

THE SCHWARZ AUTOMATIC V.P. AIRSCREW

Extreme Simplicity the Feature of Fully Automatic Two-pitch Design : Three-pitch Type to Follow : Use of Wooden Blades

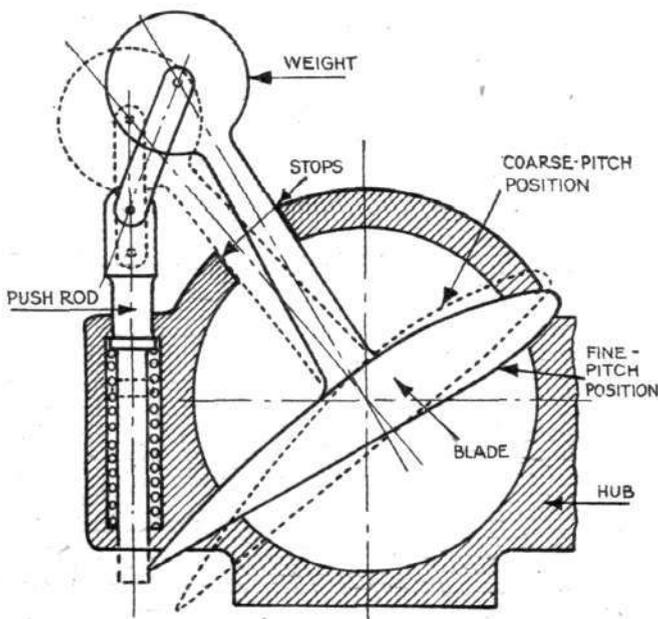
THE Schwarz variable-pitch airscrew hub has been designed to provide a simple and reliable limited solution, pending the emergence at some future date of a complete solution of the problem of an infinitely variable-pitch airscrew to fulfil ideal requirements. Even if and when the latter becomes generally available, predict the designers, it is certain that a substantial proportion of aircraft will for many years continue to be equipped with a similar variety, such as the Schwarz automatic hub, for convenience and economy.

Two-position Simplicity

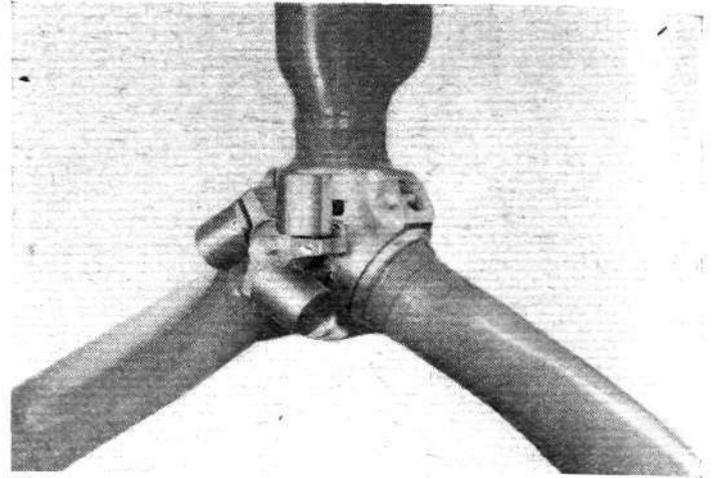
The Schwarz variable-pitch airscrew hub is an automatic mechanism giving fixed positions to the blades; at present there are two positions only, corresponding to the requirements respectively for (a) take-off and climb, and (b) for normal flight. In either position the airscrew is stable, while the change-over occurs automatically and positively in both directions at predetermined airscrew speeds. By limiting the requirements in this way to the most important needs it has been possible to simplify the design exceedingly and to make the mechanism independent of the effect of external disturbing influences, such as friction, displacement of centre of pressure, distortion of blades, etc.

The principle of the mechanism is illustrated in the accompanying diagram. Each blade is mounted rotatably in the hub; attached to the blade is an arm carrying a weight. When the airscrew is at rest a spring, actuating the weight-arm through the medium of a push-rod and link, pushes the blade into the position of minimum incidence, with the arm against a stop on the hub. When the airscrew is in motion there are two forces acting on the blade, a moment exerted by the spring, which is independent of the speed of rotation, and a centrifugal moment which increases as the square of the speed.

Take-off and climb proceed at the minimum incidence and at



Studied in conjunction with the text, this diagram clearly shows the operating principle of the Schwarz hub.



The Schwarz automatic v.p. airscrew hub, carrying wooden blades prepared by the makers' patented process.

rotational speed gradually approaching the maximum permissible speed of the engine. On the machine changing over from climbing attitude to level flight, the speed of rotation increases and oversteps the point at which the two opposing moments acting on the blades are exactly balanced. The centrifugal moment then overcomes the spring moment, and pushes the blade into the position shown dotted (maximum incidence) with the arm against the opposite stop. The axial distance of the weight, and consequently also the centrifugal moment, are thus increased. At the same time, however, the spring moment, in spite of the increased tension of the spring, is reduced, because the altered angle of the link reduces the effective leverage. Thus the change-over is quite positive from one stable position to the other, and the engine can then be throttled back quite considerably without causing the mechanism to reverse the blade position. Thus the airscrew will be kept in the position of maximum incidence required in cruising flight. Not until the engine is throttled back to the extent required for preparing to land will the mechanism change over, when the blades will revert equally positively to the minimum incidence position, in which they will be ready for a fresh take-off or climb, e.g., in the event of the pilot reopening the throttle after an unsuccessful attempt to land.

Design work is in progress with a view to the provision of a third stable position of the blades, suitable for high-altitude cruising.

German Experience

The simplicity of the arrangement has resulted in the desired maximum reliability; it is stated that even in the unlikely event of damage to the mechanism (broken spring, seizure, defective bearing, or the like) safety is not impaired, and the worst that could happen would be to continue a flight with an unfavourable blade setting.

In Germany the Schwarz variable-pitch airscrew—which, incidentally, can be adapted to the *moteur canon*—has been designed and tested for several types of engines. The first tests were carried out on two-bladed airscrews for the 240 h.p. Argus AS 10 engine, and on three-bladed types on the 660 h.p. Siemens SAM 22 B engine and the 730 h.p. B.M.W. VI (geared) engines. D.L.H., too, have used this airscrew on Jumo 5 Diesel engines. In addition, the Schwarz Company have production orders in hand for equipping the Hirth HM 8 U engine, B.M.W. Hornet, B.M.W. VI (direct drive), and other engines up to 900 h.p.

Though the Schwarz V.P. hub may, if desired, be fitted with metal or any approved type of blade, those so far built have been equipped with Schwarz patented wooden detachable blades of the type described in *Flight* of June 6, 1935.

The low weight of these blades considerably reduces centrifugal forces on the bearings; moreover, all forces exerted by the blade are taken up by a single bearing in which a novel method of elastic preloading is employed to obviate alternating stresses, which are highly undesirable in ball or roller bearings. Schwarz lightweight detachable blades are made in England by the Airscrew Co., Ltd., Weybridge, under licence. Incidentally, the Schwarz process is now the standard finish for all wooden airscrews for the Royal Air Force.

In a paper read before the R.Ae.S. recently (see *Flight* of February 6, 1936) Dr H. C. Watts described the Schwarz process of protection, and also the method of compressing the blade root to prevent play developing in the steel sleeve.