TECHNICAL MEMORANDUMS

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THE "UNIVERSAL" ADJUSTABLE AND REVERSIBLE PROPELLER BUILT BY PARAGON ENGINEERS, INC., BALTIMORE, MD.

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THE "UNIVERSAL" ADJUSTABLE AND REVERSIBLE PROPELLER.*

A device which does for the aircraft what change speed gears do for the automobile is the invention of Spencer Heath, president of the American Propeller and Manufacturing Company, of Baltimore, Md., the first aircraft propeller-making firm in America. It comprises a system of special blades and a mechanism for varying the pitch of the blades from zero to 360 degrees, while in flight or otherwise.

By adjusting the pitch, either before starting or while the engine is running, to a less than normal angle, the engine is allowed to pick up speed and deliver its maximum power which is necessary in taking-off with a heavier load than the same airplane could otherwise normally carry. Upon reaching the desired altitude, the pitch may be increased by the pressure of a finger on a knob on the dash and the engine run at its most economical speed, still with the possibility of increased speed range, should occasion demand. As the load is lessened by consumption of gasoline on a long distanced flight, the pitch may be still further increased.

In landing, the pitch of the screw may be changed to any degree in the opposite direction, or "reversed" in a few seconds, just before the instant of contact with the ground and the airplane brought to a stop in the very shortest space, obviating entirely any prepared ground system of slowing up the airplane.

This is a feature of especial moment to naval aeronautics where the shortest run after landing is a prime necessity, owing to the confined space which may be available on a ship's deck or

* Built by Paragon Engineers, Inc., Baltimore, Md.

even on that of an airplane carrier ship like the "Langley".

For the airship, the same advantages of economy are apparent while the reversible attribute exactly doubles maneuverability in docking, whether shed or mooring mast is employed.

It is even possible that the adjustable and reversible propeller may cause rapid advancement in the helicopter, or direct-lift airplane.

It was long realized that the variable pitch and reversible propeller was a development which would travel side by side with supercharged and multi-engined aircraft.

This new design now avoids the objectionable features ordinarily considered with respect to possibilities in this direction.

In the Heath propeller there has been achieved:

a. Elimination of continuously running gears, collars or bearings in the pitch control mechanism.

b. The use in flight of engine power in place of manual labor in changing the blade angle.

c. The absence of any structural limitation to the range of blade angles available as well as the limiting of the blade travel between any two predetermined extreme positions.

d. Continuous indication on the instrument board of the blade position.

e. Automatic throttling of the engine while the propeller is passing through the position of neutral pitch.

General Description of Propeller.

The two wooden or steel blades are fastened into steel sleeve which in turn are held in a steel hub, the centrifugal forces bein taken on ball thrusts and torsional and axial forces on plain bear ings.

The method of fixing the wooden blades into the steel sleeves is noteworthy. The butt end of each blade is tapered outwardly at a small angle as shown in Fig. 1, and the surrounding collar is split so that it may be first sprung over the butt and then compressed upon the taper.

Pitch Changing Mechanism.

The pitch changing mechanism is operated through the application of a braking force to either one of a pair of small brake drums surrounding the engine crankshaft and normally rotating with it. The elementary principle is shown by diagram in Fig. 2, which represents a brake drum connected through a gear train to the individual blades of the propeller. It is apparent that if the drum is allowed to revolve at crankshaft speed, all the gears will be stationary relative to the propeller and that the pitch angle will remain constant. If, on the contrary, the brake drum is held stationary the gear train will be set into action and the pitch angle of the blade will undergo a continuous change until the brake drum is released.

In order to change the blade angle in the reverse direction a second brake drum is used, connecting to the worm shaft through an

idler which serves to reverse the direction of rotation of the wo shaft. It should be noted that during normal flying none of thes gears are operative and that the blades are locked in position by the non-reversible features of the worm and the friction of the connected parts.

The actual construction of the pitch changing mechanism is more fully indicated in Fig. 3. The brakes are applied through leather faced shoes operated from the pilot's seat by a light push and pull knob attaching to a brake lever mounted on the drum housing. A small hand-crank is provided by which the pitch can be changed while the engine is not running.

Blade Position Indicator.

The angular setting of the propeller blades at any instant is a function of the relative motion which has taken place between th two brake drums. The indicating mechanism is therefore operated gearing from the two brake drums which conveys differential motio to the indicating pointer and the throttling and pitch-limiting cams. As long as the two brake drums revolve, both at crankshaft speed, the indicating hand remains stationary, but if either of them is retarded, an angular motion is shown on the indicator equ to that experienced by the blades themselves.

Automatic Throttle Control.

The mechanical throttle is provided with springs in both directions so that the pilot can at any time by applying a force on

the throttle greater than the initial tension in the springs substitute manual for automatic control.

Pitch Limiting Mechanism.

In the pitch limiting mechanism the control knob normally connects to the brake levers direct, a push increasing and a pull decreasing the pitch. If the control button is held in either operating position until the limiting position of the propeller blade is reached, the cam trips a latch plate and renders the control inoperative in that direction while leaving it ready for use in reversing the direction of propeller blade motion.

Demonstration Under Power.

To show the action under power the propeller has been install on a 150 HP Hispano-Suiza engine mounted with gasoline tank, obser ers' seats, etc., on a trailer truck weighing about two tons, whic is free to roll on the ground (see photograph). Demonstrations ar now being made, the engine and propeller being operated either by Mr. Heath or by any one present. In these demonstrations the devic is put through its entire range of performance, which includes disconnecting the pitch limiting mechanism so that the blade angles are controlled throughout a complete revolution of 360 degrees, bo forward and reverse.

With the engine turning at 1500 r.p.m., the angular change fro full speed ahead to full speed astern is accomplished in about 3 1/3 seconds.

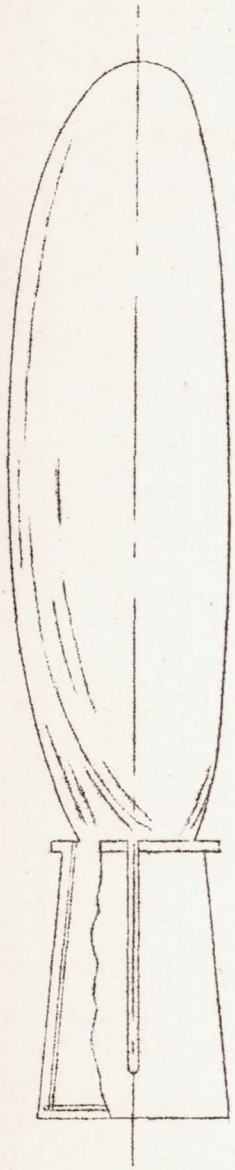


Fig. 1. Split steel sleeve compressed about butt end of propeller blade.

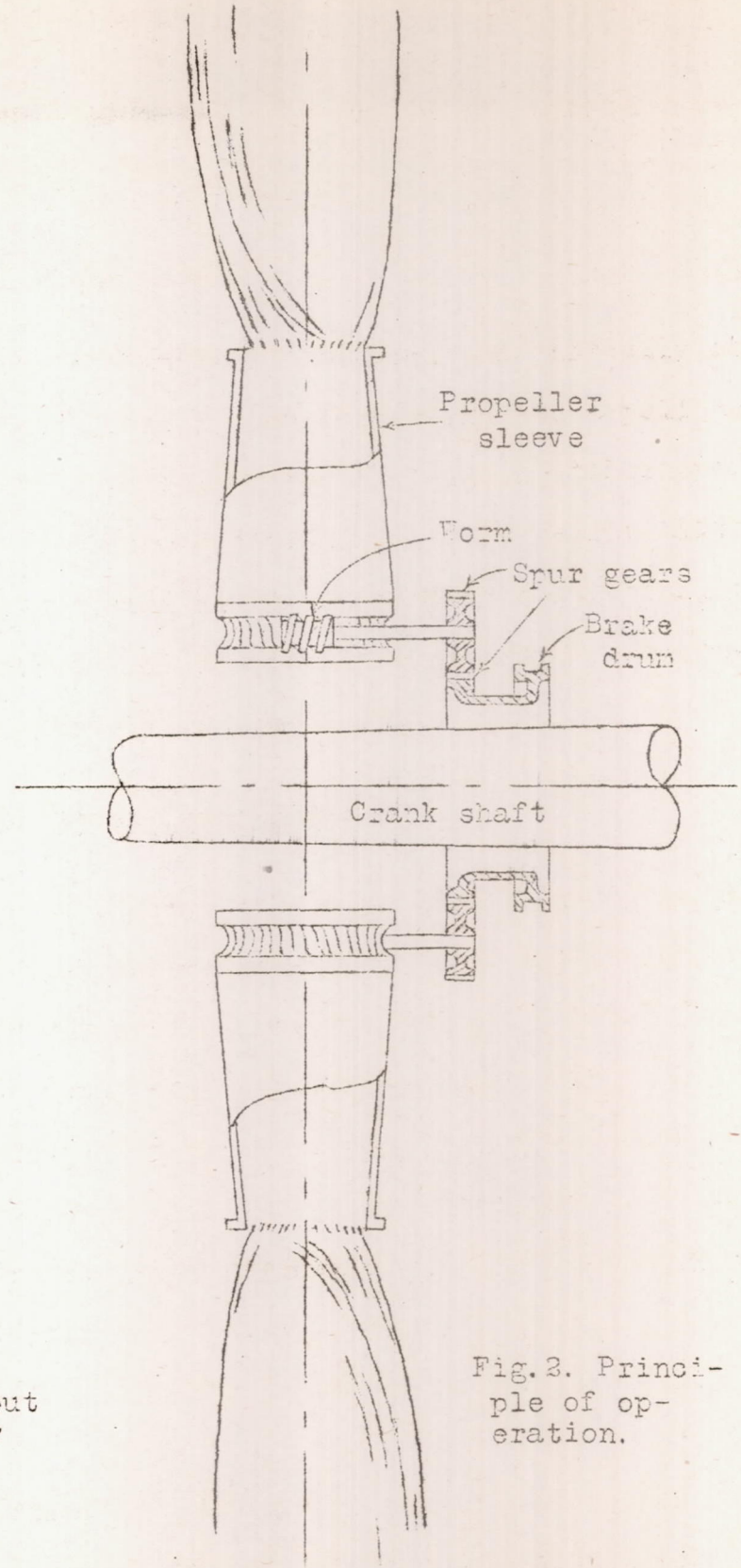


Fig. 2. Principle of operation.

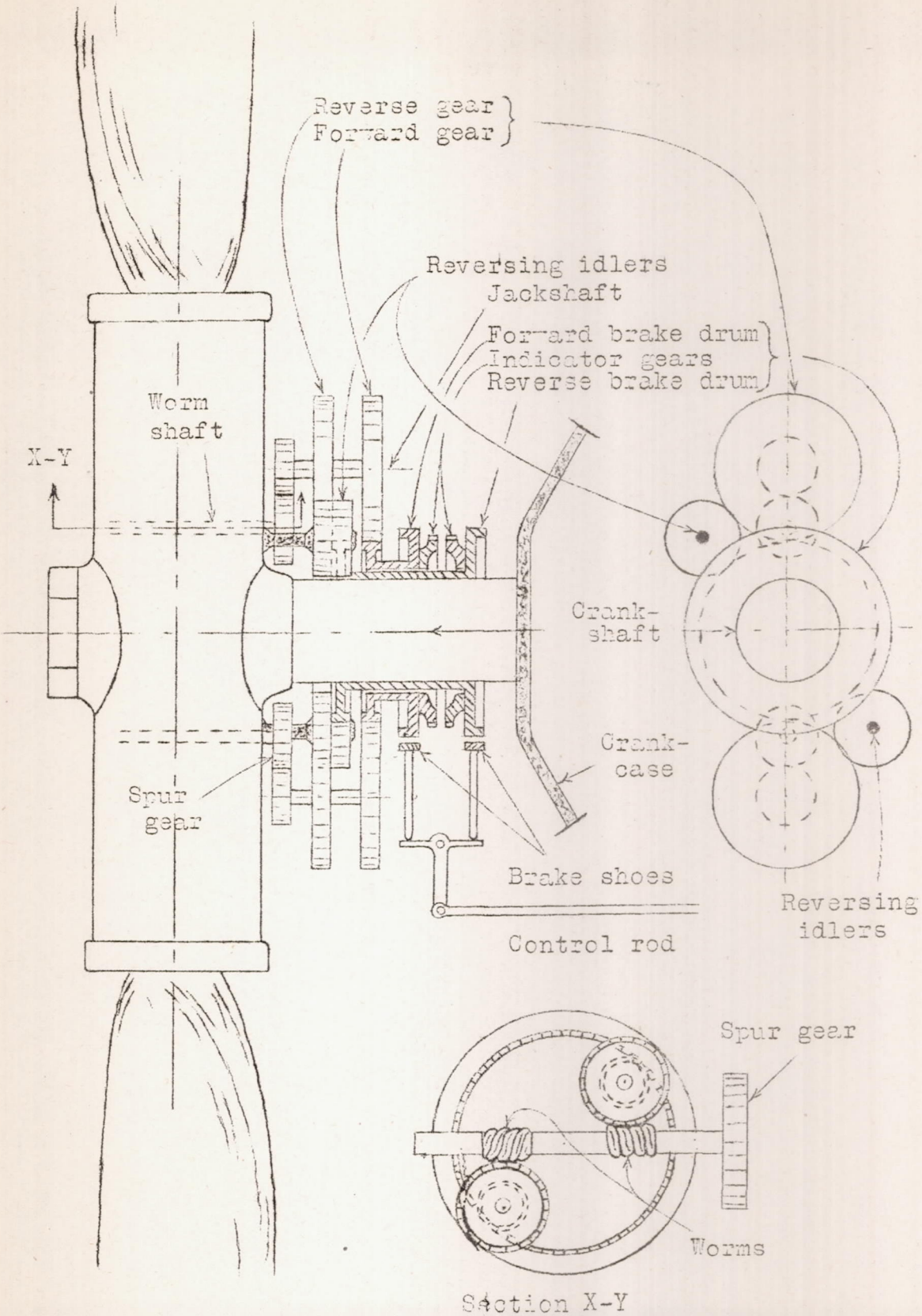
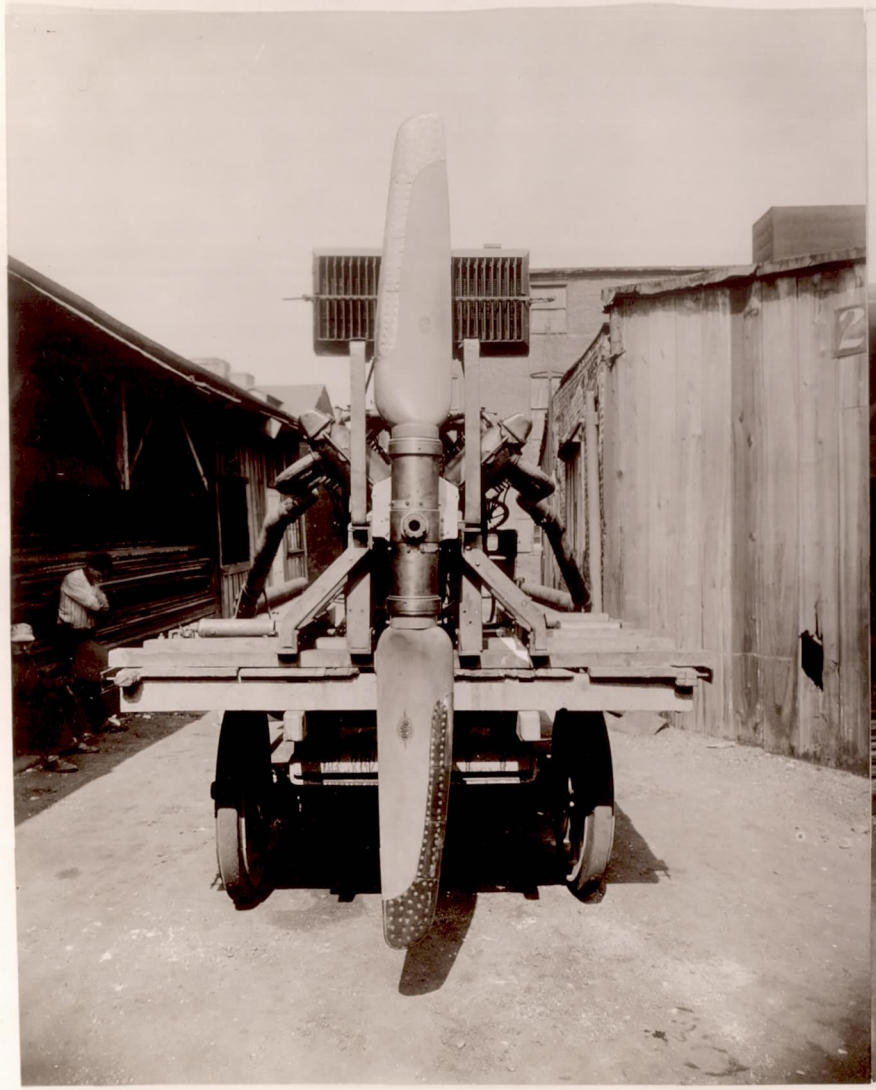
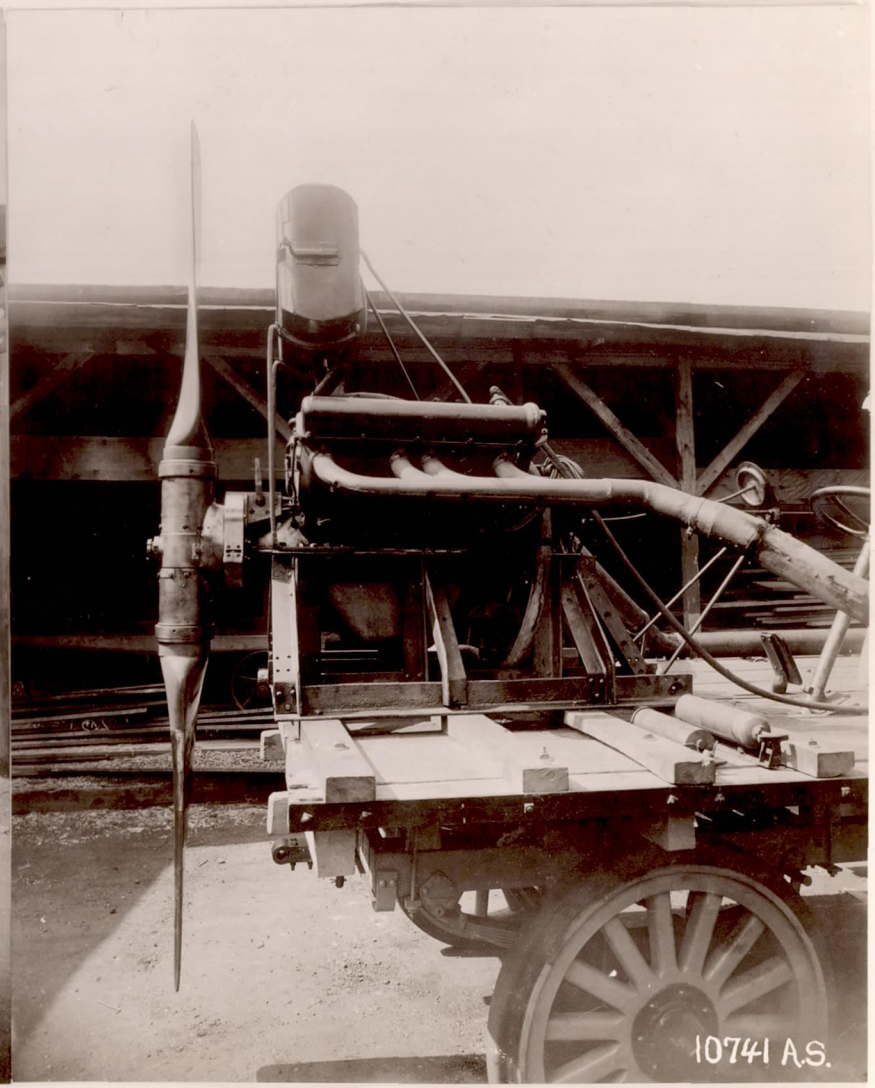


Fig. 3. Pitch changing gear train.





Propeller mounted for demonstration on 150 HP., Hispano-Suiza engine,
with blades set at neutral pitch.