believed to be of vital importance Thus the joint meeting had been arranged, which they were glad to see was well attended As President of the Royal Aeronautical Society, he was glad to acknowledge how much the Society welcomed the co-operation of the Helicopter Association in that joint effort

He then introduced Wing Commander BRIE, and complimented him on the tremendous service he had rendered to the development of the helicopter and the " Autogiro " It was as long ago as 1935 that he had made history with an " Autogiro " off and on a ship at Spezia in Italy, and had repeated that sort of thing since He did it in 1942 in Chesapeake Bay, and he had been an example and a stimulus to everyone engaged in that field, which was not always quite so popular as it had become today He was with the Fairey Aviation Company just after the war, and since 1947 had been in charge of the Helicopter Unit of the British European Airways Corporation He held Helicopter Aviation Certificate No 1, was a Charter Member of the American Helicopter Society and a Founder Member of the Helicopter Association of Great Britain

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The Operational Point of View

By Wing Comdr R A C BRIE, AFRAeS, AFIAeS

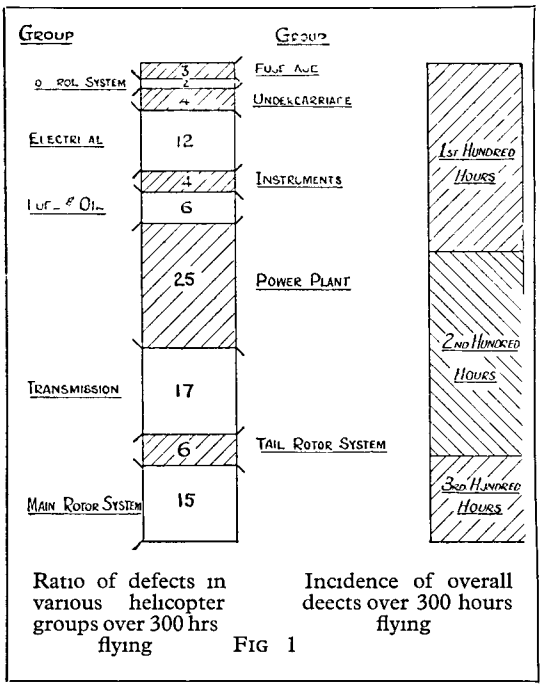
Although barely two years have elapsed since the helicopter was first certificated for civil use, the problem associated with its operation are sufficiently well defined to enable their nature to be discussed with reasonable facility Actually, of course, there are twenty-six years, including many tens of thousands of flying hours behind this particular development, and it is quite logical therefore that the most advanced and successful type of helicopter to date embodies the basic and well proven rotor features of the Cierva Autogiro

There is still much to learn, however, and at this stage of development it has in many ways been advantageous that, so far, the field of operational use has been a professional one Difficulties have been minor rather than of a major category, but circumstances could easily have been otherwise had there not been constantly available the requisite background of skill and experience not only to cure, but what is of equal importance, to anticipate and prevent trouble before it could assume proportions of a serious nature Additionally the limited number of helicopters in use has encouraged and made possible a rather intimate and desirable liaison between constructor and operator, which in turn has given the aircraft a reasonable opportunity to establish itself and prove its value under strictly controlled conditions of inspection and operation

Essentially a product of the mechanical engineer, the helicopter with its clutch, gear boxes, driving shafts, universal joints, together with numerous ball, roller and needle bearings is a mechanism comparable in many ways to that associated with more normal and accepted means of surface transport That with the aid of this transmission system the helicopter is capable of becoming airborne with an adequate degree of control is in itself remarkable The fact that it also has performance characteristics which enable it to be

operated with facility from extremely confined areas, even under pronounced conditions of turbulence, provides adequate proof of the skill with which the pioneers have solved the major problems associated with the functioning of the rotor system

To enable the subject to be viewed in a proper perspective it is opportune and appropriate to draw attention to current achievement in this country Over a recent period of nine months covering more than 1,000 hours of experimental and day-to-day scheduled operation, there was on no occasion a cancellation or interruption of a flight due to the failure of a purely helicopter component



Ratio of defects in various helicopter groups over 300 hrs flying

Incidence of overall deects over 300 hours flying

FIG 1

Criticism, therefore, will be tempered with moderation, for it has been conclusively proved that no fundamental deficiency exists in a basic configuration Whatever difficulties have arisen can be attributed to, and arise directly from a lack of refinement in detail design

General Problems

The general problems which I shall indicate and discuss fall under the headings of —

Engineering, Flight Characteristics, and Operation

The order indicated bears no particular significance, but the arrangement is convenient in that the effect of one has a direct association with, and influence on the others Appropriate sub-headings might well be maintenance, pilotage and performance

Engineering

The application of continuous power to the main rotor, the need for uninterrupted rotation of this component in the event of power failure, and the provision of adequate means for torque compensation, involves mechanical complexity and multiplicity of moving parts Moreover, the natural vibrational characteristics of the rotor system are such as to make the aircraft as a whole particularly susceptible in terms of frequency and amplitude to quite small departures from allowable tolerances on linkages

The working life of main rotor blade hinge bearings for instance is currently of too limited a nature Compactness has been achieved at the expense of reliability, comfort and performance Utilization is impaired, inspection schedules are prolonged, and costs of operation appreciably increased, not only through enforced servicing, but also by the interruption in the working life of other components which would best function if left alone

Ideally all components should have a stated life, their ready replacement and precise interchangeability being of primary importance Even so, the possible reduction in maintenance man hours thus affected is of itself inadequate unless the design layout of the aircraft has been such as to allow a concentrated effort to be applied, thus reducing turn-round time to a minimum

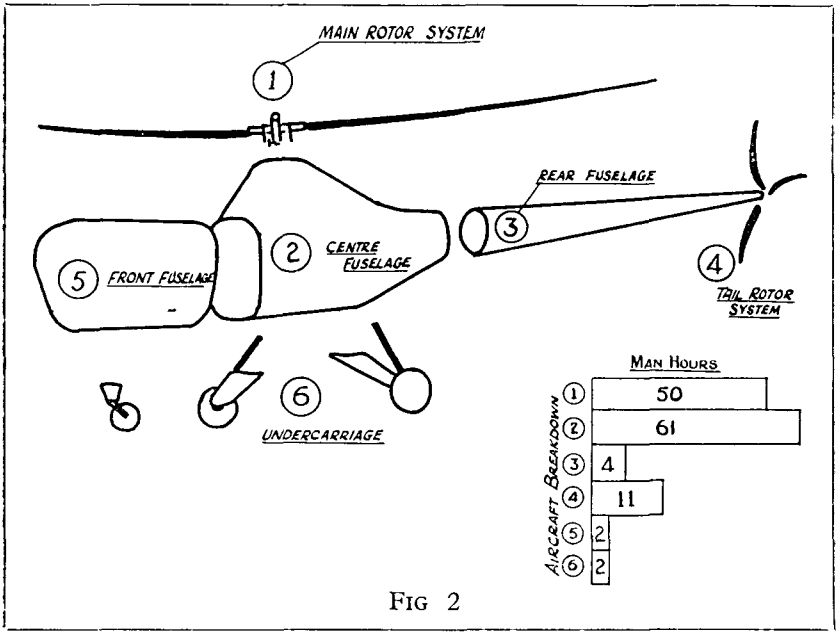


FIG 2

Accessibility for inspection and replacement of working parts also necessitates easily removable panels, jacking and sling points, hand grips and foot-rests Dismantling and assembly of unitary components can only be accomplished with facility and little risk of damage by the provision of carefully designed tools and extractors

The suppression of friction involves adequate lubrication, particularly with highly loaded bearing surfaces If a grease gun has to be used, correct positioning of the connectors is a minor point with major implications, second only to the selection of the correct grade of lubricant

Thus, sound engineering practice during the initial design period is a vital factor in the determination of maintenance procedures, and their relationship to and influence on utilisation It is in fact the hard core of reliability, operability and earning ability

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Flight Characteristics

Although the view is occasionally expressed that the helicopter is not difficult to fly, it would be an exaggeration to suggest that it is easy

The efficiency of the control system as a whole is to a certain extent offset by delicacy required in the co-ordination of individual controls, lack of uniformity in sensitiveness and feel, and the inability to trim for any sustained period Present unstable characteristics are thus accentuated, and result in pilot mental and physical fatigue

Whilst ballasting can be accepted as a pre-flight requirement to compensate for calculated C G displacement due to load carried, the lack of a satisfactory trimming device for use during flight necessitates the employment of the azimuth control, thus tending to restrict adequate control response to gusts, and adding to the difficulties associated with night and blind flying

Careful investigation is required into the positioning of controls and their relationship to normal movements of the body cockpit comfort in terms of seating, visibility and temperature, and instrument display in terms of selection, grouping and readability

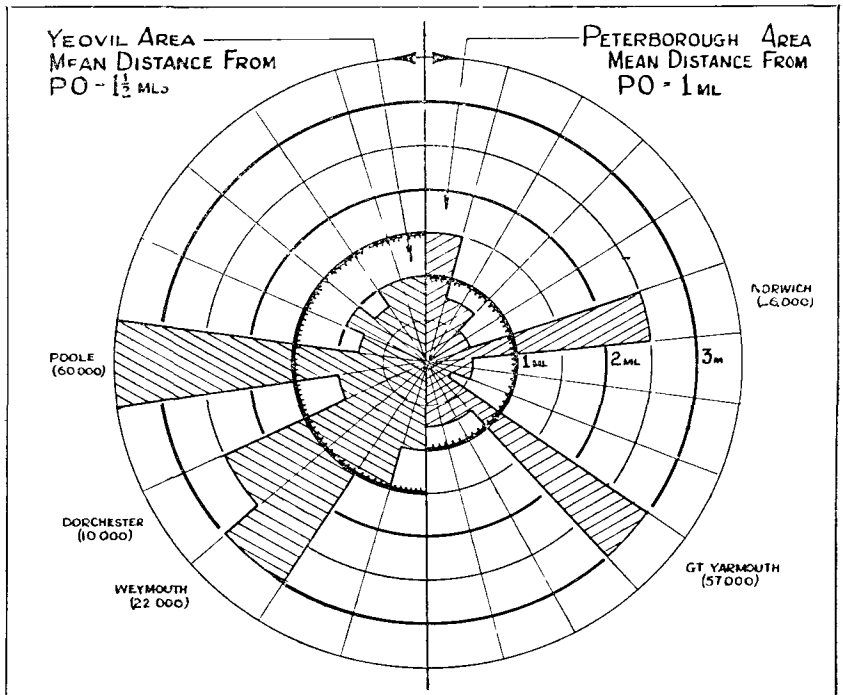

Fig 3

The psychological aspect of helicopter pilotage, and its co re'ated influence on instinctive reactions—especially during abnormal conditions of flight—needs to be explored, for the mental capacity to think may not always be in step with the physical necessity to act

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Operation from confined obstructed areas is appreciably influenced by performance characteristics Maximum safety necessitates a rapid rate of climb at a steep angle of ascent during the take-off Conversely, and to facilitate landing in the event of power failure, particularly with single engine types, the rate of descent must be slow at low translational speed These latter requirements are functions of power and disc loading, respectively, the desirable values of which should not exceed 10 lbs per h p and 2 lbs per sq ft respectively

Operation

Two essential operational requirements are that the equipment used shall be reliable and safe

Maximum utilization with minimum maintenance not only makes possible a high ratio of hours spent in the air to those spent on the ground, but this characteristic also breeds confidence amongst the operating crews in the reliability of the product they are handling

Safety on the ground both to crews and nearby spectators must be assured by sufficient elevation of the blade tips of main and torque compensating rotors

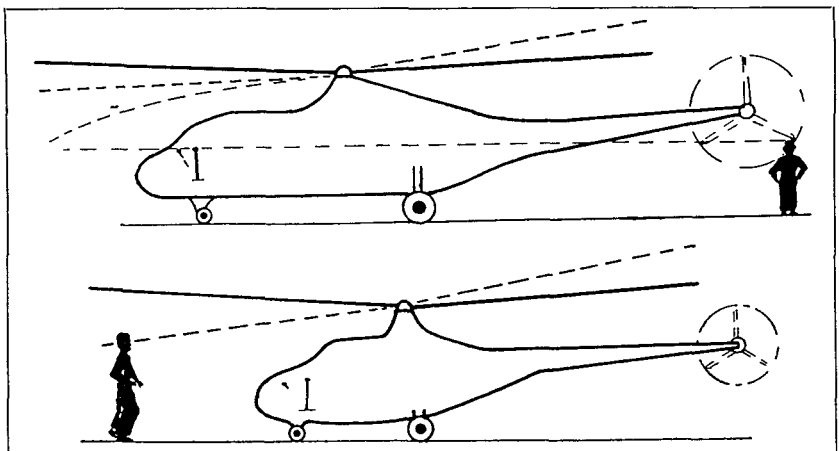

Fig 4

For safety in flight, visibility from the pilot's seat must not be impaired by the external effect of rain, or internal misting Preservation of accepted standards of transparency is particularly desirable during night and blind flying operations at low altitude

For the carriage of passengers the fuselage must be roomy and easy of access , seating comfortable with good view externally , vibrational and sound levels of a low order

Route selection will to a large extent be governed by either the lack or limitation of normal surface facilities, three obvious examples being the centres of densely populated areas, mountainous terrain and water crossings Hence to preclude the possibility of a forced landing due to power failure

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under these operating conditions, a twin-engine installation is obligatory, an essential performance requirement being the maintenance of altitude in the event of partial power failure

Closely associated and parallel requirements to which brief reference should be made are the development of instrumental and navigational aids Only by the ability to fly blind and at night will maximum utilization and operationally acceptable standards of efficiency and economy be attained The accurate identification and use of small landing areas also involves the development of suitable ground lighting equipment, the precise nature of which has yet to be determined

The economics of helicopter operation are at present such as to preclude consideration of other than highly specialised uses, a limitation which arises from high initial cost, and low pay-load capacity Thus the field of application will be restricted until the one bears a closer relationship to the other

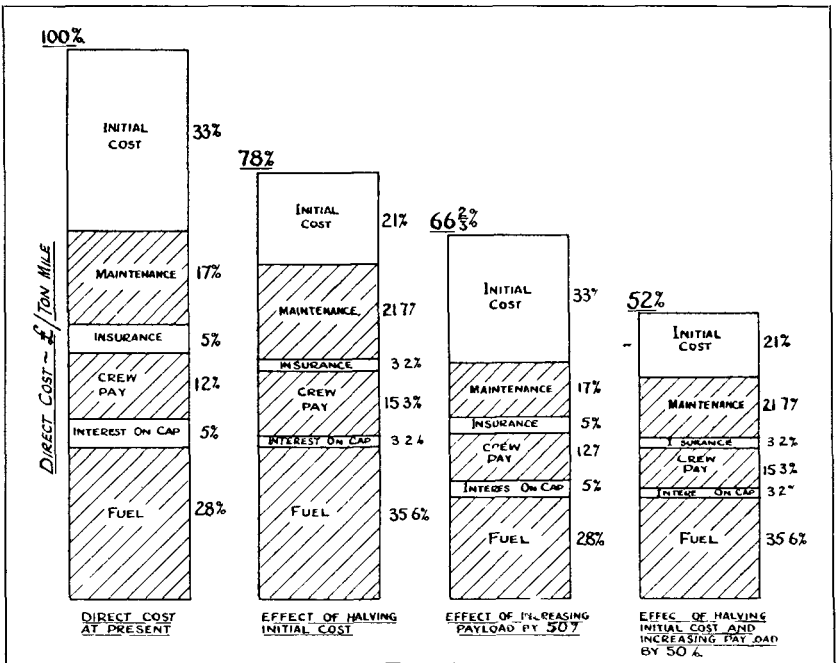

FIG 5

Whilst there may possibly be simple ways of appreciably increasing pay-load for freight or mail purposes, the solution as far as the human anatomy is concerned appears to lie in the development of bigger and better helicopters Here the economic picture tends to assume a more pleasing appearance, for a preliminary study based on current practice indicates the possibility of effecting an appreciable reduction in costs per passenger mile and to a level more in line with accepted standards, with a 12–14 seater type of helicopter

Conclusion

In endeavouring to cover a fairly wide field in the short time available, the object has been to indicate that whilst the helicopter has already arrived in a practical form, its further development is closely associated with a solution being found to many relatively small but nevertheless important problems The subject of economics is a wide one embracing many variables but there is little doubt that if there is to be any future in helicopter operation, if in fact the unique characteristics of this new means of transport with its independence of specially prepared landing grounds and its ability to save time are to be exploited to the full, then a fundamental requirement is that industry produces an acceptable product at an acceptable price

To ensure overall reliability in service, the term engineering must be considered in its broadest sense during the conception of any commercial helicopter, so much so in fact that if necessary it would be well worthwhile to sacrifice performance, in terms of high speed, on the altar of utilization Although man hours expended on maintenance have an important influence on engineering costs, hours of unserviceability reflect adversely on earning capacity

In summing up, the stage of development already reached in the rotary-wing art indicates clearly the need for boldness and enterprise in making the best use of knowledge which already exists, rather than in scanning for fresh horizons with their inevitable uncertainties There is nothing mysterious about what enables a helicopter to function, neither need there be any doubt about the direction in which its logical development should be pursued If industry desires seriously and profitably to participate in this comparatively virgin field of vast potentialities, it must keep its head clear of the clouds of theoretical procrastination, and place its feet firmly on the ground of practical reality This does not imply that improvement is not desirable, but it does imply the necessity for a sharp dividing line to be drawn between long-term research, and short-term development

The latter is our immediate concern, and satisfactory solutions to the operational problems involved will only be reached expeditiously by mutual co-operation between those who produce and those who operate

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THE CHAIRMAN

The Chairman said that, having heard a most interesting paper by Helicopter Pilot No 1 and, hoping that they would hear later from Major Cordes the holder of the 2nd Certificate, the paper on technical problems was to be presented by the holder of the third ticket Captain Liptrot had for a long time worked out the specifications and performances and things of that kind in the Air Ministry and the Ministry of Aircraft Production At the moment he was thoroughly enjoying himself working with, and on and in, helicopters At present he was Deputy Director, Research and Development (Helicopters) at the Ministry of Supply

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