2nd. Edition

PATENT SPECIFICATION

591,189

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COMPLETE SPECIFICATION

Improvements in or relating to Power Units

We, THE FAIREY AVIATION COMPANY LIMITED, a British Company, of North Hyde Road, Hayes in the County of Middlesex, and ARCHIBALD GRAHAM FORSYTH, a British Subject, of "Venlaw" Burdon Lane, Cheam, in the County of Surrey do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to power units particularly for aircraft and the like and comprises a combination of various mechanisms so connected as to give rise to a variety of operating conditions.

Generally the invention is directed to a unit comprising a pair of internal combustion engines adapted to be clutched to drive a pair of variable pitch propellers mounted on coaxial drive shafts. The engines are supercharged and at the rear may be clutched respectively to compressors which supply air under pressure to combustion chambers of jet propulsion devices. Each supercharger is adapted to supply air under pressure to its engine and also to direct air to the combustion chambers of a series of auxiliary jet propulsion devices, supplied also with exhaust gases from the engine.

In the accompanying drawings Figures 1 and 1a together comprise a side elevation of a unit constructed in accordance with the invention, some mechanisms being shown in section; Figure 2 is a view on the line 2—2, Figure 1 looking in the direction of the arrows; Figure 3 is a sectional view taken through one of the superchargers; and Figure 4 is a rear end view of the unit (only one-half showing).

The unit comprises two internal combustion engines A and B (Figure 2) which are arranged to drive two variable pitch propellers C and D (Figure 1) in contra-rotating directions, their pitch being variable by pitch changing mechanisms E and F which are actuated respectively by electric motors G and H, or the like. The specific form of pitch changing mechanism *per se* forms no part of this invention, but it may, for example, be of the type illustrated and described in the Specification of Letters Patent No. 580,745.

The unit is provided with a pair of clutching devices I and J (Figure 2), one for each of the engines A and B, respectively, so that either or both of the propellers C and D may be declutched from the respective engines.

Each engine is provided with a supercharger, the engine A with a supercharger K (Figure 2) and the engine B with a supercharger L and these superchargers are mounted on the sides of the engines at the rear and are driven from the engine crankshaft as shown in Figure 3 and as will be hereinafter described.

To the rear of the engines A and B are two compressors such as M which are arranged to be driven respectively by the engines when desired through clutching devices such as O respectively.

Each of the compressors such as M is adapted to supply gases under pressure to a series of cigar-shaped jet propulsion combustion chambers Q which extend rearwardly and terminate in propulsion jets R.

The superchargers K and L are adapted to supply air under pressure to the intake manifolds of the engines A and B and also to a series of cigar-shaped jet propulsion combustion chambers S which are also fed with exhaust gases from the engines and which terminate in propulsion jets T.

The arrangement of the propulsion jets R and T is perhaps best shown in Figure 4.

Having described generally the elements comprising the unit, some of the specific structure will now be described in greater detail.

The propellers C and D are mounted on coaxial drive shafts one of which is connected with a gear wheel 10 and the other with a gear wheel 11. The gear wheel 10 engages teeth 12 on a shaft 13 of the clutching device I, while the other gear wheel 11 engages teeth on a similar shaft of the other clutching device J. Since the clutching devices I and J are similar,

a description of the device I will suffice.

The shaft 13 of the clutching device I is mounted for rotation in the housing 14 of the device I by means of bearings 15 and 16. The engine end of the shaft 13 is formed as a bevel gear wheel 17 which engages bevel gear wheels 18 which in turn are engaged by a bevel gear wheel 19 driven by the engine A. The clutching device I is provided with a plurality of annular discs 20 and 21 alternately disposed and which may (by means not shown) be caused to engage frictionally.

The shafts of the bevel gear wheels 18 are connected with one set of the discs, so that when the discs engage frictionally, the bevel gear wheels 18 are retained against rotation about their axes. When this is the case the bevel gear wheel 19 will drive the shaft 13 and then through the teeth 12, the gear wheel 10 thus rotating the propeller C.

By similar mechanism, the propeller D may be driven or declutched by the other engine B through the clutching device J and gear wheel 11. Clutching devices of the general type of I and J are well known *per se*.

The pitch of the propeller A may be varied by the pitch changing mechanism E which is operatively connected with a shaft 22, the engine end of which is provided with a bevel gear wheel 23 connected to be driven by a shaft 24 connected with the reversible electric motor G. Operation of the motor G may thus effect a change in the pitch of the blades of the propeller C.

The pitch of the blades of the propeller D may be changed through the pitch changing mechanism F which is actuated by the reversible electric motor H.

At the rear of the engine A (Figure 1a), the crankshaft is provided with a bevel gear wheel 25 of the lutching device O which is of the same type as the clutching devices I and J. Through this clutch device O the bevel gear wheel 25 may be clutched or declutched from a shaft 26 which is engaged by pinions 27 mounted on shafts 28 and these shafts 28 have gear wheels 29 secured thereto. The gear wheels 29 in turn engage teeth on the rotor shaft 30 of the compressor M.

The compressor M has a cylindrical tubular housing 31, the inner surface of which is provided with a series of inwardly directed projections 32 of V-section. The rotor shaft 30 carries a series of compressor blades 33. The compressor is supplied with air through the chamber 34 at the front of the compressor and the compressor delivers the compressed air at the rear into the series of jet propulsion chambers Q.

Each of the combustion chambers Q is supplied with fuel through a nozzle 35. A sparking plug 36 or the like is provided for use particularly in starting and until the respective combustion chamber becomes hot.

The rear ends of the combustion chambers Q are formed as venturis 37 and terminate in propulsion jets R which direct the exhaust gases rearwardly.

Through an indentical arrangement, the engine B, through a clutching device (not shown), may drive a similar compressor (not shown) which supplies jet propulsion combustion chambers connected therewith.

The supercharger K of the engine A will be described with reference to Figure 3, it being understood that the supercharger L for the engine B is similarly actuated.

The crankshaft of the engine A has a bevel gear wheel 38 which engages a bevel gear wheel 39 on a stub shaft 40 provided with a gear wheel 41 which forms part of a step-up gear train including gear wheels 42 and 43, the latter engaging gear teeth 44 on the rotor shaft 45 of the supercharger.

The super charger is of known type having blades 46 carried by the rotor shaft 45 and disposed to rotate in a housing. Air is introduced through an inlet tube 47 controlled by a valve 48 or the like. Air may also be drawn in from the side through the opening 49.

The supercharger has convolute outlet passages 50 and 51. The passage 50 directs supercharged air to the intake end of the engine A while the passage 51 (see also Figure Ia) directs compressed air to the auxiliary jet propulsion combustion chambers S. The engine A also has exhaust outlets 52 (Figure 1a) which are disposed to direct the exhaust gases to said combustion chambers S, so that said chambers receive both said exhaust gases from the engine and also compressed air from the supercharger. The combustion chambers S are provided with fuel nozzles 53 to supply fuel from a source (not shown).

The combustion chambers S are generally similar to the combustion chambers Q. They are formed at their rear ends as venturis 54 and terminate in rearwardly directed propulsion jets T. The arrangement of the jets T with respect to the jets R is shown in the rear view Figure 4.

The general operation of the various mechanisms is believed to be clear but the manner of operation of the complete

unit for various flight conditions perhaps requires some elucidation.

On take off, both engines A and B will be operated to drive their respective propellers C and D. The clutching devices I and J will then be in clutching position. Preferably, on take-off, the clutching devices such as O at the rear will be declutched so that the compressor such as M will not be driven.

During cruising at lower altitudes, one or both of the propellers C and D may be actuated, and if desired, one or both of the compressors such as M may be driven to supply the combustion chambers Q of the jet units, so that jet propulsion through the jets R may be provided. Or, alternatively, the propulsive force may be supplied only by these jets R, with the clutching devices I and J at the front declutched so as to disconnect the propellers. The propellers may be feathered to reduce the resistance effect thereof.

At high altitudes the engine is supercharged and the propellers may be cut out. The craft may then be driven solely by jet propulsion through the jets R and also by the jets T. As explained, the jets T are supplied from the combustion chambers S which receive exhaust gases from the engine and also air from the supercharger.

Since there are two engines A and B, two compressors such as M, each of which is clutched to an engine and is connected with a series of propulsion jets R, and also since there are two superchargers K and L, (one for each engine), each connected with a series of propulsion jets T, and further, since the engines may be clutched or declutched to drive a propeller, it will be manifest that a great number of operative conditions may be effected.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. A propulsion unit for aircraft and the like comprising a pair of supercharged internal combustion engines, a pair of variable pitch propellers, means for selectively clutching each of said engines to drive said propellers, means for independently varying the pitch of the blades of either propeller, a pair of compressors, means for selectively clutching each engine to a compressor, two series of jet propulsion devices the combustion chambers of which are supplied repectively with compressed air from one of said compressors, a plurality of auxiliary jet propulsion devices, and means for supplying the combustion chambers of the latter with supercharged air from the engine superchargers and also with exhaust gases from the engines.

2. A propulsion unit for aircraft and the like comprising a pair of internal combustion engines, a pair of variable pitch propellers having coaxial drive shafts, means for selectively clutching each of said engines to drive said propellers in contra-rotating directions, means for independently varying the pitch of the blades of said propellers, a pair of compressors, one mounted rearwardly of each engine, means for selectively clutching each engine to a compressor to drive the same, a series of jet propulsion devices the combustion chambers of which are connected with each compressor to receive compressed gases therefrom, said jet propulsion devices terminating rearwardly of said compressor and disposed with their axes substantially in a circle, a supercharger driven by each engine and mounted at the side and at the rear thereof, a series of auxiliary jet propulsion devices disposed rearwardly of said first jet propulsion devices, and means for supplying compressed air from said superchargers to the combustion chambers of said auxiliary jet propulsion devices.

3. A propulsion unit for aircraft and the like, as claimed in Claim 2, having means for supplying said auxiliary jet propulsion devices with exhaust gases from said engines.

4. A propulsion unit for aircraft and the like comprising at least one internal combustion engine, a variable pitch propeller, means for selectively clutching said engine to drive said propeller, means for varying the pitch of said propeller, a compressor mounted rearwardly of said engine, means for selectively clutching the compressor to be driven by said engine, at least one jet propulsion device the combustion chamber of which is mounted to receive compressed gases from said compressor, said jet propulsion device projecting rearwardly, at least one auxiliary propulsion device disposed rearwardly of the first, a supercharger disposed at the rear side of said engine and connected to be driven thereby, and means for directing at least a portion of the supercharged air to the combustion chamber of the auxiliary jet propulsion device.

5. A propulsion unit for aircraft and the like as claimed in Claim 4, having means for directing exhaust gases from said engine to said auxiliary jet propulsion device.

Dated this first day of May, 1945.

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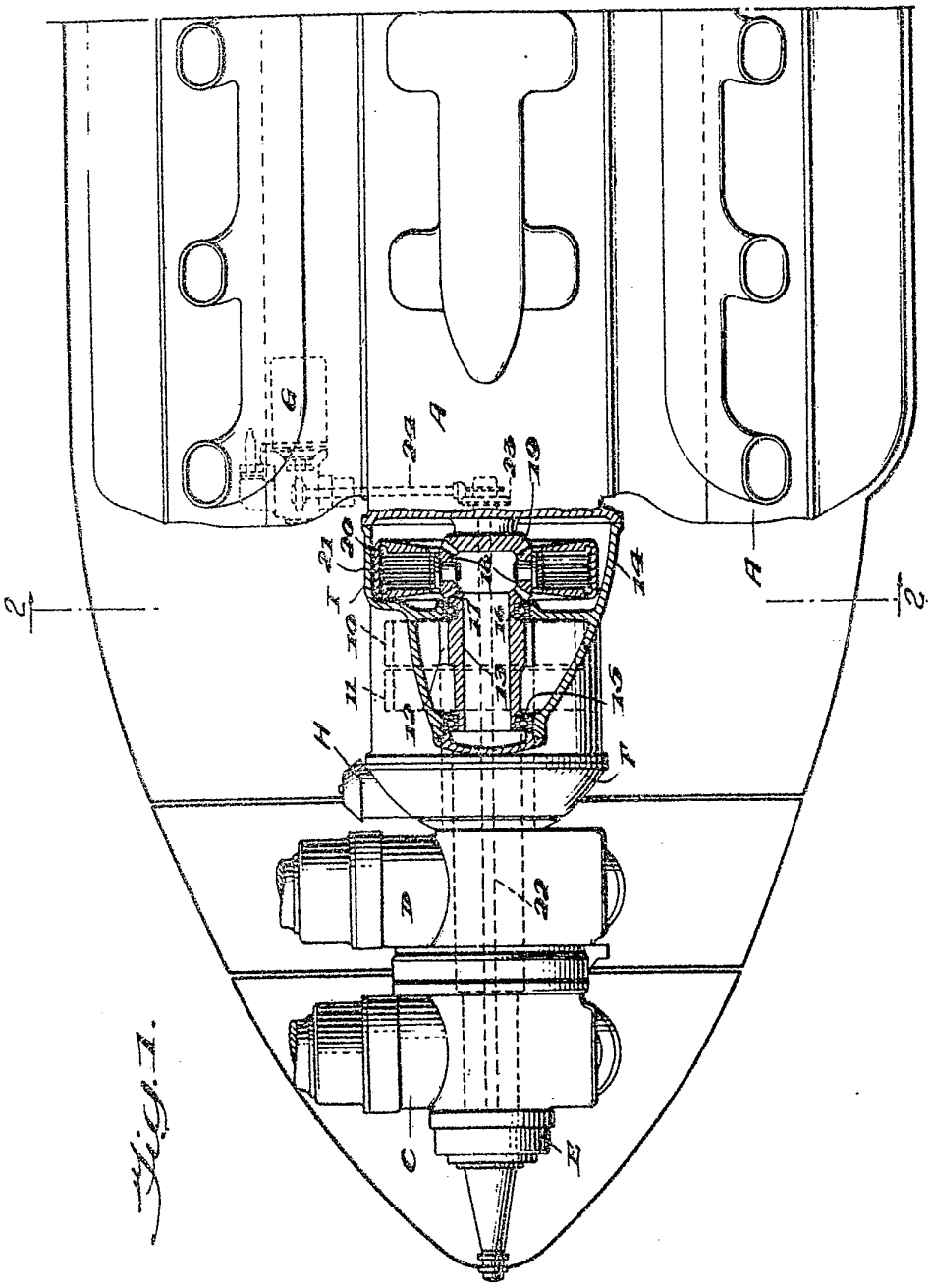
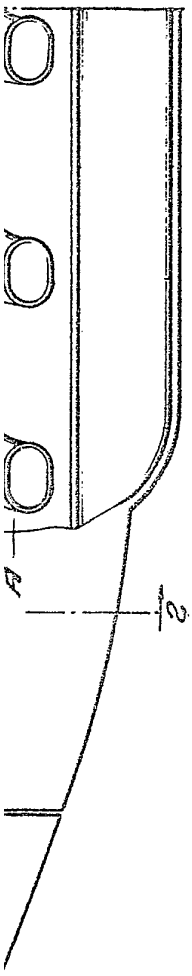


Fig. 1.

SHEET 1



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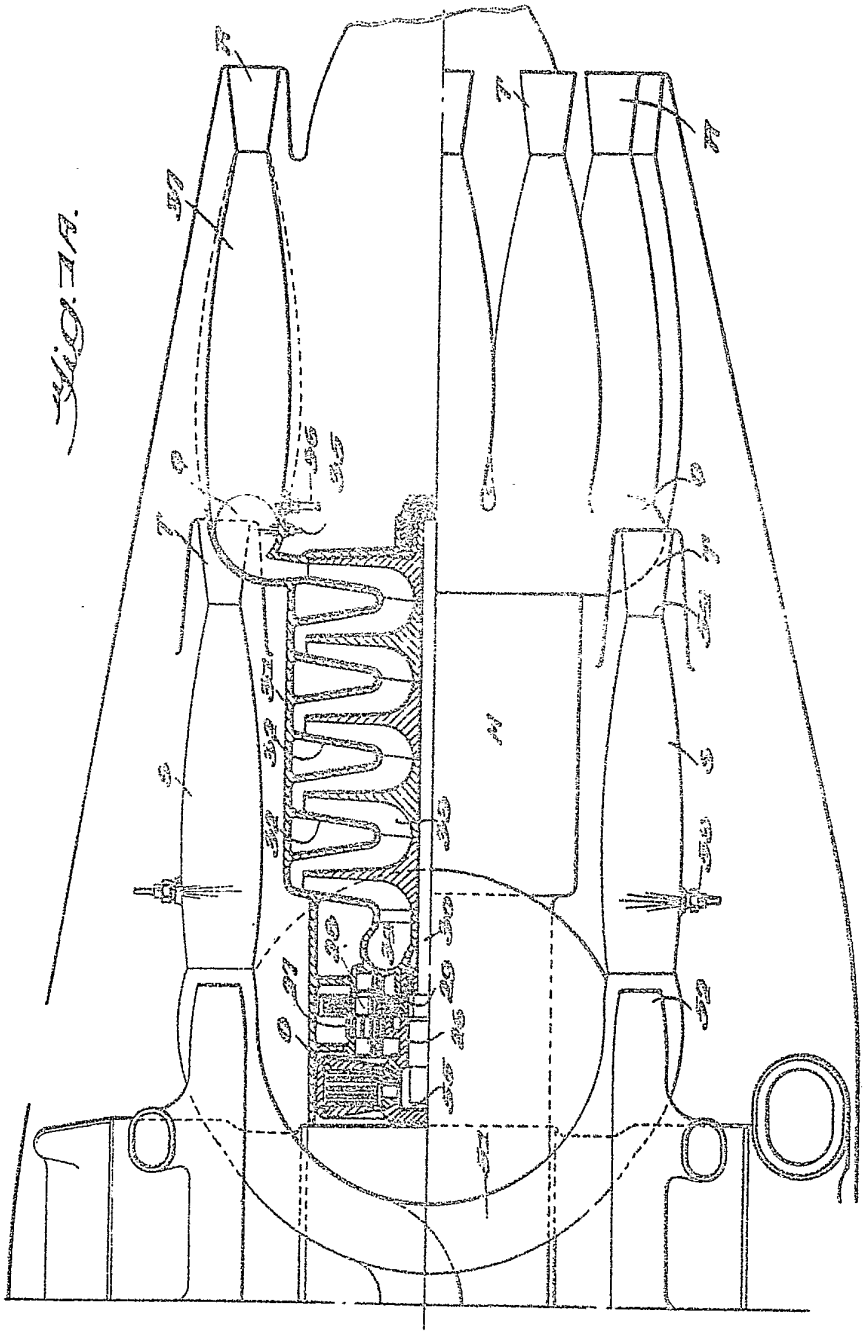

FIG. 1A.

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SHEET 1

Fig. 1.

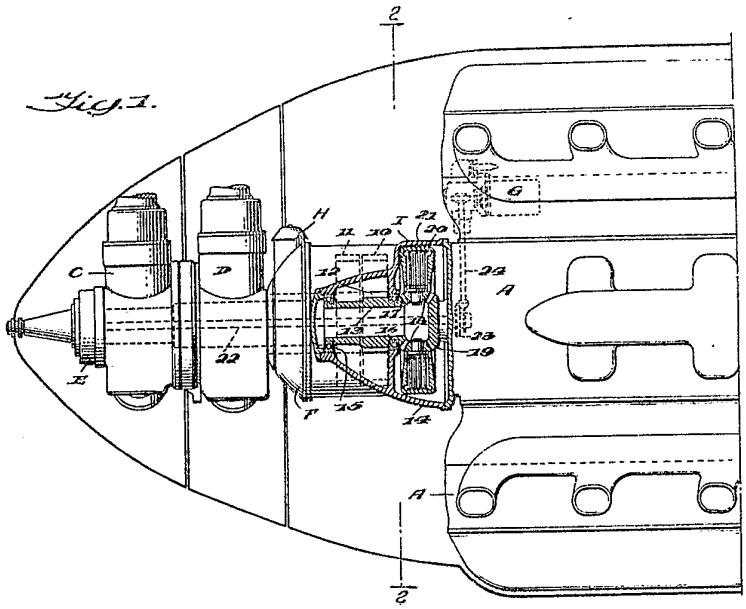
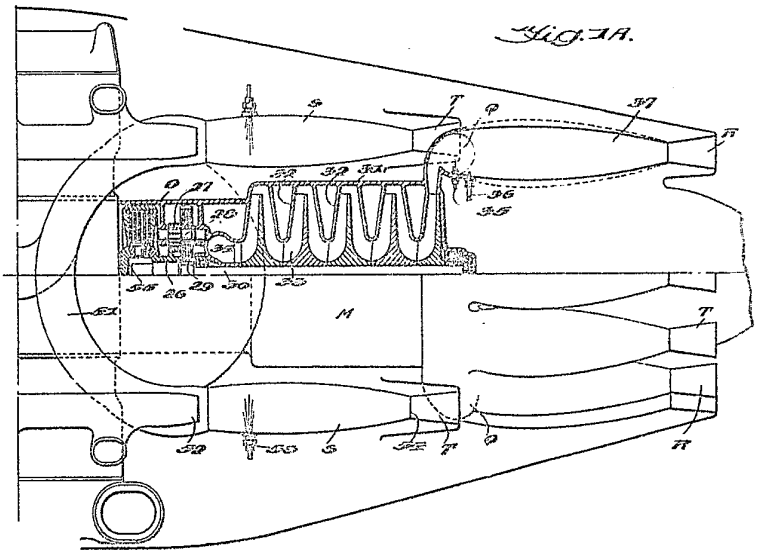


Fig. 1A.



4 SHEETS
SHEET 2

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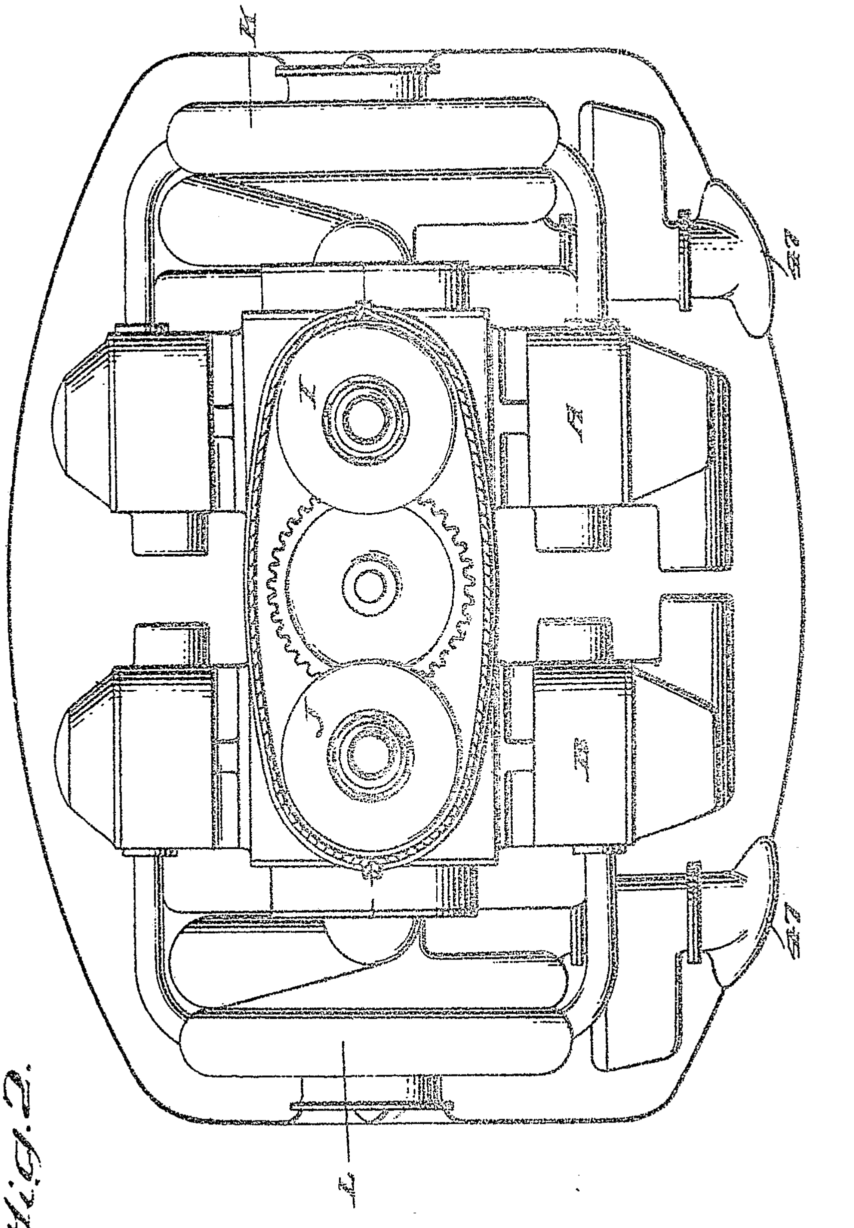
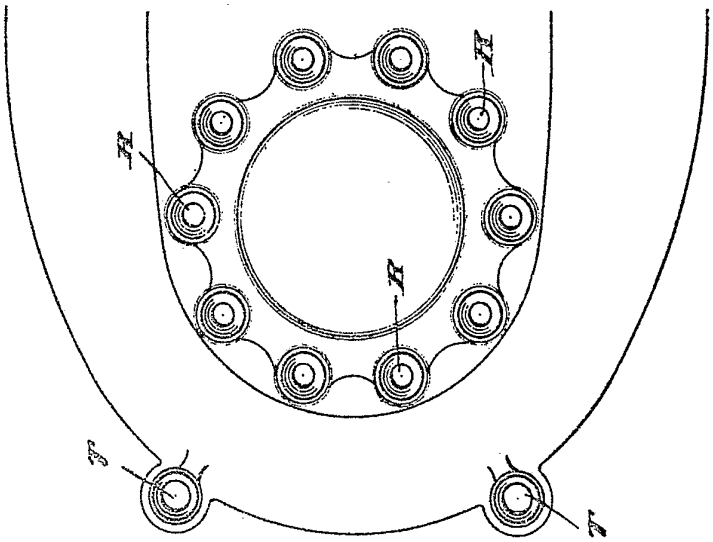
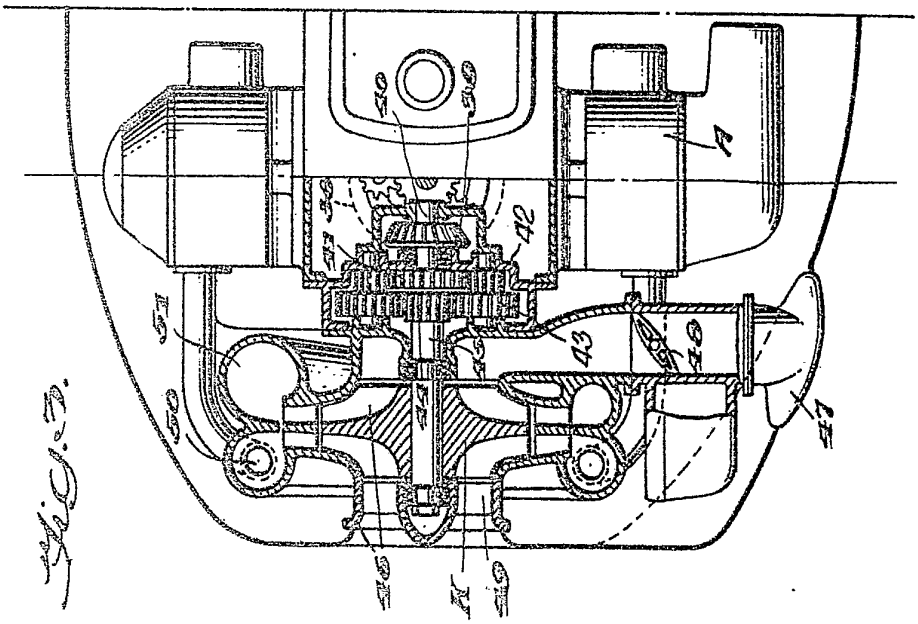


Fig. 2.





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4 SHEETS
SHEET 3

Fig. 2.

4 SHEETS
SHEET 4

Fig. 4.

Fig. 3.

M.M.P. Ltd.

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