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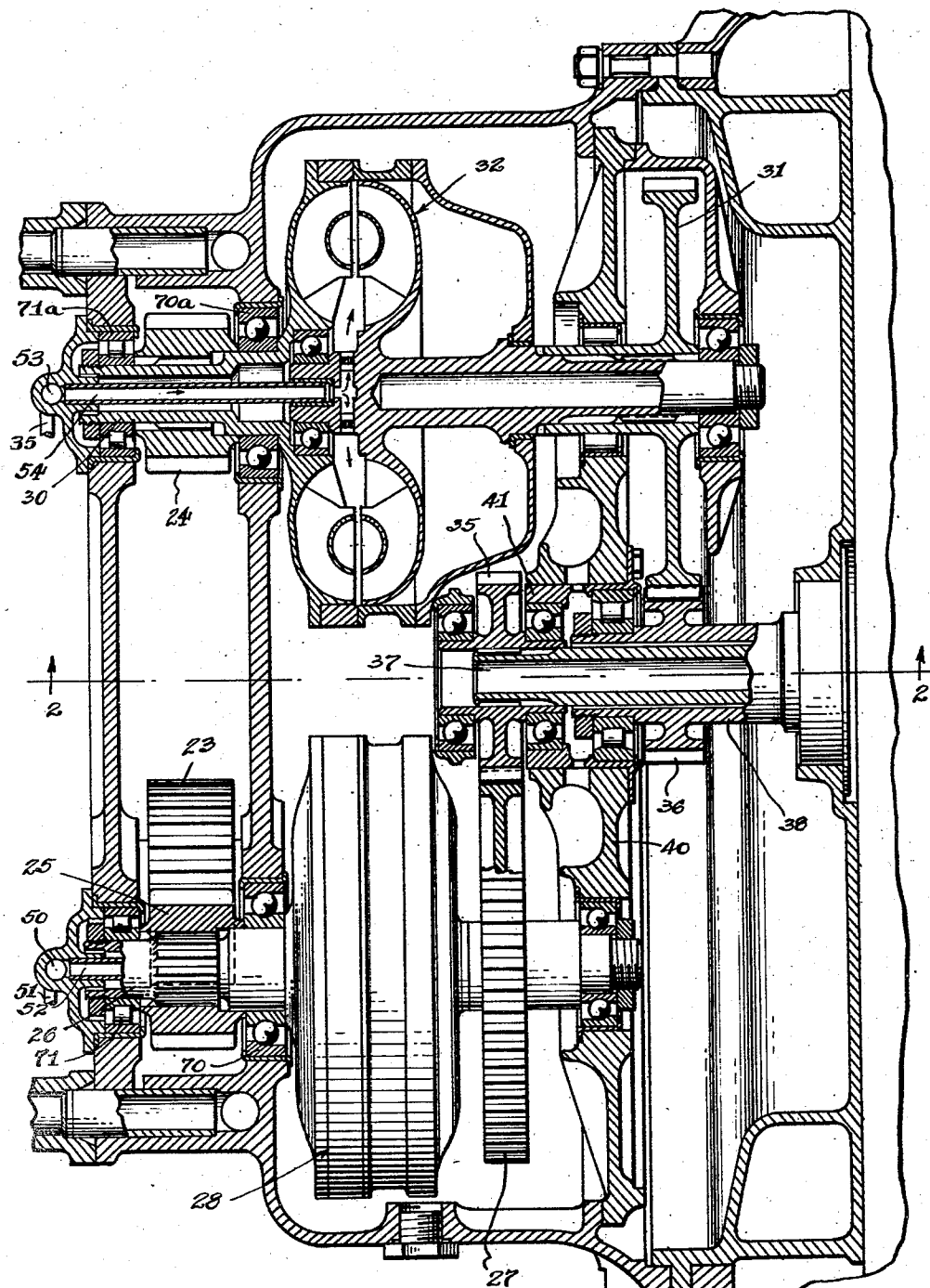


Fig. 1

BY

INVENTORS
James W. Kinnucan
Peggy L. Prescott
G. F. Hauke
Attorney

May 21, 1946.

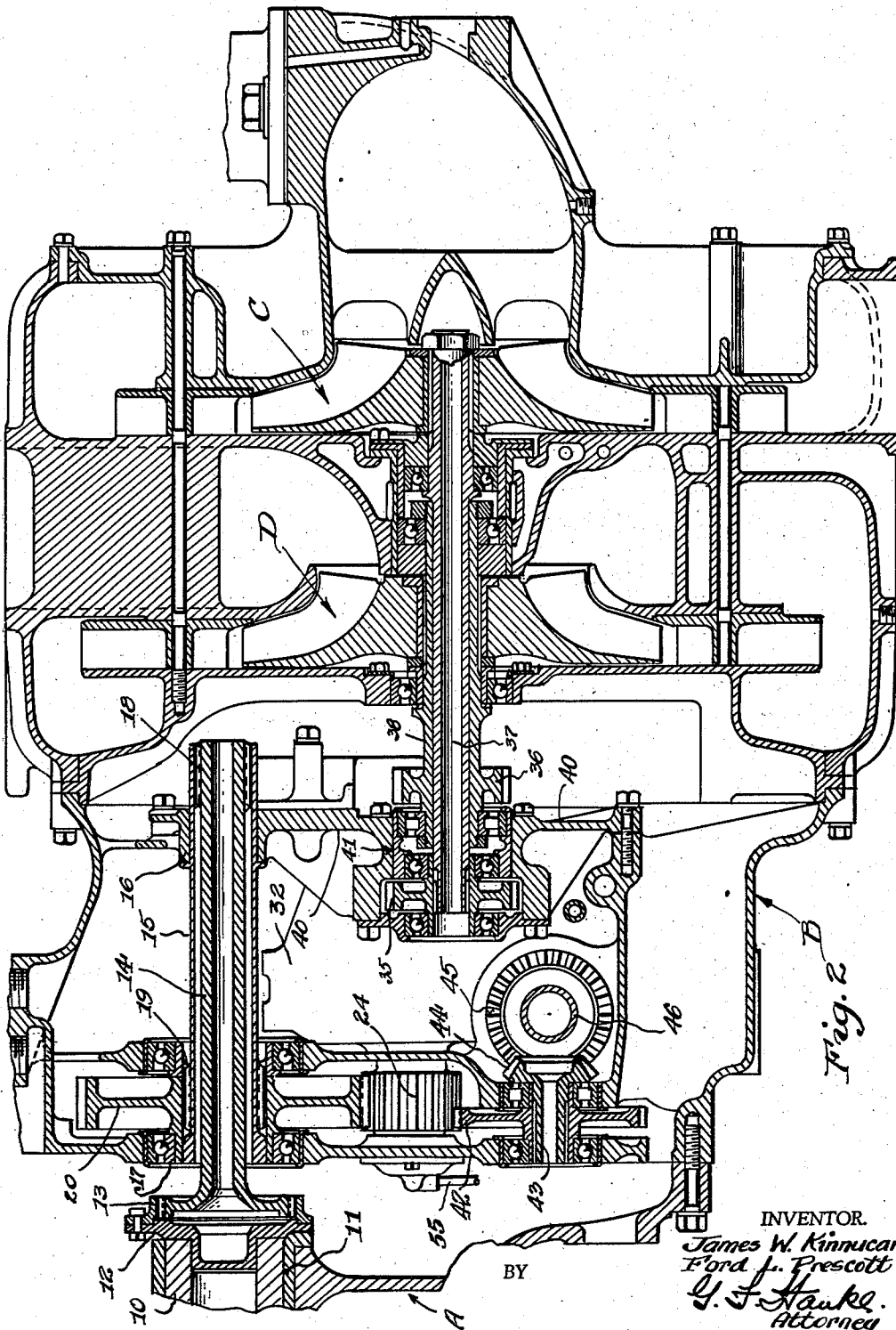
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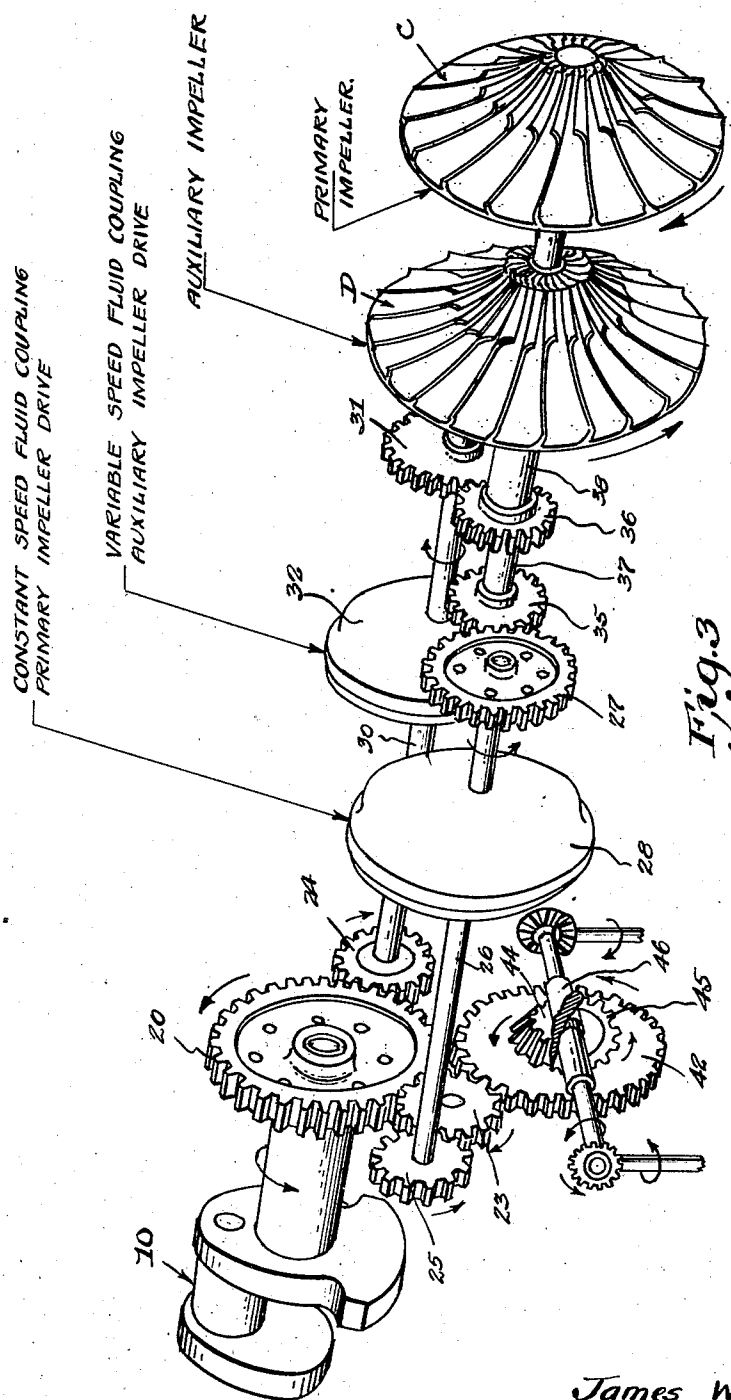
J. W. KINNUCAN ET AL

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INVENTORS
James W. Kinnucan
Ford L. Prescott
BY *L. J. Hauke*
Attorney

May 21, 1946.

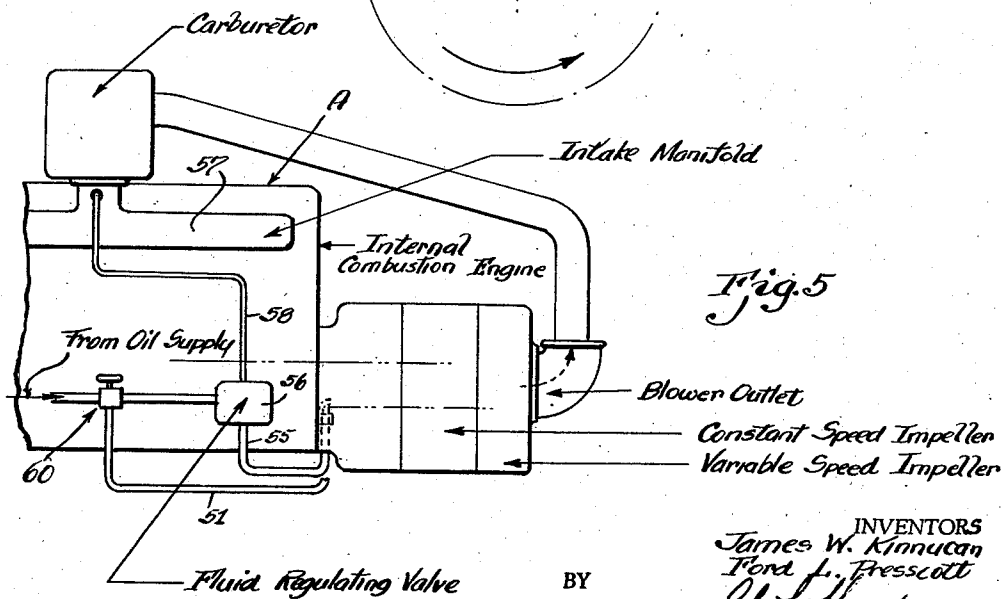
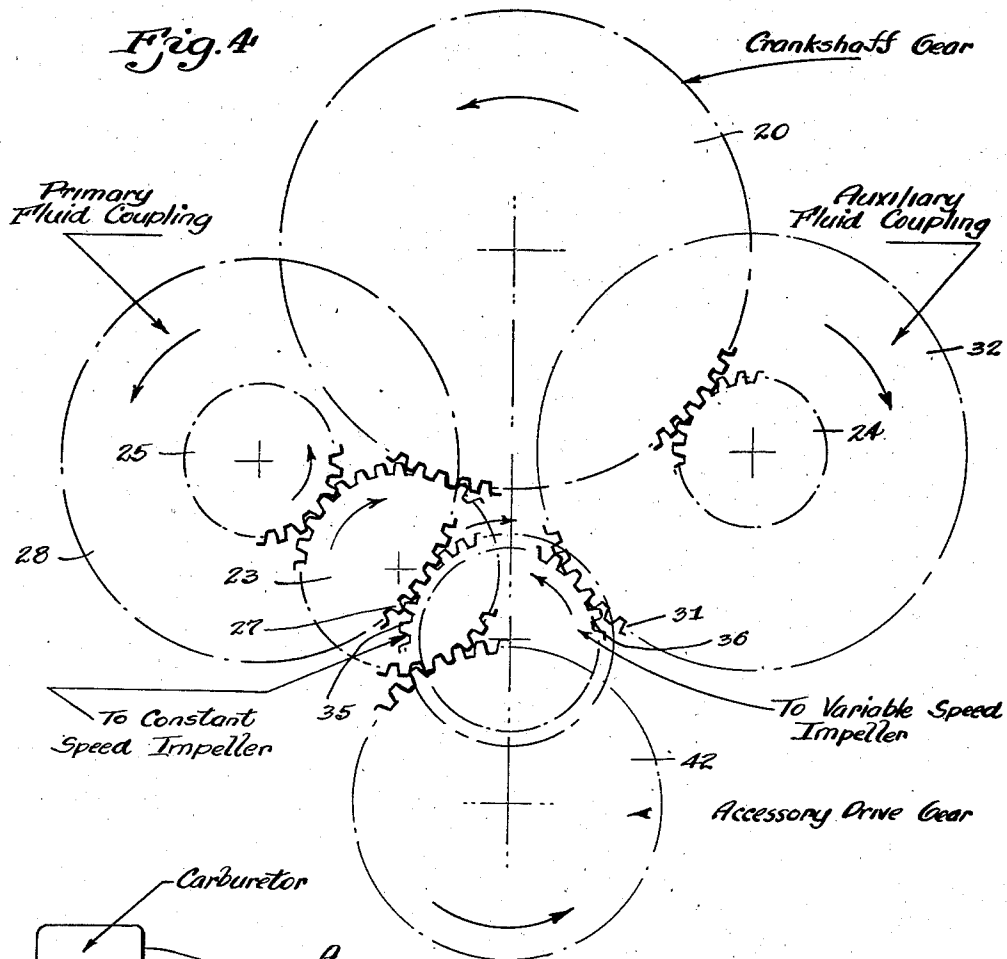
J. W. KINNUCAN ET AL

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ENGINE

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INVENTORS
James W. Kinnucan
Ford L. Presscott
G. J. Hawke.
Attorney

May 21, 1946.

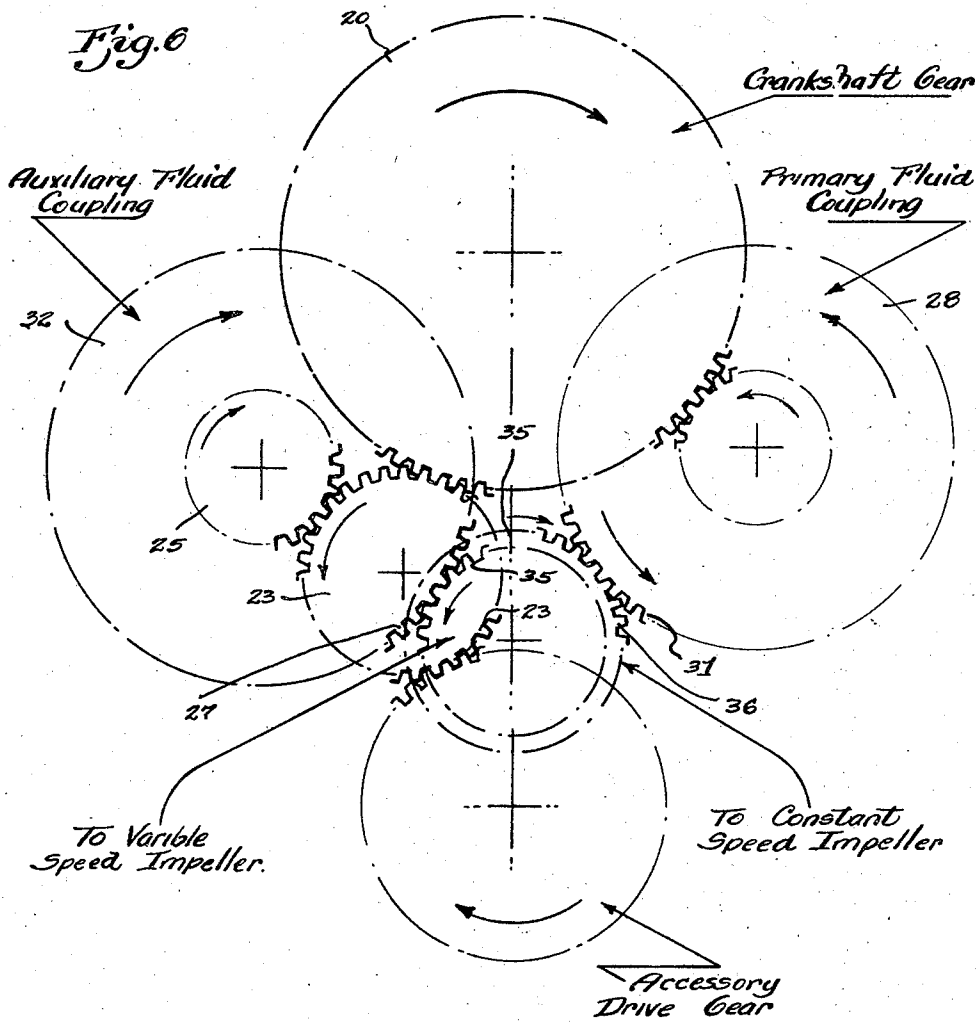
J. W. KINNUCAN ET AL

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INVENTORS
James W. Kinnucan
Ford L. Prescott
J. F. Hauke.
Attorney.

James W. Kinnucan
Ford L. Prescott

Ford L. Prescott

G. F. Hauke.
Attorney.

Attorney.

BY

UNITED STATES PATENT OFFICE

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ENGINE

James W. Kinnucan, Detroit, Mich., and Ford L. Prescott, Dayton, Ohio, assignors to Continental Aviation & Engineering Corporation, Muskegon, Mich., a corporation of Virginia

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Our invention relates to internal combustion engines and more particularly to a supercharging unit assembled therewith and more particularly useful in connection with an engine constructed for aircraft application.

In the operation of aircraft particularly at exceedingly high altitudes, it is found necessary to supply a greater amount of air to the engine than is practical by the use of a single blower which is usually operated at all altitudes with a constant output. It is common to provide a plurality of blowers for such engines, some means being provided to cut in the second blower for high altitude operation.

The inertia forces in accelerating a blower from zero rotation to maximum rotation is excessive and such an arrangement also entails a construction of some sort of starting mechanism which often fails to function properly when necessary to cut in the second blower. When it is understood that the impeller blades of supercharging blowers are rotated at speeds sometimes as high as 8 or 10 times the speed of an engine, it will be observed that any engine drive pulsations are multiplied many times in the supercharging mechanism. Also, when accelerating the engine, it will be seen that the speed of the impeller blades of the operating device must be accelerated at a corresponding faster rate and therefore, positive mechanical driving connections are unsatisfactory.

It is an object of our invention to increase engine efficiency and better engine performance by providing a supercharging assembly embodying a plurality of impellers and improved driving means connecting the impeller with the engine, whereby to overcome the disadvantages inherent in the standard positive drive type of supercharging devices.

Another object of our invention is to provide an improved supercharging device for an internal combustion engine that is smoothly and efficiently operated to meet engine requirements by incorporating an improved impeller drive which includes separate impeller driving means each including a fluid coupling which facilitates the smooth acceleration of said impellers.

A further object of our invention is to provide for a maximum of air for internal combustion engines suitable for a high altitude flying, which comprises dual impeller devices and dual impeller driving means, each including a fluid coupling and associated gears, one of said couplings arranged for driving the impeller associated therewith at substantially a constant speed while the

other fluid coupling is constructed and arranged with relatively more slip so as to drive the impeller associated therewith at variable speeds.

A still further object of our invention is to generally improve engine performance, particularly one which is provided with one or more supercharging devices, by providing a driving mechanism driven by the engine crankshaft and including engine torsional vibration damping means of a construction particularly suited for assembly with a supercharging device as above described.

A still further object of our invention is to provide a simplified supercharging construction embodying dual impellers operated at different speeds and separate driving means for said impellers including fluid couplings and associated impeller driving gears, and means for supporting said mechanism comprising supports symmetrically arranged relatively to the impellers to permit the interchange of the aforesaid couplings in order to adapt the supercharging assembly for reverse engine operation.

For a more detailed understanding of our invention reference may be had to the accompanying drawings illustrating a preferred embodiment of our invention and in which like parts throughout the several views are referred to by like characters.

In the drawings:

Fig. 1 is a horizontal longitudinal sectional view through a portion of the supercharging mechanism illustrating the dual impeller driving means, each of which include a fluid coupling,

Fig. 2 is a longitudinal vertical sectional view through the interior supercharging mechanism taken substantially on the line 2—2 of Fig. 1, and particularly illustrating the impeller construction and the vibration damping means associated with said impeller driving mechanism,

Fig. 3 is a diagrammatic perspective view illustrating the dual impeller construction and the impeller driving means,

Fig. 4 is a diagrammatic elevational view of the driving means and illustrating in more detail the rotation of the various gears,

Fig. 5 is a diagrammatic elevational view of the engine and supercharger assembly, and showing the control means for controlling the operation of the impellers, and

Fig. 6 is the diagrammatic view similar to Fig. 4 and showing the relative rotation of the gearing when rearranged for reverse engine operation.

Referring more particularly to Figs. 1 to 3 inclusive of the drawings, it will be observed that

the engine A is provided with a crankshaft 10, one end of which is supported in a bearing 11. Said crankshaft is supported with a flange portion 12 at one end, to which is secured a coupling that is adapted to be splined or otherwise secured at 13 to a stub shaft or quill 14. A hollow shaft or second quill 15 is telescoped longitudinally relatively of the quill 14 and is supported in spaced bearings 16 and 17, said quills being splined together as at 18. The second quill or outer quill 15 is keyed or splined as at 19 to a crankshaft driving gear 20. Torsional vibrations of the crankshaft are for the most part absorbed in these relatively long quills or intermediate shafts which connect the drive gear 20 with said engine crankshaft. Thus, these quills constitute a torsional vibration damping means.

The supercharger assembly includes a housing B preferably constructed of a plurality of castings bolted or otherwise secured together and housing a primary impeller C and an auxiliary impeller D.

Separate impeller driving means are provided for drivingly connecting these impellers to the crankshaft driving gears 20. Referring more particularly to Fig. 1, these impeller driving means may be seen as a whole, and same comprise a pair of gears 23 and 24 respectively associated with the primary and auxiliary impeller drives. The gear 23 meshes with gear 25 which is splined to the lay shaft 26 and drives the primary impeller driving gear 27 by means of a fluid coupling 28. This fluid coupling is constructed to have a minimum slip and is preferably constructed to have a slip which will not approximately exceed three per cent so that the gear 27 is thus driven by the engine at substantially a constant speed. The gear 24 is keyed or splined to shaft 30 which drives the auxiliary impeller driving gear 31 through a fluid coupling 32. This fluid coupling 32 is constructed with a large slip preferably approximately 50% so that the gear 31 may be driven at variable speeds, the speed of said gear being controlled by the action of the coupling, by means of devices which control the flow of fluid into the coupling.

Gear 27 meshes with gear 35 while the gear 31 meshes with gear 36. The gear 35 is splined to the primary impeller shaft 37 while the gear 36 is preferably formed as a part of the auxiliary impeller shaft 38. The supercharger housing B is preferably provided with a partition 40 carrying suitable bearing means 41 which supports the gears 35 and 36 and the impeller drive shafts.

It is preferable to drive the accessory drive gear 42 from the gear 23, this gear 42 being keyed or splined to a lay-shaft 43 which carries a beveled gear 44, this beveled gear 44 meshing in turn with another beveled gear 45 secured to the accessory drive shaft 46.

Fluid is admitted to the primary coupling 28 through the inlet 50 preferably connected with the fluid supply line 51 connected with a suitable source of fluid supply under pressure. It will be observed that the lay-shaft 26 is constructed substantially tubular and houses the fluid conduit 52 which conveys this fluid under pressure from the inlet 50 to the interior of the fluid coupling. Likewise, the auxiliary fluid coupling is supplied with fluid under pressure which is admitted through the inlet 53 to the tube or conduit 54 housed within the hollow tubular shaft 30.

The inlet 53 is connected with the fluid supply line 55 and the control of fluid flow through this supply line 55 is controlled by a suitable fluid

regulating valve 56. Preferably this regulating valve is controlled in its operation by the pressures within the engine induction system, said valve being connected preferably with the intake manifold 57 of the engine by a line or conduit 58 so as to subject the regulating valve to the pressures in the engine induction system. This regulating valve is of substantially standard construction and is operable in response to varying pressures in the engine reduction system to vary the flow of oil through the conduit 55 and thus vary the supply of fluid fed to the fluid coupling 32.

This fluid coupling 32 is preferably constructed to have a relatively large slip, preferably at least about 50%, and thus it is possible to drive the auxiliary impeller at variable speeds and in connection with this, it will be noted that the gear ratio employed in the auxiliary impeller drive is such as to provide for a speed of approximately 12,000 R. P. M. when the fluid coupling is slipping a maximum amount, but when additional fluid is supplied to the coupling to cut down this slip, the speed of the gear 31 is proportionally increased, so as to ultimately reach an impeller speed of approximately 24,000 R. P. M. Preferably, the primary impeller, which is driven through the primary fluid coupling 28, is driven at a substantially constant speed of approximately 19,000 R. P. M. The engine is designed for normal operation with this supercharger, same being placed in operation by turning on the fluid supply through actuation of the valve 50, and for extremely high altitudes, the speed of the auxiliary impeller is increased in response to pressure changes in the engine induction system. As the aircraft attempts to rise into the rarified atmosphere of the stratosphere the pressures in the engine induction system tend to decrease, but this drop in pressure in the induction system operates the fluid regulating valve 56 to increase the supply of oil to the auxiliary coupling, which thereby decreases the relative slip and proportionally increases the speed of the auxiliary impeller, whereby to increase the supply of air to the engine induction system and enable one to attain still higher altitudes. It will be seen that the control of the auxiliary impeller is preferably entirely automatic.

In Fig. 6 we have illustrated diagrammatically the construction when the primary and auxiliary fluid couplings and their associated impeller driving gears 27 and 31 are interchanged, one with the other, for reverse engine operation. Fig. 6 shows that for a reverse rotation of the crankshaft gear the gears 35 and 36 have the same rotation as in Fig. 4. Obviously the fluid connections are reversed when the supercharging driving assembly is reversed as in Fig. 6 as it is necessary that the auxiliary fluid coupling be supplied with the variable amounts of fluid as controlled by the regulating valve 56. It will be quite plainly seen that these couplings 28 and 32 together with their associated impeller driving gears may be withdrawn longitudinally from their bearing supports which comprise bearings 70 and 71, 70a and 71a respectively and interchanged, one with the other. The position of the gears 35 and 36 are unchanged.

It will be apparent to those skilled in the art to which our invention pertains, that various modifications and changes may be made therein without departing from the spirit of our invention or from the scope of the appended claims.

We claim:

1. In an internal combustion engine having a crankshaft, a supercharger drive comprising a fluid coupling, gearing mechanism intermediate said coupling and said engine crankshaft, and a pair of interconnected quills intermediate the crankshaft and the first gear of said gearing mechanism, one of said quills driven by the crankshaft, said other quill driven by said first quill and drivingly connected to said gear, said quills constructed and arranged to absorb at least a major portion of torsional vibrations produced in said engine crankshaft.

2. In an internal combustion engine having a crankshaft, a supercharger drive comprising a fluid coupling, gearing mechanism intermediate said coupling and said engine crankshaft, and a pair of interconnected quills intermediate the crankshaft and the first gear of said gearing mechanism, said quills constructed and arranged to absorb at least a major portion of torsional vibrations produced in said engine crankshaft, one of said quills connected at one end to the crankshaft and telescoping longitudinally within the second quill, said other end of the first quill keyed at the end remote from the crankshaft to one end of said second quill, the other end of the second quill keyed to the said first gear, said quills having a length sufficient to absorb at least a major portion of torsional vibrations produced in said engine crankshaft.

3. In an internal combustion engine having a crankshaft, a supercharger drive comprising a fluid coupling, gearing mechanism intermediate said coupling and said engine crankshaft, and a pair of interconnected quills intermediate the crankshaft and the first gear of said gearing mechanism, said quills constructed and arranged to absorb at least a major portion of torsional vibrations produced in said engine crankshaft, one of said quills connected at one end to the crankshaft and telescoping longitudinally within the second quill, said other end of the first quill keyed at the end remote from the crankshaft to one end of said second quill, the other end of the second quill keyed to the said first gear, said quills having a length sufficient to absorb at least a major portion of torsional vibrations produced in said engine crankshaft, a housing for said gearing and provided with axially spaced bearings respectively supporting the outer second quill.

4. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, driving means for drivingly connecting each of said impellers to the engine crankshaft and comprising a common crankshaft gear, separate gearing mechanism connecting the crankshaft gear with the supercharger impellers and each including a fluid coupling lying intermediate some of said gears, and driving means connecting said crankshaft gear with the engine crankshaft and including means absorbing torsional vibrations produced in said crankshaft.

5. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, driving means for drivingly connecting each of said impellers to the engine crankshaft and comprising a common crankshaft gear, separate gearing mechanism connecting the crankshaft gear with the supercharger impellers and each including a fluid coupling lying intermediate some of said gears, and driving means connecting said crankshaft gear with the engine crankshaft and including means absorbing torsional vibrations produced in said crankshaft,

said crankshaft gear driving means comprising a pair of telescoping interconnected quills, and a housing enclosing said gearing and driving means and provided with spaced bearings for supporting said quills.

6. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, separate driving means for drivingly connecting each of said impellers to the engine crankshaft and each including a fluid coupling, one only of said fluid couplings constructed and arranged to have at least approximately fifty per cent slip whereby to permit operation of the impeller associated therewith at variable speeds, and means operable in response to engine intake manifold pressures for controlling the speed of said variable speed impeller.

7. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, separate driving means for drivingly connecting each of said impellers to the engine crankshaft and each including a fluid coupling, one only of said fluid couplings constructed and arranged to have at least approximately fifty per cent slip whereby to permit operation of the impeller associated therewith at variable speeds and means including a regulating valve operable in response to varying intake manifold pressures to vary the supply of fluid only to said fluid coupling associated with said variable speed impeller, whereby to control the speed of said variable speed impeller.

8. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, separate driving means for drivingly connecting each of said impellers to the engine crankshaft and each including a fluid coupling, one of said fluid couplings constructed and arranged to have at least approximately fifty per cent slip whereby to permit operation of the impeller associated therewith at variable speeds, said other fluid coupling having a minimum slip preferably not in excess of approximately three per cent whereby to drive said other impeller at substantially a constant speed.

9. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, separate driving means for drivingly connecting each of said impellers to the engine crankshaft and each including a fluid coupling, said fluid couplings constructed and arranged to drive one of said impellers at all times at substantially a constant speed and to drive said other impeller at a variable speed, and means operable in response to varying engine intake manifold pressures to control the speed only of said variable speed impeller.

10. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, separate driving means for drivingly connecting each of said impellers to the engine crankshaft and each including a fluid coupling, said fluid couplings constructed and arranged to drive one of said impellers at all times at substantially a constant speed and to drive said other impeller at variable speed, and fluid flow control means operable in response to varying engine intake manifold pressures to control the speed only of said variable speed impeller.

11. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, driving means for drivingly connecting each of the said impellers to the engine crankshaft and each including a fluid coupling and torsional vibration absorbing means lying interme-

date said fluid couplings and said engine crankshaft.

12. In an internal combustion engine having a crankshaft, a supercharger including a pair of impellers, driving means for drivingly connecting each of said impellers to the engine crankshaft and each including a fluid coupling, a gear for driving said impeller driving means, said gear operatively connected with and driven by said engine crankshaft, and torsional vibration absorbing means embodied in said means which drivingly connect said gear with said engine crankshaft.

13. A supercharger for an internal combustion engine comprising a structure including a plurality of impellers, and driving means for each of said impellers including means associated with only one of said impellers and operable to vary the speed thereof, said means including a fluid coupling constructed and arranged with a maximum slip and a regulating valve responsive to varying engine intake manifold pressure for regulating the supply of fluid to said coupling and operable to vary the speed of said variable speed impeller.

14. In an internal combustion engine having a crankshaft and a crankshaft gear driven by said crankshaft, a supercharger device comprising a pair of impellers, separate impeller driving means driven by said crankshaft gear and each including a fluid coupling and an impeller drive gear, said fluid couplings constructed and arranged to drive one of said impellers at substantially a constant speed and to drive said other impeller at a variable speed, means supporting said impeller driving means and including bearing means symmetrically positioned relative to the impellers, the associated fluid coupling and impeller driving gears being interchangeable one with the other

in the assembly in order to adapt said impeller driving means for reverse engine operation and to thereby drive said impellers in the same direction.

15. In an internal combustion engine having a crankshaft and a crankshaft gear driven by said crankshaft, a supercharger device comprising a pair of coaxially arranged impellers, a housing for said impellers, telescoping impeller drive shafts respectively connected to each of said impellers and supported by said housing, separate gear mechanism connecting each of said drive shafts with said crankshaft gear and each including a fluid coupling.

16. In an internal combustion engine having a crankshaft and a crankshaft gear driven by said crankshaft, a supercharger device comprising a pair of coaxially arranged impellers, a housing for said impellers, telescoping impeller drive shafts respectively connected to each of said impellers and supported by said housing, separate gear mechanism connecting each of said drive shafts with said crankshaft gear and each including a fluid coupling, one of said fluid couplings constructed and arranged with a minimum of slip whereby to transmit a substantially constant torque at all times to drive the impeller associated therewith at substantially a constant speed at all times, said other fluid coupling constructed and arranged to have at least approximately fifty per cent slip whereby to transmit a variable torque and to drive the impeller associated therewith at a variable speed, and means controlling the amount of fluid supplied to said last mentioned fluid coupling to control the operation thereof.

JAMES W. KINNUCAN.
FORD L. PRESCOTT.