures in that portion of the tube 2 lying between the closed end 32 thereof and the mixing bell 14. The gases thus compressed during the initial stages of combustion, expand during the later stages of combustion to prolong the period of relatively high pressure within the combustion chamber and thus the actual combustion cycle approximates the theoretical high degree of efficiency obtained from the well known Brayton cycle of combustion. The efficiency of the cycle is further enhanced by the internal rise in pressure of the air introduced to the ports 29 and 31 following each period of combustion, due to the absorption of heat by said gases from the walls of the tube 2, the head 8, and the blades 10.

From the foregoing description it is apparent that I have provided an exceedingly simple, compact internal combustion motor of the reaction type where the motor, its compressor and fuel and ignition devices, are arranged as a unit to facilitate mounting and removal of the unit upon a vehicle or other device to be driven thereby. By arranging the compressor to be housed within the casing which supports the rotating combustion chamber and reaction member, I have not only simplified the construction of known motor design, but have reduced the overall weight to a figure which makes it readily adaptable for aircraft propulsion.

Furthermore, the intermittent feed of combustible mixture and subsequent burning of the mixture within a closed combustion chamber, makes for a combustion cycle approximating quite closely the Brayton cycle, and thus insures a high percentage of combustion efficiency.

It will be understood that I have indicated more or less diagrammatically the construction and arrangement of the ignition and fuel accessories in that these can be arranged in any desirable and convenient manner to accommodate conditions of any particular installation.

Furthermore, it should be understood that while I have illustrated a preferred embodiment of my invention, I reserve the right to make such changes in minor details of construction, and in the size and proportion of parts, as fairly fall within the scope of the invention as pointed out more particularly in the appended claims.

What I claim as new is:

1. An internal combustion reaction motor including a tubular member mounted for rotation and defining a combustion chamber, a hollow reaction member carried by the tubular member and having communication with the combustion chamber and rotatable therewith, discharge ports carried by the reaction member to reactively discharge products of combustion from the combustion chamber to thereby rotate the same, means for intermittently feeding air to the combustion chamber, means for feeding fuel to the combustion chamber, and means for intermittently burning the combustible mixture within the combustion chamber while closed except for the discharge ports in the reaction member.

2. An internal combustion reaction motor including a tubular member defining a combustion chamber and mounted for rotation, a reaction member carried by the tubular member and having communication with the combustion chamber, means for discharging the products of combustion from said reaction member to cause rotation thereof, means for intermittently supplying fuel to said combustion chamber, valve means for intermittently supplying air to said combustion chamber, means for opening and closing said valve means, and means for burning the fuel within the chamber when the valve means are closed.

3. An internal combustion reaction motor including a tubular member defining a combustion chamber and mounted for rotation, a reaction member carried by the combustion chamber and having communication therewith, means for discharging the products of combustion through the reaction member to rotate the same, means for delivering fuel to the combustion chamber, a compressor for supplying air under pressure to the combustion chamber, means for driving the compressor from said rotatable tubular member, valve means for controlling the flow of compressed air from the compressor to said combustion chamber, and means for igniting and burning a combustible mixture within said chamber when said valve means are closed.

4. An internal combustion reaction motor including a tubular member defining a combustion chamber mounted for rotation, a casing member supporting said tubular member for rotation, said casing member being enlarged at one end and provided with a rotor chamber, a rotor mounted within the chamber, means for driving said rotor from said tubular member, a compressed air manifold into which air from said rotor chamber is discharged, a cylindrical wall circumscribing

the tubular member, valve means cooperatively formed in the tubular member and said cylindrical wall for providing intermittent communication between the combustion chamber and said compressed air manifold, means for delivering air to said combustion chamber through said valve means, means for delivering fuel to said combustion chamber, means for burning the fuel within the combustion chamber during periods when said valve means are closed, a reaction member carried by the rotary combustion chamber, and means for discharging the products of combustion from said reaction member.

5. An internal combustion reaction motor including an elongated tubular member forming a combustion chamber, a casing within which said tubular combustion chamber is mounted for rotation, said combustion chamber being open at one end, a reaction member carried by the tubular member and communicating therewith at its open end, an annular series of ports provided in the wall of the combustion chamber, said casing including a circumscribing wall having a series of ports overlying the ported portion of the wall of the combustion chamber, an air compressor including a rotor mounted within said casing, means to drive said rotor from said tubular member, means for intermittently delivering fuel to the combustion chamber, means for delivering air from the compressor intermittently to the combustion chamber through said ports when aligned, means for burning the fuel within the combustion chamber when said ports are out of alignment, and means for discharging the products of combustion from said reaction member.

6. An internal combustion reaction motor comprising an elongated tubular member defining a combustion chamber, a casing surrounding said tubular member and supporting the same for rotation, an annular series of inlet ports adjacent one end of said tubular member, said casing including a circumscribing wall overlying the ported portion of the said tubular member, a series of ports provided in said circumscribing wall and disposed for intermittent registration with the ports of the tubular member when the same is rotated, said casing having a belled portion providing a rotor housing, a rotor mounted within said housing in axial alignment with the axis of rotation of said tubular member, means for driving said rotor from said tubular member, said drive means being housed within said casing, said casing including an air manifold circumscribing the driving means and communicating at one end with the rotor housing and at the other end with said ported circumscribing wall, means for intermittently delivering fuel to the combustion chamber when the combustion chamber is in open communication with said air manifold, and means for burning the fuel within said tubular combustion chamber when said manifold is cut off, a reaction member carried by the rotatable tubular member, and means for discharging the products of combustion from said combustion chamber through the reaction member.

7. An internal combustion reaction motor including a casing provided at one end with a centrally disposed air inlet, an air compressing rotor mounted within said casing, an air manifold receiving compressed air from said rotor, an elongated tubular member defining a combustion chamber and mounted for rotation within said casing about the axis of said rotor member, said tubular member and air manifold in-

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cluding juxtaposed ported, relatively movable wall portions for intermittently delivering air from the manifold to the combustion chamber as said tubular member is rotated within the casing, means closing one end of the combustion chamber, a reaction member carried by the tubular member at the opposite end thereof and in open communication with the combustion chamber, means for admitting fuel to the combustion chamber, means for burning fuel within said combustion chamber when the latter is out of communication with said air manifold, and means for discharging the products of combustion through said reaction member to rotate the tubular member and said compressor rotor.

8. An internal combustion reaction motor including an elongated tubular member defining a combustion chamber, means closing one end of said tubular member, a reaction member in open communication with the opposite end of said tubular member, rotary valve means for intermittently supplying air under pressure to said combustion chamber, an air compressor, means for driving said air compressor including a ring gear carried by said tubular member and operatively connected to said compressor, fuel delivery means passing through the closed end of said tubular member, means for intermittently supplying fuel to the combustion chamber concurrently with the air under pressure, means for burning the fuel-air mixture within the combustion chamber while the chamber is out of communication with the compressor, and means for discharging the products of combustion through said reaction member to rotate the tubular member and drive the compressor.

9. An internal combustion reaction motor including a tubular member, casing means mounting the tubular member for rotation about its axis, said tubular member and casing including concentric ported portions defining air admission means for the combustion chamber, a compressor driven by said tubular member, a reaction member in open communication with the tubular member, means for admitting fuel to the combustion chamber, means for burning fuel within the tubular member, and means for discharging products of combustion through said reaction member to drive the tubular member, air admission means, and air compressor.

10. An internal combustion reaction motor including an elongated tubular member defining a combustion chamber, a reaction member carried by the tubular member at one end and in open communication therewith, the opposite end of said tubular member being closed, fuel admission means passing through the closed end of the tubular member, a casing member supporting the tubular member for rotation about its own axis, a compressor including a rotor coaxially disposed with respect to said tubular member, means for driving said rotor from said tubular member including a ring gear operatively connected to said rotor, means within the casing defining an air manifold communicating with said rotor, said casing and tubular member including concentric ported wall portions defining air admission means for the combustion chamber, fuel supply means and ignition means carried by the casing, means carried by the tubular member for driving the fuel and ignition means, respectively, and means for burning a combustible mixture within said

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tubular member, and means for discharging the products of combustion through said reaction member to simultaneously rotate the tubular member and drive the compressor, fuel supply means and ignition means and said air admission means.

11. An internal combustion reaction motor including an elongated tubular member defining a combustion chamber, means for mounting the tubular member for rotation about its own axis, one end of said tubular member being closed, a fuel admission means passing through said closed end portion and including a conduit extending coaxially of the tubular member, the opposite end of said tubular member being open and in communication with a reaction member carried thereby, an open-ended, substantially bell-shaped mixing member mounted in the upper end of the tubular member in spaced relation thereto and providing an annular air space surrounding the mixing member, said conduit terminating within the lower end of said mixing member, means for intermittently supplying air under pressure to said tubular member, means for supplying fuel to said chamber, means for initiating combustion of said fuel-air mixture within said mixing chamber, a reaction member carried by the tubular member and in open communication therewith, and means for continuing the combustion of said mixture through said reaction member by air passing around the mixing member and mixing with the products of combustion issuing from the upper end thereof, and means for discharging the products of combustion from said reaction member.

12. An internal combustion reaction motor comprising means defining a combustion chamber for receiving a combustible mixture of fuel and air for burning, means mounting said combustion chamber for rotation a reaction member mounted for rotation and in open communication with the combustion chamber, said reaction member being provided with discharge ports for reactively discharging the products of combustion from said chamber, an air compressor, means for driving the air compressor from said reaction member, means for intermittently delivering fuel and air from said compressor to said combustion chamber for burning, and means for igniting and burning said fuel-air mixture within said combustion chamber under pressure and substantially in accordance with the Brayton cycle of combustion.

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