022 Vol. LII

SEPTEMBER 25th, 1947

FLIGHT

and

AIRCRAFT ENGINEER

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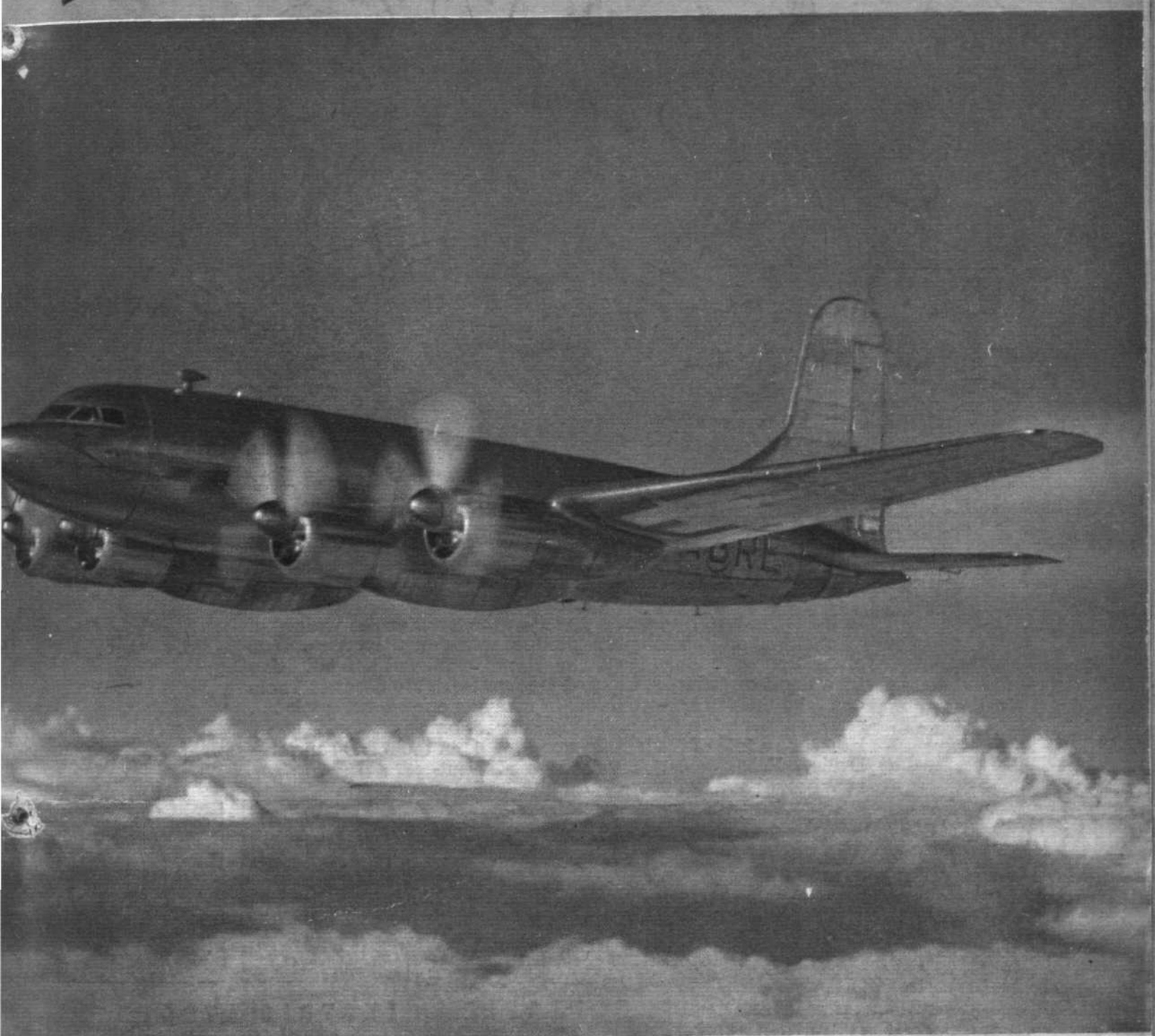

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The Outlook

The New Jet Bombers

GUARDED as it is, the recent announcement by the Ministry of Supply concerning plans for jet bombers does serve to confirm what any reasonably intelligent person could have deduced for himself. It was in June of last year that Mr. Wilmot announced that in future the R.A.F. would be interested only in fighters and bombers with gas turbines. At the time, we uttered a warning against undue optimism, and it appears that we were well justified in doing so.

The Ministry's announcement states that "an order was placed to an Air Ministry specification 2½ years ago for a medium-range bomber powered with two 'straight' jet engines and capable of a speed approximately twice that of the current reciprocating-engined bomber, namely, Lincoln." That brings us to a speed somewhere in the 600 m.p.h. region. But evidently the range contemplated in the original specification was not deemed sufficient, and a year ago an order was placed for a heavy bomber of longer range and powered by four straight jet engines.

In the meantime, however, the demands of the Air Staff have increased still further, and even more difficult targets have been set up in the matter of speed, range and operating height.

"To effect these last improvements," the announcement states, "it will probably be necessary to adopt some unorthodox shape of wing." From this it would appear to emerge that the first two bomber designs have fairly orthodox wing shapes, while the latest have swept-back wings.

The problems which confront designers are many and difficult, as the recent Anglo-American Aeronautical Conference showed very clearly. They are basically similar, so far as aerodynamics and structure are concerned, whether the aircraft is a bomber or a transport. In both types, fuel consumption is also an important factor, although not for identical reasons, and it is thus not very surprising to learn from the Ministry's announcement that, in addition to the probable placing shortly of orders for two of the new long-range bombers, "development contracts cover new engines." The Ministry would not be doing its job if this were not so.

It is a little disquieting, however, to be told that the placing of contracts for two of the large long-range bombers with unorthodox wings is still only in the "probable" stage. If the decision is left much longer, the Air Staff will quite likely discover that they are not, after all, what is wanted, and a new set of tasks will be set our designing staffs. In that way we shall never get anywhere. There is not unlimited designing capacity in the country.

Another Let-down

SYMPATHY for any monopolistic body or organization does not usually bring ready tears to anyone's eyes, but in the case of the Government's currency ban on tourist travel, the likely effect on British European Airways Corporation's future is such as to give cause for misgivings.

Mr. d'Erlanger, the Corporation's chairman, did not exaggerate when he described the situation as "grim." Granted that a ground personnel of 7,000 to keep about 100 aircraft in the air points to top-heaviness, in fairness it must be said that B.E.A.C. was encouraged by the Government to prepare in every way for expansion, to open up routes and services which were obviously unremunerative at present, and in general to do things on the grand scale which seems to have such an irresistible appeal at the moment. In short, the base of the pyramid was, presumably, planned to be capable of supporting several hundred aircraft when the time came.

Regrettable as is the prospect of throwing large numbers of directly affected people out of work, many of whom will probably be compelled to go into occupations in which their previous experience is of little value, this

is not the only aspect of the problem. If B.E.A.C. are to curtail their European services, fewer aircraft will be needed, and this in turn will mean still further dismissals from factories. Already Miles Aircraft have begun a reduction of staff.

While it is true that the other two Corporations need more aircraft, that fact does not help much, since the long-distance routes require very different types. Perhaps an amelioration of the situation might be found in changing the cargo from passengers to mails. The conversion of aircraft should not be a very lengthy task, nor a very expensive one. The rates now charged for air mails are far too high, and if there is likely to be a surplus of aircraft they could be usefully employed. The Post Office must be making a very nice profit and could well afford to pay more for the carriage of air mails.

Tudors—Immediate Action Called For

THE ferment caused by Sir Roy Dobson's outspoken statement in Manchester last Monday—precipitated by the unconfirmed B.B.C. announcement that completed Tudor I Atlantic transports might be gutted and used only as freighters—can only be settled by an immediate enquiry and a prompt and impartial statement of all the facts.

It is well-known, of course, that a most regrettable atmosphere has surrounded the Tudors for many months past, and that these airliners, lineal descendants of the war-winning Lancaster bombers, had been the cause of some friction between B.O.A.C. and the A. V. Roe Company. It is also certain that the Tudors are not as inefficient as is implied in some quarters, nor, probably, are they as suitable for their purpose as has been suggested by the flattering remarks of the chief of another Corporation.

One of the main troubles seems to have been the confusion and wavering as to the equipment, final form and precise employment of the Tudor I. It is contended that B.O.A.C. could not make a decision and hold to it. This continued vacillation has led Sir Roy and his workers openly to charge that delaying tactics have been deliberately employed and that "a certain element in B.O.A.C. has always preferred American aircraft."

Obviously, it is desirable from every point of view that British airlines should fly British aircraft. If there is truth in Sir Roy's charges of delaying tactics with the purpose of influencing purchases, such an accusation must form the subject of investigation.

The nation and the British aircraft industry are suffering both in prestige and financially from this unfortunate state of affairs which for some months has amounted almost to an impasse, and finally promises to come to a head. Ministries, our leading national airline and a most important aircraft manufacturer are concerned. A prompt investigation by experts, publicly revealing the facts without fear or favour, is the only solution.

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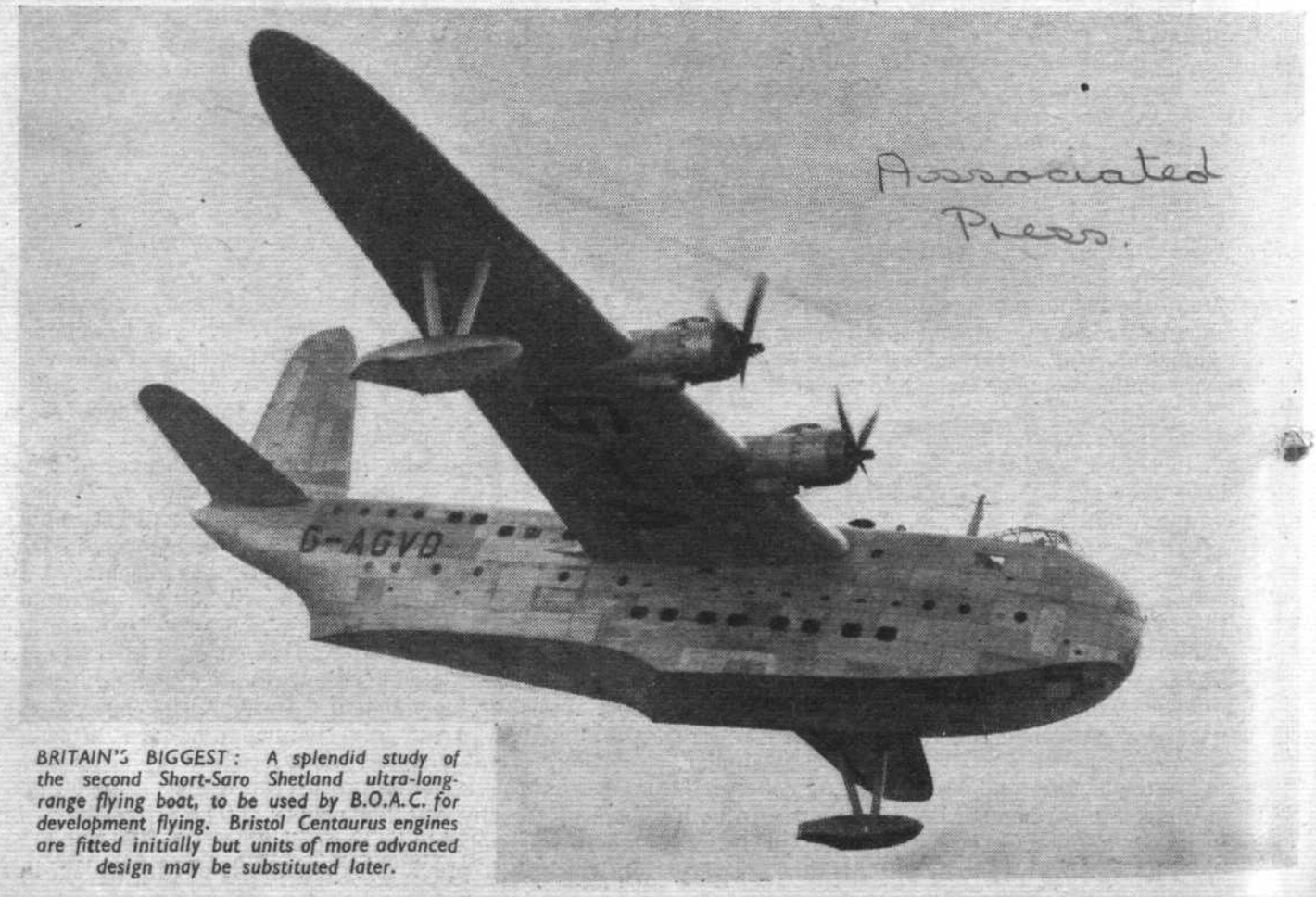


BRITAIN'S BIGGEST: A splendid study of the second Short-Saro Shetland ultra-long-range flying boat, to be used by B.O.A.C. for development flying. Bristol Centaurus engines are fitted initially but units of more advanced design may be substituted later.

INTRODUCING THE BELL

Hardy Two-seater Helicopter Demonstrated by New British Company

Illustrated by "Flight" photographs

Captain A. B. H. Youell "levitates" A.V-M. D. C. T. Bennet, one of the chosen few to fly in the Model 47B at Hanworth. B.O.A.C. have already taken delivery of two of these machines.

AT the end of August a new company, Irvin-Bell Helicopter Sales, Ltd., which has been formed to "keep the United Kingdom in the closest possible touch with helicopter development," gave its first demonstration of the Bell 47B to a small but important gathering at Prestwick Airport, location of the company's engineering and training division. Last Thursday, September 18th, another demonstration was given at Hanworth airfield and was attended by senior representatives of the Services, Ministries, Corporations and industry.

The machine was put through its paces by "Jimmy" Youell, who finally placed it precisely on the lawn of the Hanworth Park Hotel which had been very appropriately chosen as a meeting place for the occasion.

Irvin-Bell Helicopter Sales, Ltd. has resulted from the collaboration of Scottish Aviation, Ltd., with Mr. Leslie L. Irvin, founder of the Irving Air Chute Company, and the directors are the four of Scottish Aviation, namely, the Duke of Hamilton, Sir Ernest Lemon, Mr. D. F. McIntyre and the Earl of Selkirk, together with Mr. Leslie Irvin, Captain Cyril Turner and Captain A. B. H. Youell of the Irving Air Chute Co. The head offices of the company are at Ickneild Way, Letchworth, Herts.

The executive, operational and technical staff of the new organization have all attended courses of instruction at the Bell Helicopter Flight Training School and the Bell factories in America in order to take full advantage of America's experience in flying and operating helicopters. The main purposes of the company are now to sell the Bell helicopter in this and other countries, to train helicopter pilots and mechanics, and to explore the possibilities of commercial operation of helicopters for crop spraying, rescue and ambulance work, aerial survey and photography, mail carrying, traffic control and taxi work. Before turning from the organization of the new company to some details of the Bell helicopters it should be mentioned that Capt. Youell and W/C. N. J. Capper will be responsible for sales and training respectively. Both hold American unrestricted helicopter licences. Engineering instruction will be the work of Mr. Fred Noble and Mr. Ian Wondsborough, both of whom took the Bell training course at Niagara.

Cost of Instruction

In America a course on the Bell 47B for pilots with experience on conventional aircraft costs about £300, and consists of 25 hours' dual and solo flying plus a ground course. At Prestwick a full helicopter course will probably cost a little over £300 and a shorter course for conversion on the Bell of pilots with some experience will cost about

After its demonstration the Bell came under expert scrutiny. Its roomy and attractive cabin, and neat, business-like appearance were appreciated.

Introducing the Bell . . . .

£150 for a minimum of 10 hours, or £100 if the pupil is flying his own aircraft.

During the last war the Bell Company became known in this country particularly for the Bell Airacobra fighter, and more recently in addition to its helicopter designs the company's XS-1 rocket-propelled research aircraft for investigation of problems of high-speed flight has frequently been referred to. The Bell Aircraft Corporation was formed at Buffalo in 1935 by three ex-senior officials of the Consolidated Aircraft Corporation, which in that year moved its factory from Buffalo to San Diego. The Bell 47 was its second helicopter design and the first helicopter to receive a commercial licence (March 8th, 1946). The Model 47B, which was demonstrated at Prestwick and Hanworth, is a neat little two-seater cabin machine developed from the Perspex-enclosed 47 or YR-13, which has been ordered by the U.S. Army and Navy. The Model 47B can be fitted with either a four-wheel landing gear, the front two wheels of which are self-castering, or with floats.

The four-wheeled undercarriage is an interesting feature of the 47B. The front wheels are castering. Note the small coning angle of the rotor blades.

The fuselage is made up in two sections, both with welded tubular framework, the rear portion being the triangular-section boom which supports the torque-compensating rotor and its drive shaft. Immediately behind the cabin is the 175 h.p. Franklin horizontally opposed six-cylinder engine. This unit is mounted with the drive shaft vertical and is surmounted by the clutch, rotor shaft and rotor assembly. The drive for the rear rotor is also taken from the front or top of the engine. Air cooling is assisted by a fan.

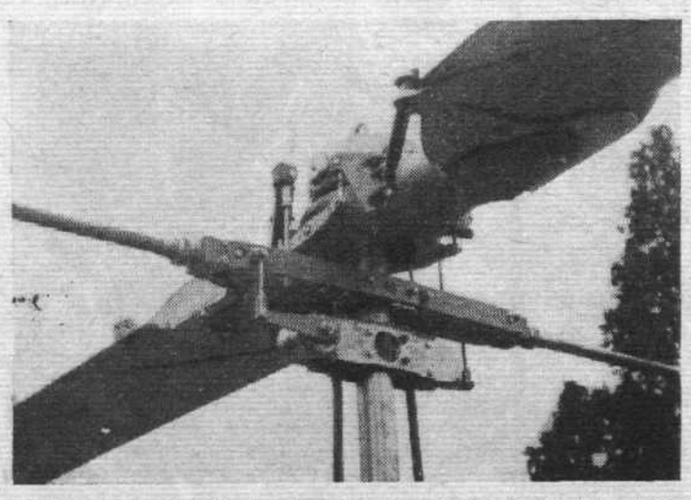
The rotor head differs from those of other helicopters in several respects To begin with, the rotor is a two-blader instead of the more usual three-blader used by most other designers. This has the advantage of making for mechanical simplicity, and the Bell rotor head is very neat indeed. This advantage is, however, not attained without drawbacks in other directions. For instance, to make up for the reduced blade area the rotor has to be either of larger diameter or run at greater speed or both. A limit is set by the need to avoid the blade-tip speed approaching too closely to that of sound.

BELL MODEL 47B

Diam of main rotor	33ft 7½in
Diam of anti-torque rotor ...	5ft. 5in
Max weight	2,100lb
Total useful load	612lb
Cruising speed	80 m.p.h.
Rate of climb	950ft/min
Service ceiling	9,700ft
Range	200 miles

Another drawback of the two-blade rotor is that it sets up aerodynamic vibrations twice per revolution. In the Bell, these vibrations are isolated from the machine by having the mast flexibly mounted.

In addition to the two-blade arrangement, the rotor of the Bell is unusual in that the blades are rigidly attached to the hub; that is to say, there are no flapping hinges. Instead, the blades have a "see-saw" movement, the retreating blade on one side descending while the advancing one is ascending.



The very neat rotor head is made possible by the two-blade arrangement. The stabilizing bar is seen just below the head, and under it are the friction dampers for the bar pivots.

The two-bladed rotor lends itself to the use of the stabilizing bar, which is an exclusive Bell feature, and is only applicable to two-bladed rotors. Perhaps the easiest way of visualizing the action of this bar is to think of it as an artificial horizon. It is placed at right angles (in plan view) to the rotor blades and so mounted that when the mast tilts (within limits) the bar does not follow it but prevents, by suitable feathering, the rotor from following the tilt of the mast.

The rotor is controlled partly by the stabilizing bar and partly by the pilot. This is achieved by a set of auxiliary levers housed inside the forked centre of the bar. At their outer ends these levers are hinged to the bar fork. From their inner ends, control rods run downwards to the pilot's control. From about halfway along the levers, connecting links run up to the cranks which control the pitch of the blades. Thus for stability the bar maintains the rotor in its proper attitude, but for control, the pilot tilts the bar in relation to the mast and thus alters the pitch of the blades. In addition, there is a swashplate which partakes of the control.

It will be appreciated that friction in the bar pivots has an important effect. If the friction is great, the bar tends to follow the inclined mast, and the stability is reduced, but manœuvrability is, of course, increased. If there is very little friction, the reverse occurs. Adjustable dampers make possible a very delicate control of the friction in the bar pivots.

Full dual control is provided in the neat, roomy and comfortable cabin, and view in all except the rearward direction is excellent. Instruments and switches are neatly grouped on a central pedestal, and collective pitch control levers with the usual twist-grip throttles are positioned between the seats and on the left-hand side of the port seat respectively. The dual control columns, or cyclic controls, are tubular, free from all impediments and cranked at the top, while the rudder or torque pedals are of the separate swinging type. Standard equipment includes two-way radio and navigation lights.

In the Bell it may be said that for the first time a small helicopter approaches the requirements of the private owner. It is compact, attractive and relatively simple, and the price of a little over £6,000, whilst still high by comparison with conventional two-seat aircraft, is a considerably lower figure than one has learned to associate with helicopters.

The demonstration of the 47B at Hanworth took place on a misty evening, and flying continued well into the dusk, the red and green navigation lights on the cabin sides shining brightly. Although helicopters cannot yet be flown at night or on instruments, it is understood that good progress is being made in this direction on both sides of the Atlantic.

The Bell Company in America now has flying a smart five-seater commercial helicopter known as the Model 42. This machine has a 445 h.p. Pratt and Whitney Wasp Junior. It resembles the smaller machine quite closely but the two front castering wheels are replaced by a single nose wheel. The diameter of its main rotor is 47ft 6in and it is designed to carry a useful load of 1,445lb.

HERE AND THERE

FOUR-JET NIGHT-FIGHTER?: Sixty-five feet in span and sixty feet long, the new Curtiss XP-87 fighter has four axial-flow jets of unspecified type. It should have a long range, if only two jets are used for cruising, and would appear suitable for use as a night-fighter.

Atomic Energy Exhibition

A TRAVELLING train Atomic Energy Exhibition, the aim of which is to teach the public the basic facts of atomic energy and its implications, is to begin on November 10th. The tour, which has been organized by the Atomic Scientists' Association with the full co-operation of the Ministry of Supply, will visit twenty-six towns in England, Scotland and Wales. The Exhibition, which will be fitted into two railway coaches, will be divided into two parts: the first part will deal with the basic principles of atomic energy, and in the second part of the Exhibition the application of atomic energy will be shown with models illustrating the chain reaction in uranium and the principles of the separation of isotopes and atomic energy piles. Scientists will be in attendance to answer any questions and to give additional explanations, and it is planned to organize at the same time atomic energy weeks in each town visited, when lectures and film shows will be given.

The official opening will take place at Liverpool, but the first showing to the public will be at Chester. The Exhibition will finish in London on April 20th next year.

GREETINGS: Major E. D. Degrcot, Captain of the American team which took part in the Battle of Britain sporting contests held at Uxbridge last week, is seen being welcomed by Marshal of the Royal Air Force, Viscount Portal of Hungerford, President of the contests.

Aeronautical Scholarship for Women

THE Women's League and the Women's Engineering Society have co-operated to found a new aeronautical scholarship for women. The scholarship will be awarded every two years, and the winner will be enabled to train in any branch of aeronautical engineering. Girls who have passed the School Certificate examination, and who are aged between 15 and 20, will be eligible. Applications for the first scholarship must be received before April 30th, 1948. Application forms may be obtained from the Secretary, the Women's Engineering Society, 35, Grosvenor Place, London, S.W.1.

A.S.M.E. Establishment

THE Council of the American Society of Mechanical Engineers has finally approved the establishment of a Gas Turbine Power Division. This division will take over the work of the Gas Turbine Co-ordinating Committee, which committee will in future be called the Advisory Committee of the Gas Turbine Power Division.

In December, at the annual meeting of the A.S.M.E. in Atlantic City, there is to be an aircraft exhibition which will include gas turbines, turbo-superchargers, rockets, accessories and nuclear energy equipment only.

Loitering with Intent

IN an effort to apprehend private motorists in Germany who violate traffic regulations, the U.S. authorities have inaugurated air police patrols. Using light aircraft which cruise above the Autobahns, the aerial policemen radio the descriptions and particulars of the offending cars to officers waiting in jeeps below. A similar idea was used in England recently, when August Bank Holiday traffic to the coast was controlled by radio from an Auster aircraft.

Delivery Flight

CAPT. D. KEESING and F/L. Engineer L. J. Goldie of Tasman Empire Airways, Ltd., recently flew to this country by B.O.A.C. to collect *Auckland*, the fourth and last Sandringham Mark IV type flying-boat ordered by Tasman Empire Airways from Short Brothers. The other three, named *Tasman, Australia* and *New Zealand* respectively, were delivered last year. The boats, which have accommodation for 30 passengers and a take-off weight of 60,000lb, are operated by Tasman Empire Airways between New Zealand and Australia.

Metrovick Meteor

A NEW experimental version of the Gloster Meteor is flying successfully with two Metropolitan-Vickers axial flow turbo-jet units. It may be recalled that as long ago as 1943 an early type of Meteor was fitted with Metropolitan-Vickers' F2/1 jet engines.

News in Brief

SIR HENRY TIZZARD, Chairman of the British Defence and Research Advisory Committee, hinted at a Press conference held in Ottawa recently that Britain, the United States and Canada would, if necessary, co-operate for the defence of the Artic. In this respect Canada has completed surveys for the establishment of V-2 rocket-testing ranges in the northern part of the province.

* * *

To ease the present milk shortage in Lancashire, aircraft are flying 10,000 gallons of milk a day from Belfast to Liverpool. York and Lancaster aircraft make several trips daily and the Ministry of Food have stated that deliveries will continue for at least six weeks.

* * *

The amalgamation of two famous British companies was announced recently. They are Kelvin, Bottomley and Baird, Ltd., and Henry Hughes and Son, Ltd., who formed a close association during the war, when their London depots were destroyed by enemy action. A new company, under the name of Kelvin and Hughes has been registered to acquire the issued capitals of the two firms.

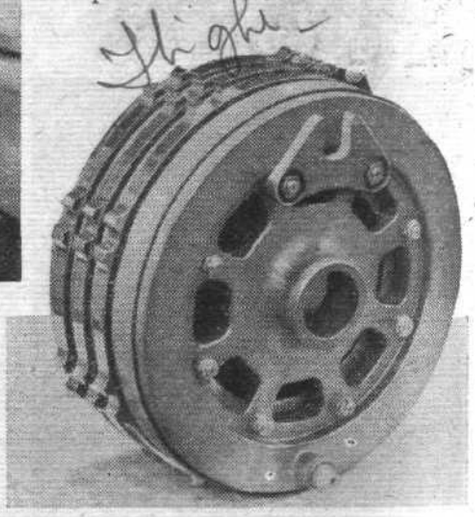
A Dynamic Static Show

Review of Many of the Chief New Features Exhibited : High Standard of Display Attained : General Advances

THERE was too much to see, too much to talk about, too much to absorb in the tent-extended hangar, which housed the static exhibition at Radlett, for one even to begin to give a detailed appraisal of the show. At best one can but pick out the highlights which are new. So we propose to take our readers on a mental stroll round the crowded, colourful, bright and shining stands, noting the names on the neat blue head-boards, and casting a rapid glance over the exhibits in a search for new items of interest.

Passing through the cream-painted, pillared entrance—which might well have carried the legend *Industria hic Regnat*—one was met by a babel of languages that immediately established the international nature of this British event. It cannot be gainsaid that, in the aeronautical sphere, it now in few others, whatever Britain does is still the subject of intense interest to the world.

All the exhibits were immaculate, although naturally a rough casting has not the eye-appeal possessed by a sectioned, motorized engine. Nevertheless, in every instance the range of work displayed by each manufacturer was laid out with skilful attention to the capture of interest, and the astonishing variety of items shown emphasized again and again the immensely wide scope of activity embraced by the aviation industry. Meteorological instruments and tablecloths, cannon-loading devices and air-cooling units, plastics in profusion and lights of every type. It was all too easy to contract mental indigestion.



(Above) On the G.E.C. stand was a 1½-kW location beacon with automatic lamp-changer. (Left) The new directional-gyro and artificial horizon, were shown by Smiths Aircraft Instruments Ltd. (Right) Main undercarriage wheel by British Messier for the Meteor.

Model Exhibits

Naturally enough, the exhibits featured on the aircraft and engine companies' stands are dealt with in the other sections of *Flight's* review and there is thus not much point in repeating them here. Suffice to say that the standard of display everywhere was up to that very high level which we have learnt to accept as a norm. In particular, the double stand jointly occupied by the de Havilland Aircraft and Engine Companies was strikingly bounded on two sides by a chronological line of scale models, starting with the DH 1 two-seat Pusher Scout of 1914 and ending with the DH 108 of to-day; this feature of the stand seemed to evoke as much interest as the prime exhibits.

Fairey Aviation had a crowded stand, one of the more interesting features upon which was the motorized transmission system of the Fairey Gyrodyne helicopter, this being complemented by a motorized large-scale model of the Gyrodyne itself. Another interesting Fairey exhibit was a four-blade 13ft-diameter metal airscrew intended for a 2,000 to 2,500 h.p. turbine, and employing electric constant-speeding actuation in conjunction with mechanically actuated feathering and braking; the pitch-change rates quoted were respectively 8 deg/second for constant-speeding and 40 deg/second for feathering and braking.

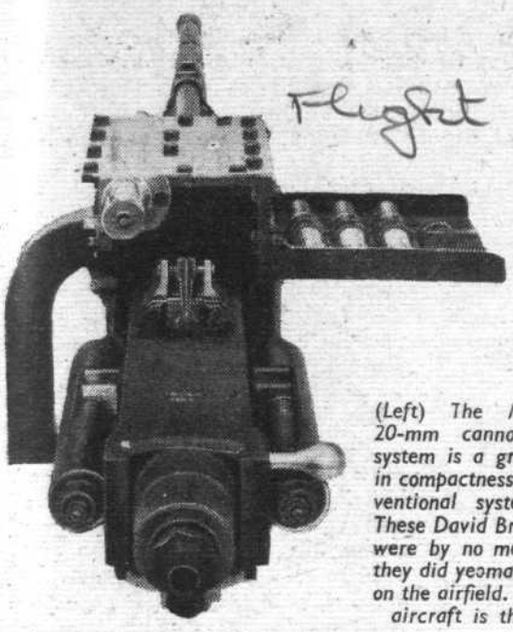
Freighter Components

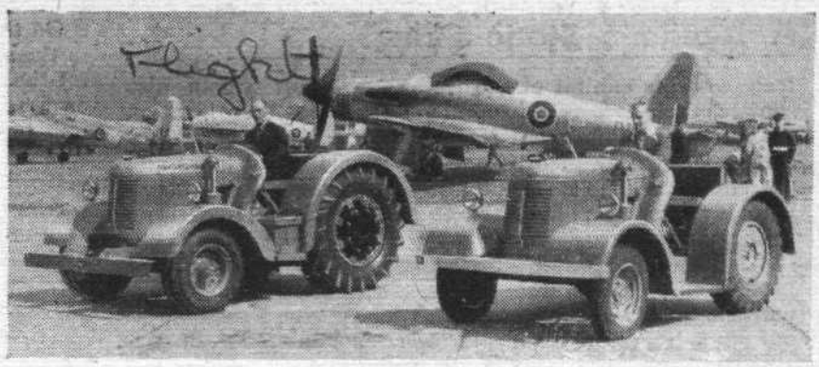
General Aircraft, Ltd. showed two chordal sections of the outer-wing panels to be used on their huge Universal Freighter, and it was interesting to see that these comprised an integral thermal de-icing duct in the leading edge and pressed Warren-girder-braced contour ribs in conjunction with Z-section stringers. Between these two aerofoil sections was the lower part of a fuselage frame incorporating the transverse floor beam which, illustrating the very massive floor structure, made it easy to appreciate how such typical loads as the 5-ton agricultural tractor shown in an accompanying model will be catered for. These components were actual units.

On the Avro stand were extremely attractive models of the company's Woodford airfield, Langar and Bracebridge Heath repair depots, and Chadderton main works. Also on show was a scale model of the Avro wind tunnel which, now being built at Chadderton, will finally be erected at Woodford. The model showed the tunnel to be of closed-circuit type with a 9ft by 7ft working section; a 500 h.p. motor is to provide a maximum airspeed, tunnel empty, of 265 ft/second, and model reactions will be assessed by a six-component balance.

Miles Aircraft, Ltd. had a very attractive stand with a highly decorative but apparently unsignificant central motif. Of chief interest among the items displayed was the control-surface trimming system by means of Miles electric actuators governed by a three-motion switch, and the Miles Co-Pilot in main-component form.

British Messier, Ltd. had on view a Meteor main undercarriage wheel incorporating their new triple-disc hydraulic brake, this exhibit being supplemented by a range of press-button hydraulic selector-switches, which introduce the company's novel system of operation by means of hydraulic relays to obviate the necessity of carrying major





(Left) The Martin-Baker 20-mm cannon flat-feed system is a great advance in compactness over the conventional system. (Right) These David Brown tractors were by no means static—they did yeoman service out on the airfield. The hooded aircraft is the Wyvern.

hydraulic pipe lines to and from the cockpit. This has been made possible by the—also novel—introduction of a system-operating pressure of 4,000 lb/sq in, this figure being, it is claimed, considerably higher than any aircraft hydraulic-system pressure previously attempted. All these innovations are of Messier design, but they are manufactured in this country and the new company are to be congratulated on their performance in producing what they have done in the four and a half months of their existence.

R.F.D., Ltd. had on their stand two or three pneumatic chairs into which it was a considerable relief to sink. These chairs, designed primarily for domestic pleasure use, are constructed of a rubberized-fabric similar to that used for aircraft dinghies and weigh but 4½lb. They are quite comfortable and are made interesting by the fact that they may possibly be adapted to aircraft use by incorporating a tubular framework for compliance with A.R.B. stress requirements.

Hordern-Richmond, Ltd. have returned to the manufacture of Hydulignum improved-wood airscrew blades and, in addition to the torque-reaction rotor blades for the Bristol helicopter, also had on display a cooling fan intended for a Hercules engine. The fan was a single unit with integral disc and blades and was finished in white Phenoglaze. Not the least interesting application of Hydulignum is in its use for rubber press form-tools.

Plastic Compressor Blades

Cape Asbestos, Ltd. showed a fire- and heat-resisting plastic shroud for the oil tank fitted to de Havilland Gipsy Queen 34 E engines as one of the more interesting Capasco applications, whilst Aeroplastics, Ltd., among their wide range of typical components, displayed an extremely interesting experimental development which is being undertaken in conjunction with Rolls-Royce, Ltd. This was rotor and stator blading for an axial compressor, fabricated in an especially developed heat-resistant, high-shock plastic. So far as test results have gone, this interesting departure apparently holds considerable promise.

Harley Aircraft Landing Lamps exhibited their new taxying lamp intended for mounting beneath the aircraft, preferably under the nose. This lamp provides a circular pool of light with the aircraft as its centre, the upper limit of the beam being horizontal and the radius of illumination of the order of 500 yards. Although at the moment designed only in static form, there is every intention that future development will provide for flush retraction in, perhaps, a similar manner to that used for the company's landing lamps. Another interesting exhibit on this stand was an instantaneous-release universal-joint in the form of a ball and socket, the ball section of the unit being held between two rows of ball-bearings, housed in a cage, enclosed within a spring-loaded outer-sleeve: when this latter is slid back, the ball joint part of the union may be instantaneously extracted.

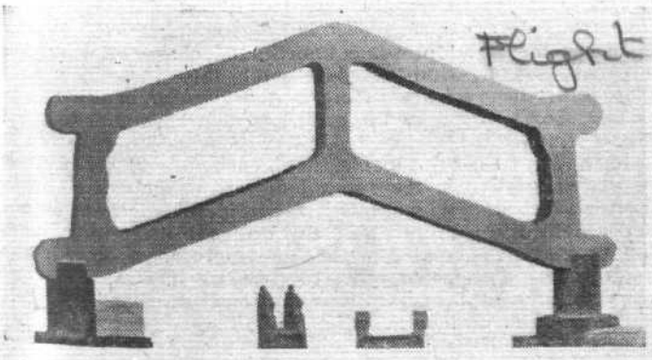
Aircrew Aids

Sangamo Weston displayed a quite new navigational device in the form of an orbit-radius meter for use with Rebecca. This, briefly, is an indicator which can be set according to the instructed radius of orbit and then shows any deviation from the selected radius relative to the Rebecca beacon. Another new instrument by this company is a British version of the standard American glide-path indicator for use with SCS-51.

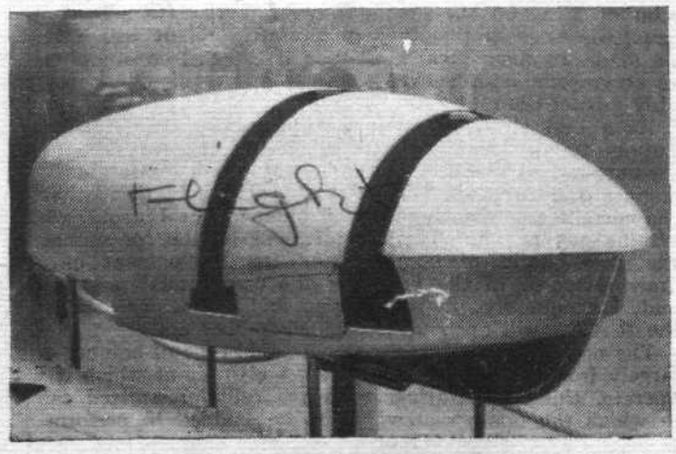
Martin-Baker Aircraft exhibited their ejector seat for fast-flying aircraft and also showed the 20-mm cannon flat-feed system whereby the recoil of the gun is caused to rotate two helical scrolls which draw the new round in and then force it down into the breech. On this stand was also shown the company's patent lubrication system for the translation bearing-unit of contra-rotating airscrews. By means of this a pre-determined, metered quantity of oil is automatically injected into the bearing whenever the airscrew comes to rest.

The Decca Navigator Company, in addition to a full-

Above a float designed for Auster aircraft this port wing-tip float for the SR/A1 was a feature of the Saunders-Roe display.



The true scale of this centre-section spar member for the SR/45 shown by James Booth may be appreciated by its span of over 9ft.

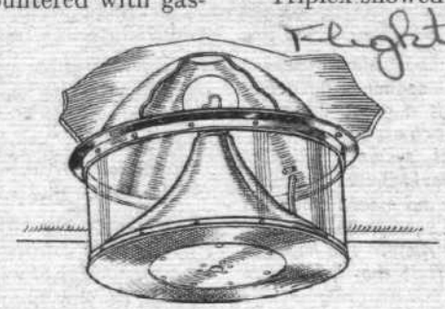


A Dynamic Static Show . . . . .

scale working exhibit of the Decca Navigator system, also showed their latest development of Lane Identification whereby any aircraft entering one of the Decca Navigator zones can at once identify the hyperbolic signal lanes and thereby determine its position. The normal Decca Navigator system then gives the required position fixes from that point onwards.

The Graviner Manufacturing Company showed a new type flame detector head which has been evolved for use with gas turbines. The normal capillary-type detector will not cater for the temperature range encountered with gas-turbines and, until new capillary detectors are available, these high-temperature detector heads have been evolved as an interim measure. They can be obtained in three temperature ranges, according to how close to the combustion chambers they are required to be mounted. Graviners also exhibited their new hand-type light-alloy extinguisher for aircraft cabin use.

Sir George Godfrey and Partners displayed the Marshall cold-air unit which, in fact, is a simple turbine-driven centrifugal compressor fitted in the cabin air-conditioning system downstream of the spill and non-return valve. It antithetically complements the air heater. Incoming air is fed to the centrifugal compressor from which it passes from the unit through an air-to-air intercooler and is thence brought back into the unit and expanded through the turbine, which latter is used solely to drive the compressor. The air cooling is achieved simply by expansion as between compressor and turbine, with a further inter-stage heat-exchange at the intercooler. For a weight of 21lb the capacity of, for example, the model to be fitted to the Vickers Viscount, is 54lb of air per minute delivered at 37 deg F from an inlet temperature of 90 deg F.



An ingenious taxying lamp by Harley which throws a flat-topped pool of light around the aircraft.

On the James Booth stand was a most interesting exhibit in the shape of the hand-forged centre-section spar member for the 120-ton Saunders-Roe SR/45 flying boat. Executed on a 12,000-ton press, this component is by far the largest unit of its kind ever attemped. It was a most impressive sight.

Dowty Equipment, Ltd. had on view a main undercarriage leg of the Brabazon I, utilizing levered suspension and the company's unique liquid-springing shock absorption. Among the various pumps on display was a Duplex-type twin-row 14-cylinder fuel pump intended for serving gas-turbine engines.

Triplex showed an electrically-heated optically-flat screen for fighter aircraft, the heating being to preclude ice formation. Seventy 0·0005in wires per inch are enclosed in the laminæ, and, although at present under development, this scheme has engaged considerable attention and is said to be progressing very favourably.

Kelvin, Bottomley and Baird showed a low-range airspeed indicator among their many instruments which, for one and three-quarter turns of needle sweep, gives an indicating range of from 10 to 150 m.p.h. The scale is quite open, and the indication is so dead-beat that half-mile an hour indications can easily be read even within the 10 to 20 m.p.h. range. This instrument should find great favour with gliding enthusiasts since it is capable of very precise indications at the low stalling speeds.

From this catholic survey of the static novelties it may readily be gathered that the British aircraft industry is by no means in need of prodding: the incentive to get on with the job of making our civil and commercial aeronautical world as pre-eminent as that of our military side is as strongly developed in the makers of the smallest components as it is in the makers of the largest. It is a state of affairs of which everyone may well feel justifiably proud.

British Jet Bombers

Long-range Aircraft Ordered : Many New Problems with Increased Speeds

SOME uneasiness has been felt during the past year because no official factual announcement has been forthcoming concerning the development of jet bombers in this country, while America has been completing and flying several prototypes. Now, at last, the Ministry of Supply has pronounced on the subject.

To take proper advantage of the turbine engine the bomber requires a new concept. The mere insertion of turbine engines into a bomber originally planned for reciprocating engines will not, in general, result in the full benefit of the change being obtained. Moreover, the "straight" jet engine achieves its highest efficiency only at speeds considerably higher than that of current bombers. The step we are likely to see in bomber speeds is, therefore, larger than the corresponding step in fighter speeds. Another factor affecting the reorientation of ideas on the bomber layout is that to achieve the required range in this type of aircraft, Flight will have to be made at much greater altitude if the fuel consumption is to be reasonable, and even then the fuel required is considerably greater than hitherto.

As a first step, an order was placed by the Ministry of Supply to an Air Ministry specification 2½ years ago for a medium-range bomber powered with two "straight" jet engines and capable of a speed approximately twice that of the current reciprocating-engined bomber, the Lincoln, which attains 305 m.p.h. This aircraft will be the forerunner of the new family of bombers and its development on the drawing-board, in the hands of the contractors' test teams, and, subsequently, in its training and operational stages in the R.A.F., will open up a completely new era.

The new problems associated with this type of bomber arise largely from the considerably greater altitude at which it will operate, this necessitating in turn a fully pressurized cabin, in which the bomber crew has to be enabled to perform all of its exacting military duties; this asks almost more ingenuity of the designer than does the comparable problem of the pressurized civil air liner. Other problems which present themselves are concerned with the very high speeds which will be possible at great altitudes, and this necessitates the development of new navigating methods which will depend more than in the past on radar.

Subsequent to the placing of this contract, an order was placed a year ago for a longer range heavy bomber of performance otherwise very similar to the twin-engine machine; this aircraft will be powered with four "straight" jet engines.

The two jet bombers that have been ordered will be great steps forward, but the demand by the Air Staff during the past eighteen months for still higher performance in terms of speed, range and operating height have led to further careful studies by the Ministry of Supply and design teams in the aircraft industry. To effect these last improvements it will probably be necessary to adopt some unorthodox shape of wing, and a great deal of wind-tunnel research into these new wing plan forms is necessary before a well-founded choice can be made. Some of this work has already been completed, but much remains to be done. On the information collected to date, however, it is probable that contracts will very shortly be placed for two of these new long-range bombers. Further increases in range will necessitate considerable growth in size and weight of the aircraft, and this brings in its train engineering problems, associated with the structure, of considerable magnitude. The major relief to this size increase will come through improved engine consumptions, so that here, too, much experimental work with new forms of turbine engine is needed. Model work, both in wind tunnel and by powered flying models, has been put in hand to throw light on all the airframe problems which arise in relation to these larger aircraft, and development contracts cover the newer engines.

National Gas Turbine Establishment

Increased Activity and Expanding Facilities

GOVERNMENTAL interest in and support of research and development for gas turbines was emphasized by Mr. Arthur Woodburn, M.P., Joint Parliamentary Secretary, Ministry of Supply, on the occasion of a visit to the Whetstone plant of the National Gas Turbine Establishment on September 17th. The gas turbine is regarded as the power producer of primary importance at the present time as it must precede the longer term development of atomic power.

Whilst the most spectacular advances have been made in the turbine propulsion of aircraft there are attractive possibilities for marine and rail propulsion and, also, for stationary installations for industrial power and electricity generation. The visit, in fact, was intended to direct attention to this aspect and to show that the investigation of basic problems by the N.G.T.E. would be of value to all branches of industry. It is constitutionally laid down that it is not the policy of the Establishment to produce complete engines. The manufacturing department is occupied in making components of advanced design for investigation, test and ultimate incorporation into engines. Either by direct contacts or by the issuing of reports, the results of research, tests and improvements in methods of design or production are passed on to the industry. Technical evaluation of new designs and equipment and the testing of new components or complete engines is undertaken. Mr. Woodburn expressed the opinion that the N.G.T.E. is a happy example of the co-ordination and co-operation of public and private enterprise. The Government desires all industry to be built on a sound basis of science and regards this method of centralized research for the benefit of all to be an economic utilization of scientific manpower.

The Establishment is directed by Dr. H. Roxbee Cox, who is responsible to the Ministry of Supply. Activities are organized into two main divisions each under the control of a Deputy Director. Mr. H. Constant, M.A., leads the Research Division with departments for aerodynamics, combustion, performance assessment and project assessment, while W/C. G. Lees controls the Manufacture and Testing Division with mechanical design, metallurgical, experimental and test departments.

Future Policy

At present the Establishment is scattered over four sites. Apart from Whetstone, Leicester (the venue of the visit), there are the laboratories at Pyestock, Hampshire, the buildings at Lutterworth, near Rugby, where the original Whittle engines were developed, and a London office where administrative, commercial and patent matters are handled. Lutterworth is now being used for the series of training courses on aircraft and industrial applications of the turbine, which are run by the Establishment for representatives of industry, Government departments, and also overseas and foreign personnel.

Eventually the various branches will be amalgamated into a single unit at Pyestock. Plans are under way for both short- and long-term development of the available 100-acre site, but present conditions are likely to enforce initial delay. When the long-term plan is completed in 10-15 years' time, facilities will include up to 14,000 h.p. for driving compressors, and test beds for both aircraft and marine units of high power. Aircraft engines will be tested under simulated conditions of altitudes up to 80,000 feet and speeds up to sonic velocity.

Mr. Woodburn suggested it is not too vain to say that, in the air, we are ahead of the rest of the world. In respect of land and sea applications we were, as a result of our preoccupation during the war years, perhaps not so advanced in practical development as certain other countries. Nevertheless, we have already powered a ship with a gas turbine and will soon have gas turbine locomotives. Our basic knowledge is established and our experience with aircraft turbines is invaluable. We can sell our turbines abroad and, furthermore, can and do sell our ideas abroad. British gas turbine patents are earning much-needed dollars for the country to-day.

With regard to the exhibits, many of the items were purely experimental and most were specifically related to aircraft units. In a number of instances they were components of engines still on the secret list. The range was remarkable as examples under investigation included parts from a diminutive turbine-propeller unit of about 250 equiv. h.p. as well as from engines of considerably higher power output than are already in operation. It is sometimes suggested that research stations are prone to expend so much time investigating a current problem that when the results are forthcoming the matter has ceased to be of more than academic value. This gibe does not apply to the N.G.T.E.

It was refreshing to observe that work was being conducted on equipment to meet requirements that have not yet arisen but may be expected in the not-distant future. An example of this, occurring in the combustion department, is worth quoting. Intensive effort is being made in many quarters, and with a variety of metals and materials, to raise the permissible operating temperature of turbine blades and rotors. As these materials become available new combustion systems will be needed in order to exploit fully the potential advantages. At Whetstone a special "high temperature" combustion chamber with a gas outlet temperature of 1,200 deg C was shown in operation.

The department has a fully developed combustion system with upstream injection which is claimed to have an exceptionally low pressure drop of approximately 3 lb/sq in.

Fuels of all types are investigated, and for marine and industrial applications considerable work has been done on the combustion of the heavier and cheaper grades of fuel oil. Pumps and injection equipment have been developed which permit the successful utilization of bunker oils, such as are burned under boilers to raise steam for marine turbines.

Test Facilities

The full scale test house is powered by a 6,000 h.p. steam turbine. It can be used for running compressors up to a maximum of 18,000 r.p.m., for driving a plant compressor supplying air for turbine tests and for reproducing altitude conditions up to about 35,000ft in the test chamber. In the engine test house was shown after-burning equipment by means of which additional fuel may be burnt in the jet pipe behind the turbine to furnish a temporary increase in thrust at take-off or in emergency.

Conversely, a thrust spoiler was demonstrated. This device, comprising a pair of flaps which may be brought into spaced relation immediately to the rear of the end of the jet pipe, diverts the issuing jet into two streams directed horizontally to right and left. The flaps are actuated by a hydraulic jack and a rapid control from full to idling thrust is obtained. It would appear to be particularly of value for deck-landing aircraft apart from its emergency use in the event of an overshot landing approach. The device has been tested in the air on one of the so-called "flying test beds."

Of outstanding interest was the watercooled turbine, invented by Dr. Ernest Schmidt, of Brunswick, which is now being set up for investigation. Whilst particularly suitable for large stationary units, the additional weight and complication of the watercooling system does not necessarily preclude its application for aircraft power plants. The hollow rotor and blades are machined from a single forging of mild steel; each blade having three radial drillings which are plugged and welded at the tip. In these holes the water film adjacent to the metal is raised to a higher temperature than the water core on the axis. This density differential combined with the centrifugal loading arising from high-speed rotation sets up an outward and inward flow of water in each blade drilling. At the tip the specific water pressure is in the region of the critical state and the rate of heat transfer is exceptionally high. On the return to the rotor axis the pressure decreases and the water vaporizes into steam which is led off to drive a small steam turbine, condensed and returned to the cooling system.

The output of the steam turbine will be from 5 to 10 per cent of that for the gas turbine. Cooling of the stator blades and casing is by a straightforward pump system. In Germany a thermal efficiency of at least 35 per cent was predicted; presumably with a gas entry temperature of 1,200 deg C.

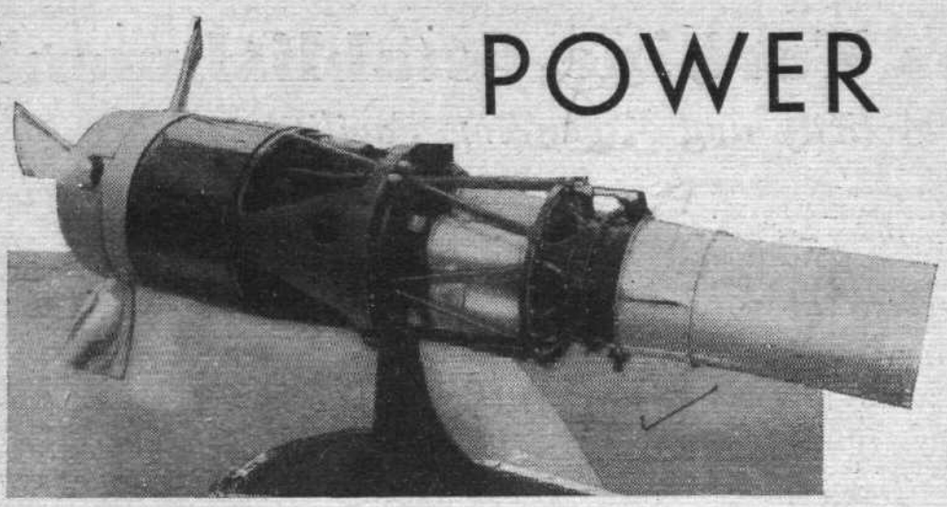
A great deal of attention is devoted to materials for and methods of producing blades. In the workshops special tools have been developed for the accurate machining both of forged and cast blades for the rotors and stators of compressors and turbines. The Establishment produces its own precision castings on the "lost wax" method and an interesting experimental project was a small turbine rotor complete with blades to form and the shaft in a single casting.

Without overstraining the term, the research and experimental teams may be described as "youthful." Their enthusiasm is infectious. One left Whetstone with the impression that the lead established by Britain in the air is not in immediate danger.

POWER PLANTS

Good Progress with Development but Few New Designs

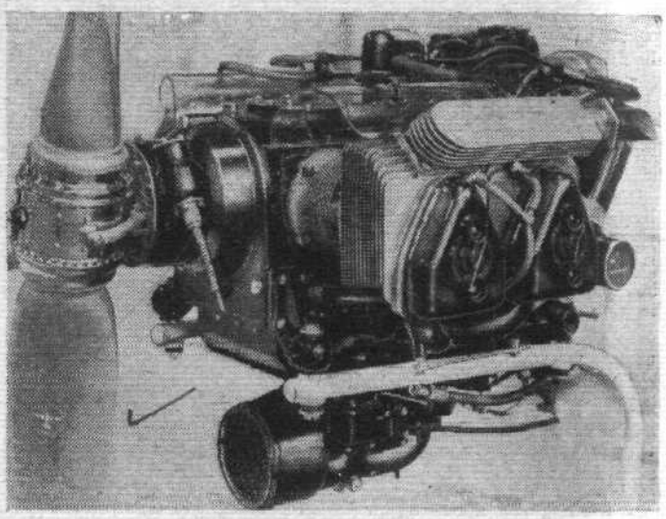
Illustrated by "Flight" Photographs



Napier's new high-revving airscrew turbine, the Naiad, will deliver a maximum of 1,590 equiv. b.h.p. for take-off.

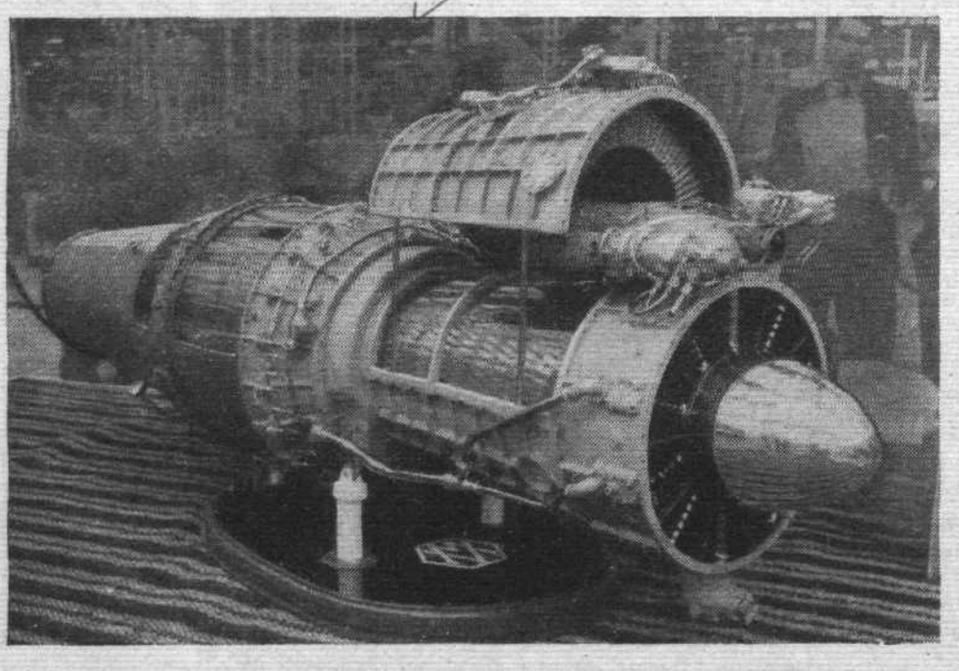
MUCH well-deserved praise of British aircraft engines is still to be heard and the past year has seen no reduction in the country's lead in gas turbine design and development. The present position regarding airframes, large or small, suitable for the latest pure jet units cannot, however, be regarded as being so satisfactory. The recent S.B.A.C. Display provided an opportunity to consider the power plant position to date. Generally speaking the development of all of them had progressed well since the previous year, but there was little that was new among the larger units. This was to be expected of piston engine designs which, if introduced now, would hardly be able to reach a sufficiently advanced stage in time to compete with airscrew-driving turbines of similar power. The highly developed existing piston engines still, of course, have a number of important advantages to offer for all civil or military aircraft types except fighters.

So far as gas turbines—airscrew-driving or pure jet—are concerned, much has still to be learned about reliability, durability and economy to mention only a few major points. Therefore it is again not unexpected that few new designs have appeared during the year. Manufacturers are absorbed in consolidating their position and in developing the quite large number of different units which are already running. Only one new gas turbine was shown at Radlett, namely the airscrew-driving Napier Naiad, and if all continues to go well during its development running an important future is assured for this promising unit.



A sturdy-looking comparative newcomer is the flat-four Monaco light aircraft engine, here fitted with D.H. manually-operated v.p. airscrew.

The only new large piston engine, the Rolls-Royce Eagle, which has 24 cylinders in horizontal H-form and sleeve valves, was present in the static exhibition in model form. An example of this unit was installed in the Westland Wyvern which was demonstrated in flight. The Eagle was built for the Wyvern and is not likely to go into large-scale production. Even if the Wyvern proves to be its only installation it is still important to have this high-power piston engine in reserve until such time as the large airscrew turbines prove themselves.



A most striking show-piece is the sectioned Metrovick Beryl with half its compressor casing lifted. This unit has an annular combustion chamber and was recently re-rated at 3,850 lb thrust.

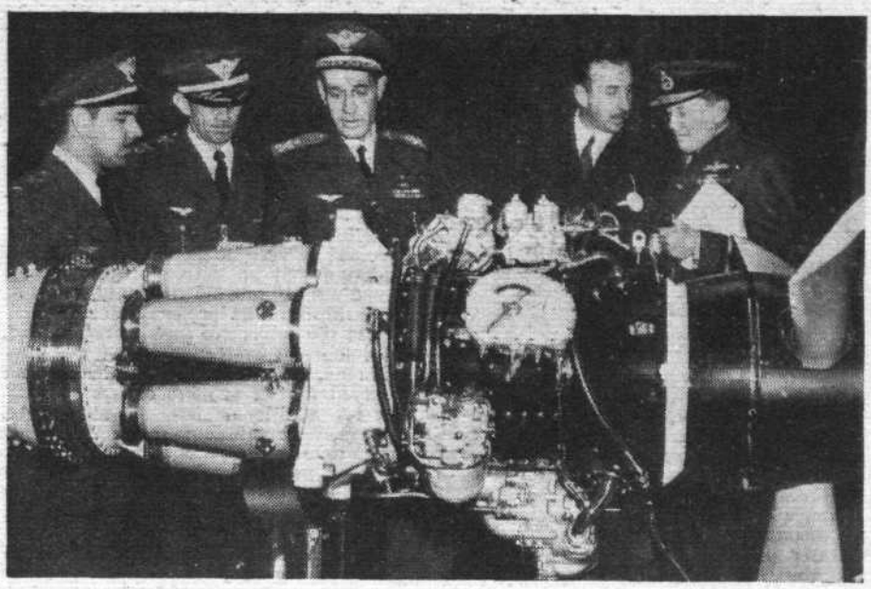
Foreign Interest

Opportunities had previously been offered to British visitors to examine most of the aircraft engines in the static display at Radlett this year, but the excellent manner of their presentation assured keen re-examination, while the great interest of foreign visitors in these outstanding products was obvious.

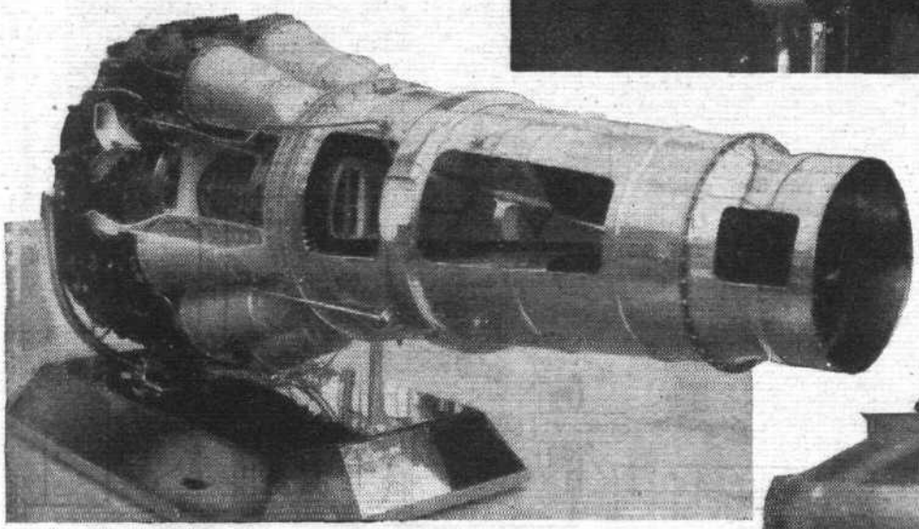
The majority of the more familiar gas turbines—Rolls-Royce Nene and Derwent, D.H. Ghost, Metrovick Beryl, Bristol Theseus—were sectioned and each was magnificently finished in shining enamel and chromium plate.

The large piston engines, similarly prepared—Merlin, Griffon, Centaurus, Hercules with free exit-cowling, and Sabre—were also outstanding in their classes. As usual the Armstrong-Siddeley Mamba and Python were admired, the one being as impressive for its diminutive size as the other is for its massiveness. Both are to begin flight tests in a matter of weeks.

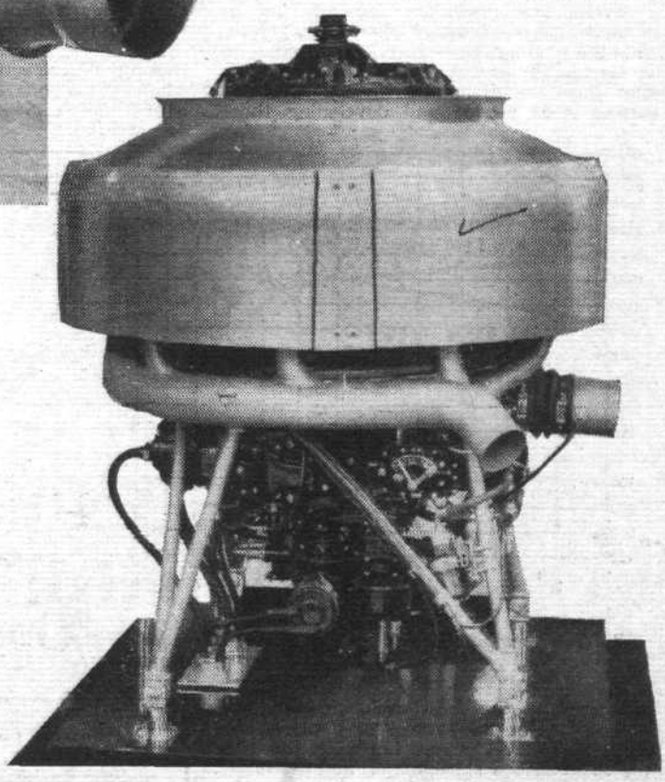
A most interesting novelty was the air-cooled Alvis Leonides helicopter power plant, which is designed for horizontal installation and has down-flow fan-assisted cooling. This type of unit is to be installed in the Westland-built Sikorsky S.51. The Fairey Gyrodyne, which is also powered with a Leonides, has an alternative installation, and the transmission, rotor clutch, and drive to torque-correcting airscrew were shown as a unit on their stand.



BRAZILIAN GROUP: *General Duncan, Colonel de Menetes and Lt. Pelosi of the Brazilian Air Force with Air Commodore J. Constable-Roberts, the British Air Attaché, show interest in the Mamba on the Armstrong-Siddeley stand.*
(Below) The Alvis Leonides helicopter power plant provides for a horizontal engine position and fan-assisted cooling.



Interior details of the D.H. Ghost have only recently been exposed. Our photograph shows the sectioned display engine.



Although the adaptation of the Leonides for use as a helicopter power plant will no doubt provide for our immediate needs, the possibility of a demand for a specialized engine designed from the start for rotating-wing aircraft should not be overlooked. It is a characteristic of petrol engines that very high power can be developed for a few minutes. In the case of the helicopter, hovering and vertical ascent demand every ounce of power.

It was noteworthy that the smaller aircraft engines are now beginning to appear with v.p. airscrews, and that smaller supercharged units have been, or are being, developed. The Gipsy Major 10 was fitted with a manually operated variable-pitch D.H. airscrew, and the 100 h.p. flat-four Monaco had a similar one. The supercharged Queen 70 had a D.H. braking airscrew. The Blackburn Cirrus Majors and Minors shown were familiar, but this company also have a larger series under development which includes a supercharged six, the Grenadier.

General Major Aviateur Decquet, Lt. Col. J. Corlier, Belgian Air Force, and L. J. le Boutte, Chief of Staff, Belgian Air Force, studying the model of the Bristol Theseus at Radlett.

The Anglo-American Conference

Summaries of Further Lectures : Hazen on Development of Piston Engines and Hafner on Helicopters

Factors Affecting Future Development of Reciprocating Engines

By R. M. Hazen

MR. HAZEN, who is Director of Engineering, Allison Division, General Motors Corporation, introduced his Paper with the statement that he proposed to present the viewpoint of the power plant manufacturer on the future of the reciprocating engine by a process of elimination, with more emphasis on practical than on theoretical factors. To start off with the lecturer postulated that the basic premises for this analysis are that every mission, whether military or commercial, which can be accomplished satisfactorily with pure jet units will be powered with this type, every possible mission on which the jet engine cannot meet requirements will use airscrew-turbine engines, and that only on sucn missions as cannot be accomplished with either of these units will the reciprocating engine be used. Accomplishment of mission embraces such factors as speed, range, cost of initial equipment, cost of operation and general performance of the aircraft.

Development funds are definitely low in a peace-time economy, continued Mr. Hazen, and their allocation must be devoted to developing the simplest type of power which may meet requirements, in exploring the various sizes needed and developing those lines whereby the most rapid progress can be made. The advantages of applying research and development funds to the turbine are obvious since major improvements in efficiency, in output for a given size, in economical fabrication and use of materials are possible, due to the newness of the product. In addition, application of such improvements applies to the power sections both of pure jet engines and airscrew-turbines, and, furthermore, provides basic information suitable for the exhaust-turbine necessary in compounding the reciprocating engine, should this be desired.

Production considerations favour the future of the airscrew-turbine as compared to the piston-engine. The only important variable is the time of prior development and this is, of course, important. The centrifugal gas-turbine and the piston-engine are both at the stage where only careful production engineering can result in further cost reduction and, in fact, costs may increase due to the greater complication of the production. The axial-flow unit has been subjected to very little emphasis on cost reduction and an active programme on this type would probably reduce its cost to about two-thirds of its present value.

On the subject of fuels in regard to future development and supply and the effect on power plant development, the lecturer observed that it is more or less obvious that every additional jet- or airscrew-turbine powered aircraft not requiring high-octane fuel reduces the probability of the fuel companies providing development of facilities for higher octane fuel because of the greater uncertainty of its use. Under the heading of "one-way aircraft," Mr. Hazen suggested that the pilotless aircraft is an important factor in favour of emphasis on turbine-engine development since it reduces emphasis on the greatest weakness of the turbine, i.e., high fuel consumption, and underlines the major advantage of low unstalled weight.

Perhaps the most glaring weakness of the simple jet is its poor take-off and early climb characteristics. There is, however, some evidence that water/alcohol injection and after-burning may give additional thrust increments whereby take-offs in line with those given by piston engines can be expected in the future.

The variable range with altitude characteristics of the pure jet unit is, perhaps, the least discussed disadvantage of aircraft powered by such engines. We are prone to look at the high-speed sea-level performance and the range at the tropopause and feel rather pleased. The better specific fuel consumptions at sea-level static than at high speed and altitude are sufficiently soothing that one is apt to get a jolt when it is stated that the range of a jet-propelled aircraft at sea-level is of the order of one-fifth or one-sixth of the usually quoted 35,000 feet range. After-burning for high speed, permitting a smaller basic power plant, helps this problem appreciably, as would a variable nozzle. Multiple low-drag units, some of which may be switched off at altitude, may be another approach.

The airscrew turbine, continued Mr. Hazen, has to meet the tough competition of piston engines, with all their past history of development, and to succeed, it has to better in certain respects, and equal in all others, the qualities to be expected from the piston engine of two or three years from now. The airscrew-turbine has the basic advantages of high output per pound of weight, smoothness, low fuel cost, small size, and the important advantage of readily being scaled up or down, once a good fundamental design is developed. In the light of these circumstances, Mr. Hazen observed that expenditure of engineering time and development funds cannot be undertaken on an airscrew-turbine without carefully designing such a unit and comparing it with what could be expected from a reciprocating engine of the same development time. His company's developments indicated that this should be compared to a compounded reciprocating engine.

The Allison V-1710 is selected as the example of a reciprocating engine only because there is very complete information on not only the basic design but on various systems of supercharging, and on the unusual variable-speed hydraulic drive of the auxiliary or first-stage of compression, which made the application of a geared turbine for compounding relatively simple. The necessity for concurrent production of a single-stage, single-speed version with turbo-supercharging, single-stage medium-altitude and two-stage high-altitude versions, led to the development of a separate initial or so-called auxiliary-stage super-

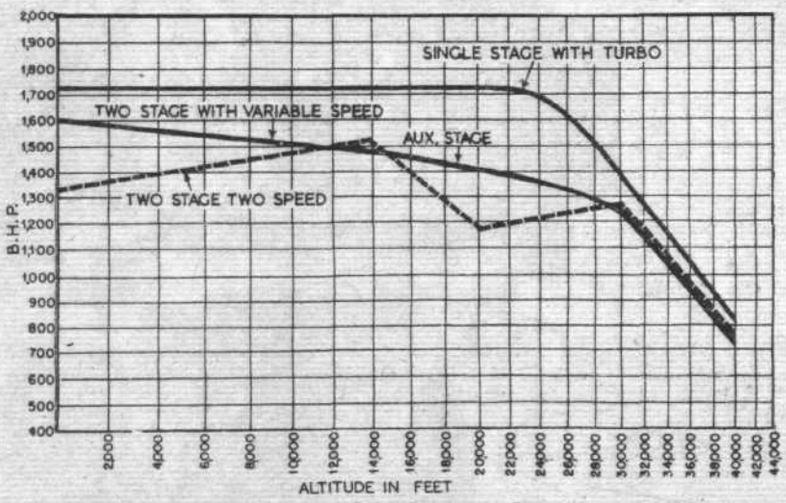


Fig. 1. Comparative curves of performance for Allison V-1710 engine employing diverse types of supercharger.

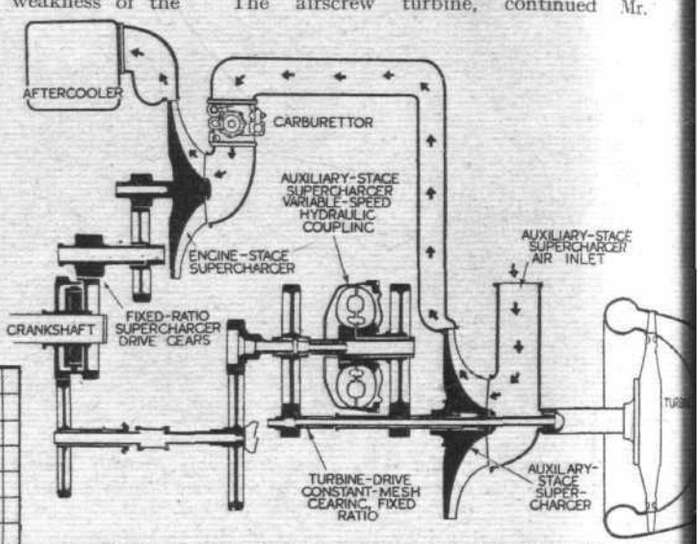


Fig. 2. Schematic diagram of coupling between turbine, auxiliary-stage supercharger and engine-stage supercharger showing, in addition, the induction flow.

WITH these précis of two particularly interesting papers—one American and one British—we conclude the series of summaries we have given in recent issues of the lectures delivered before the joint convention of the Royal Aeronautical Society and the American Institute of the Aeronautical Sciences held in London from September 3rd to September 9th.

The Conference has provided a most welcome and extremely valuable meeting ground, not the least important aspect of which has been in the provision of opportunity for informal unfettered conversation and interchange of ideas to supplement the "official" views given in the lectures.

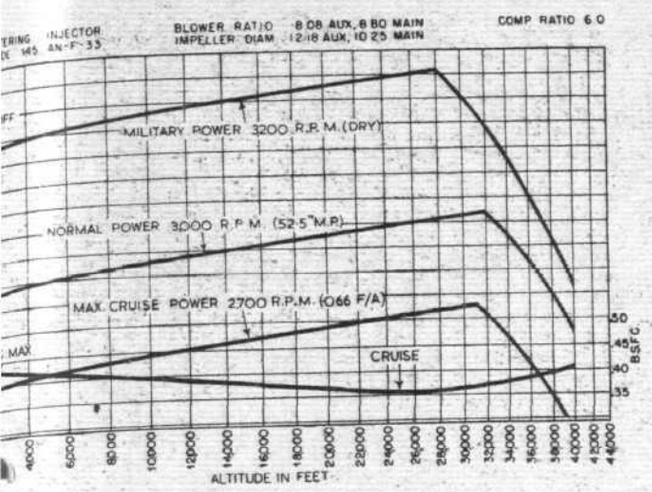


Fig. 3. Comparative curves of performance for the compound V-1710 engine with geared turbine.

charger for variable-speed hydraulic drive, the latter having the following advantages: (a) wide altitude- and power-operating range without surging; (b) smooth altitude/power curve without "weak" areas as can be seen in Fig. 1, and (c) high performance available without aftercooling, due to lowest total compression temperature rise at all altitudes. This combination provided a quick and very simple means of compounding a geared turbine with a supercharger and providing complete engine control of known characteristics. It was possible to gear the turbine to the engine directly with *all* exhaust gases passing through the turbine at all times on our particular auxiliary-stage combination without reference to the compressor, simply by adding a pair of gears on the engine side of the hydraulic coupling and driving through a hollow compressor shaft to the turbine as shown in Fig. 2.

A low-cost, short-time development application was therefore possible, and tests on the compounded engine with the turbine power absorbed by external means confirmed our preliminary studies that the maximum advantage of compounding occurred at high airflows, and that the limiting factor on either lean-mixture high b.m.e.p. cruise, or rich-mixture high-power operation was the temperature of the buckets on the turbine and not the basic engine or its supercharger.

Exploratory data were taken at temperatures of the turbine well over those available for anything except extremely short periods of time, failures were encountered and modifications made and retested. The results obtained were not as complete as desired, but the general conclusions were that exhaust gas temperatures in the area 1,800 to 1,850 deg F are required for lean-mixture high-cruise conditions, and 1,850 to 1,950 deg F for military-power rich-mixture conditions on an engine with 6:1 compression ratio. The following important conclusions were reached: (1) that for optimum compounding on the V-1710 no available turbine would be adequate; (ii) that a new design turbine, preferably two-stage with either air or other cooling of the first stage was necessary with present known materials; (iii) that fuel injection was essential at the high manifold temperatures and pressures required for advantageous compounding; (iv) that the basic engine would not require important changes, but that for higher compression ratios considerable development would have to be done; and, (v), that considerable redesign and additional development was desirable on the basic power plant to utilize improved high-octane fuels, high compression (and expansion) ratios for better specific fuel consumption, and easier turbine conditions as part of any future compounding programme for continuous improvement.

Revolutionary Results

The power and fuel-consumption curves which we were willing to guarantee, based on the factual data available on other components and operating combinations, are shown in Fig. 3, and, had there been no revolution in *types* of power plants, this unit would have been revolutionary from the standpoint of specific weight, specific fuel consumption, cost per take-off h.p., or accepted criteria of aircraft engine evaluation. It could have been available for production in about 2½ years. We decided, said Mr. Hazen, not to build this engine because concurrent studies of airscrew-turbine engines and experience with pure-jet units showed that going ahead with a two- or three-year development on such a compounded engine was a highly dubious venture. Basically, the weakness of such a development was that it was based on a turbine development in which the gas temperature entering the first-stage nozzle must of necessity be 1,800 to 1,950 deg F with lengthy cruise operation in this temperature range.

The engine was then compared with an airscrew-turbine unit on the basis of a reasonable exhaust temperature and also assuming the same maximum temperature as the compounded engine required. It was our conclusion that there was a great deal more certainty in developing a 1,600 deg F airscrew-turbine engine in a given time than in compounding a piston engine with a turbine requiring 1,800 to 1,950 deg F temperature operation. On the basis of this comparison we recommended, and obtained, determination of our compounding development in order to devote our full engineering time to turbines of various types and, concluded Mr. Hazen, as time has gone on we feel this decision was more and more sound and that the estimates made for airscrew-turbine performance were, if anything, conservative.

Rotor Systems and Control Problems for the Helicopter

By Raoul Hafner

MR. HAFNER, Chief Designer (Helicopters) of the Bristol Aeroplane Company, Limited, opened his lecture with a reference back to the time ten years ago when he built the Hafner Gyroplane and demonstrated it at the Society's garden party, saying that the helicopter for which the old Gyroplane had paved the way has, in the form of the Bristol type 171, arrived at last.

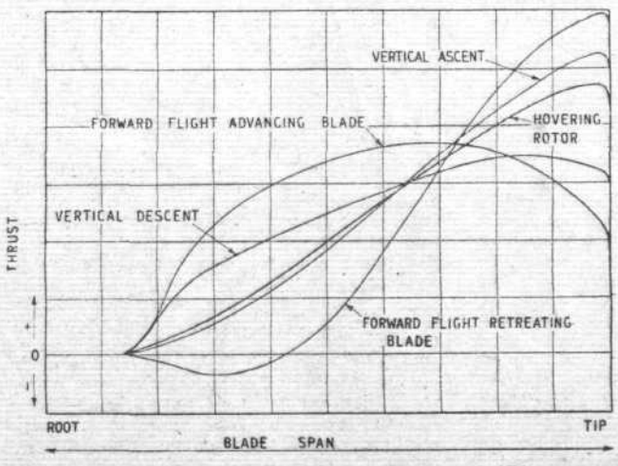
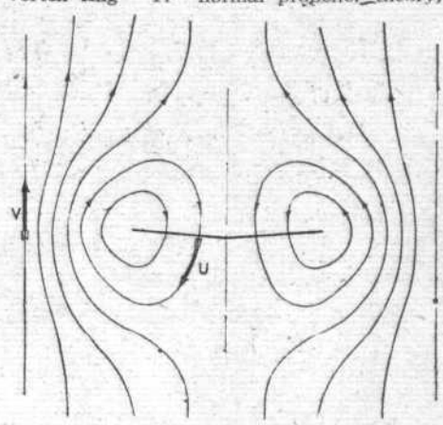


Fig. 1. Radial thrust grading for the Bristol 171 rotor. Hovering outside ground cushion at maximum r.p.m. and full load.

In making general considerations of rotor state, Mr. Hafner started by defining that a rotor moving in the direction of its thrust vector is in what is known as the "propeller working state," and the boundary condition for this is hovering. When the rotor begins to descend, i.e., moves against the direction of the thrust vector, it enters into the vortex ring state, a diagrammatic view of which is shown in Fig. 2. The rotor is then surrounded in a vortex of turbulent air. Whilst the rotor is descending power is still needed to maintain it in rotation and air is blown through the disc in a downward direction, whereas in the outer laminar region air is moving in an upward direction relative to the rotor disc. There is little knowledge yet on the aerodynamics of the vortex ring The normal propeller theory,



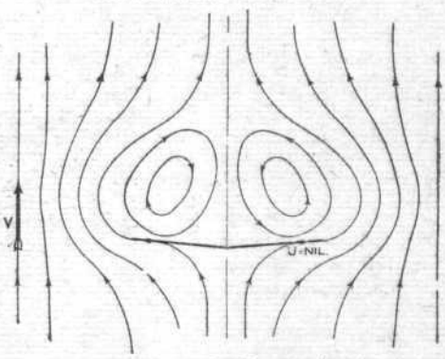


Fig. 2. Above is shown air-flow pattern when rotor starts to descend. Below is shown windmill break state.

in particular the strip theory, breaks down in this working stage. There is evidence of instability of this vortex and of continuous movement of air into and out of this area.

Beyond the vortex ring state extends the windmill break state where work is done by the air on the rotor. In this condition air flows through the rotor disc in the direction of the thrust vector (upwards). A point of special interest in this working state is the auto-rotating condition where the work done by the air is exactly equal to the work needed to overcome the profile drag of the blade (see Fig. 2). The flow through the rotor is therefore relatively small and a small vortex ring will be found above the rotor.

Going on to consider blade flutter, Mr. Hafner observed that in a rotor blade which is articulated at the root, there is as the only restraint in the vertical plane the centrifugal force which corresponds to the flexural stiffness of the wing in a conventional aircraft. As this force is acting at the inertia axis, the flexural axis in an articulated rotor blade becomes irrelevant. It is therefore important only that the

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aerodynamic axis of a rotor blade, which should be a straight radial line, should contain the inertia axle. If the latter axis lies aft of the former, i.e., if the blade is tail heavy, flutter will occur at a given critical flutter speed, which will depend on the degree of tail heaviness, the aerodynamic damping, and the torsional frequency of the blade. Of these parameters, tail heaviness and torsional frequency can be varied by the designer to control flutter speed, the latter increasing and the former decreasing critical flutter speed. It can be shown that the flexural (or flapping) frequency of an articulated blade in flight is approximately equal to its rotational frequency, so that in order to avoid a resonant condition the torsional frequency of the blade must be kept well above any probable rotor frequency.

Turning to general considerations on control, the lecturer gave a brief résumé of collective and cyclic pitch controls and then passed on to deal with rotor combinations. There exists a list of forceful arguments in favour of the freely flapping rotor blade and, notwithstanding the certain technical complications, Mr. Hafner was of the opinion that the flapping blade has become a permanent feature in rotating wing aircraft.

A very important section in any discussion on control is the effect of specific breakdown in the mechanism of control, in particular of power failure. The lecturer suggested that it is possible, however, to regain full control after power failure—at least, for brief periods—if the kinetic energy stored in the moving vehicle can be utilized in a controllable form. In the helicopter there is kinetic energy due to the movement of the aircraft which may fall from a given maximum to, sometimes, nought, and, in addition, the considerable kinetic energy in the fast-rotating rotor mass which, at all times, is stored in flight. The latter, particularly, is always virtually "on tap" because it is directly convertible into lift by means of the lift lever. This suggests that putting mass into the rotor is a profitable undertaking as it offers an additional, if only temporary, form of control. The Bristol helicopter is equipped in this manner, having a rotor with an unusually large moment of inertia and which is capable of rotating within a wide speed range so that the kinetic energy thus available permits the aircraft to hover for periods up to three seconds: a very valuable feature in the case of forced landings.

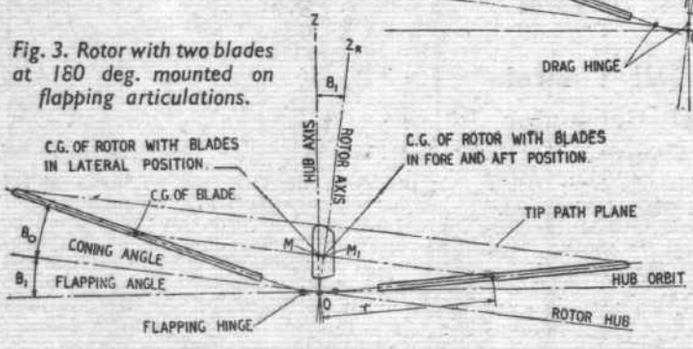


Fig. 3. Rotor with two blades at 180 deg. mounted on flapping articulations.

Longitudinal mass balance of a freely flapping blade is obtained if a radial mass distribution is achieved whereby at every radial blade element the inertia force due to the local mass is in balance with the local aerodynamic thrust derived from the radial thrust grading (see Fig. 1). Such a distribution of mass will result in a straight blade axis in flight and, consequently, a constant (and minimum) moment of inertia of the blade in pitching which offers not only advantages for cyclic pitch control but, in addition, the absence of blade bending in flight. Owing to the variable nature of the radial thrust grading, however, perfect balance at any point of the blade and for all conditions of flight is not possible, but a tolerable balance can be achieved for average flight conditions if the root portion of the blade is made as light as is practicable and (usually) the tip portion is artificially weighted.

Mr. Hafner suggested that the most likely form of blade construction in the future which, although very expensive for small numbers, lends itself to mass-production methods will be the metal monocoque. He then went on to give details of the rotor hub and blade articulation in the Bristol helicopter. Apart from the tie-rod articulation the rotor hub of the Bristol 171 features a flapping and drag hinge for each blade. The flapping bearing consists of a flapping pin made of case-hardened steel which is grooved to take five sets of needles in line, care being taken that all needles share equally when the pin is deformed under load. The outer race of the flapping bearing forms part of the blade link which houses the drag hinge consisting of two needle-bearings. These latter locate the flapping pin which carries the blade inner sleeve on which the root portion of the blade is mounted by means of the tie rod and two light journal bearings. Stops limiting the drag movement are provided allowing each blade on the one hand to move slightly ahead of the auto-rotating position, and on the other hand remain slightly aft of the position determined by high torque at low speed. This freedom is only provided for simultaneous movement of all blades in the same sense. The freedom for differential movement is restricted by means of short rods and rubber pads connecting the three rotor blades.

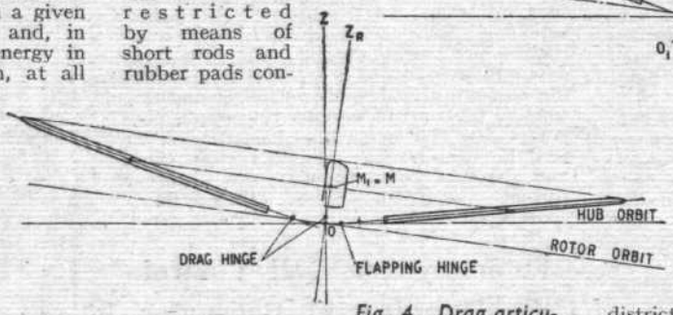


Fig. 4. Drag articulation permitting movement of blade in plane of hub orbit.

There are, of course, stops limiting flapping movement, the upper stop being rigid but the lower consisting of an elastically mounted ring concentric with the rotor axis, which provides a rigid limit to the downward coning angle of the rotor, but permits a limited variation of rotor tilt at this coning angle. This form of elastic flapping stops allows a low rotor pylon and, therefore, a generally more compact geometry of the helicopter without the danger of blade fouling either as a result of extreme control displacement during flight or when at rest.

In concluding his lecture, Mr. Hafner commented that the view is generally held that the domain of the helicopter is crammed with complex problems of all kinds ranging from shock stall and aero-elasticity to fatigue and deformation in highly loaded needle-bearings. This view has emerged especially since we have moved from the elementary investigations and efforts of the early pioneers to a less romantic and more tedious development phase, which is showing up continuously that everything is really much more complicated than we thought when we started with this enterprise—an experience which, of course, has many parallels in history. The design and construction of the helicopter to-day is very comparable with the development of a modern aero-engine or turbine. It cannot be done by the enthusiasm and the backyard efforts of a few, but requires organization and a strong, well-equipped and expert team. Helicopter development will automatically move into the offices of large establishments with the capacity and the extensive research equipment needed for the rational approach to the problems which is the only sure basis for steady progress.

There prevails another belief—borne perhaps from an association of ideas—that the helicopter and its operation is necessarily very expensive. Whilst this holds true in the present phase of helicopter development, where development expenses are quite out of proportion to production output, as a generalization this concept is quite wrong.

The design and development costs for a modern helicopter, like those of a fixed-wing aircraft or modern motor car, are very high and can only be borne economically if large numbers are manufactured. Fortunately, the helicopter has, in common with the motor car, another important feature—a large potential market—which is based on the following premises:—

(a) Although speed is a "luxury" commodity which only a community enjoying a high standard of living can afford, the demand for it is quite universal. The helicopter, if properly developed and used, can offer the fastest transportation for distances between 30 and 300 miles.

(b) Whilst the helicopter does not possess the ubiquity of the motor car, it offers an enormous advance on the orthodox aircraft. Helicopter landing places can be established, not only in country districts but in built-up areas, in the form of landing towers. It is estimated that approximately 4,000 landing platforms would provide an appropriate base for the operation in this country of a fleet of some 40,000 helicopters of all descriptions (coaches, taxis and privately operated helicopters) with an annual aggregate of well over 1,000,000,000 miles. It can be based on an area which is not much larger than twice that of the London Airport.

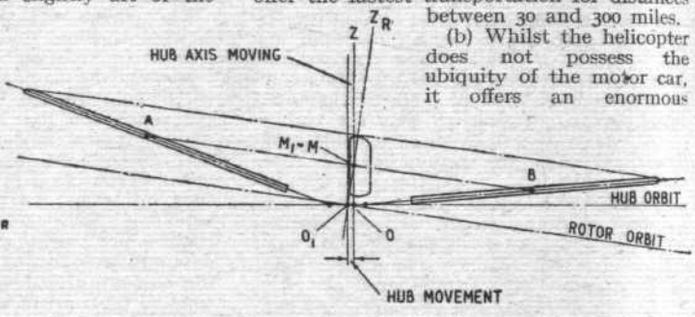
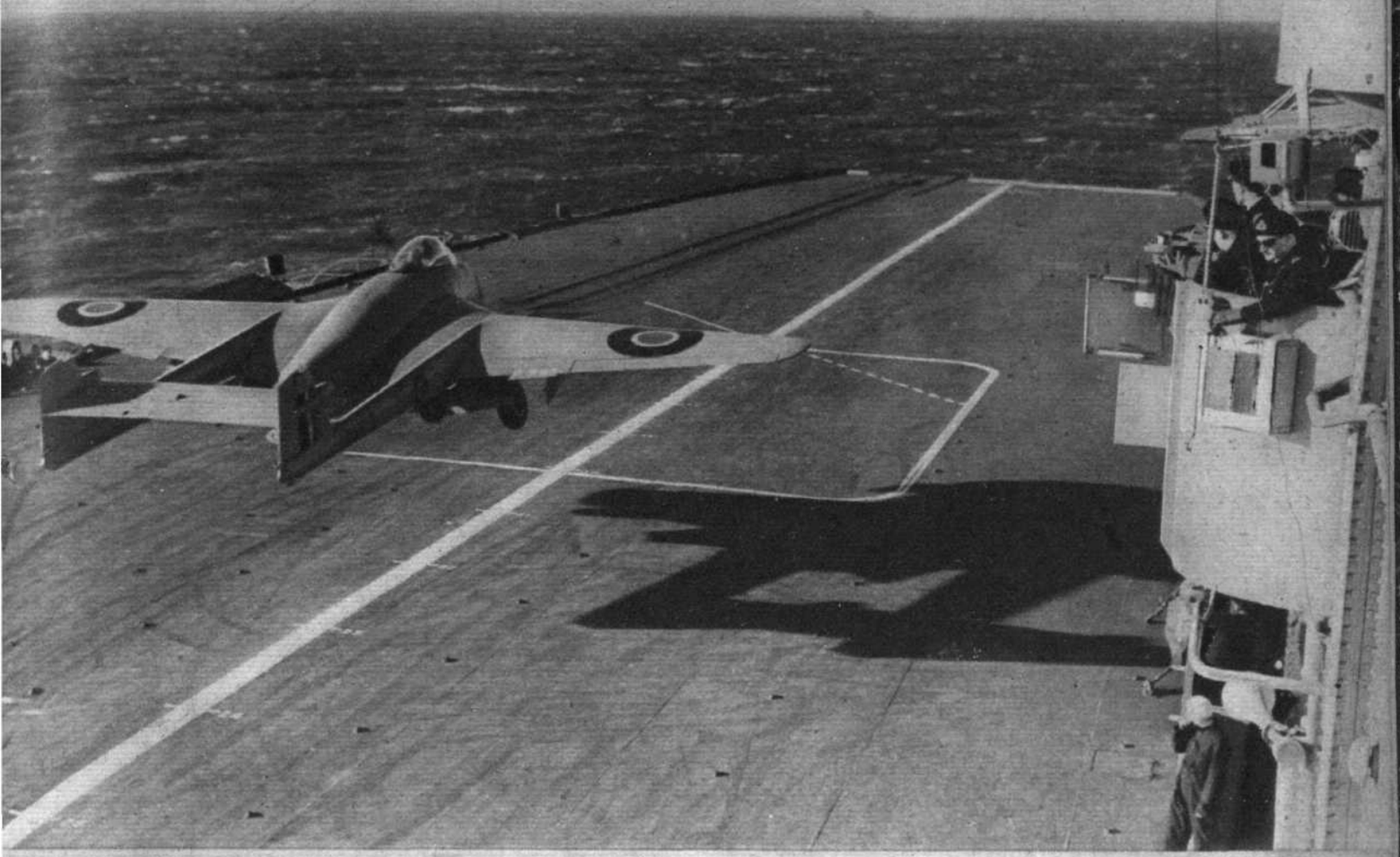


Fig. 5. Floating hub which may move within limits in plane of hub orbit.

(c) The helicopter has, further, in common with the motor car, the ability to move slowly or to stop in any uncertainty or danger. This fact reflects not only on safety—which is obvious—but on regularity of service. Many air journeys which are discontinued or, indeed, never started could be completed if only in critical parts of the journey it was possible to reduce speed.

(d) Whilst there will be a need for helicopters which are specially equipped in order to carry out specialized duties such as ambulance, mail carrying, harbour work, etc. (such helicopters will carry full blind-flying, de-icing and radio communication equipment so that they may be entirely independent of weather), the normal run-about of the air will be comparatively simply equipped and simple to fly. Such helicopters need only carry blind-flying and homing gear of a most crude form as an aid for brief blind periods only. They will be operated essentially like motor cars, i.e., flown under contact conditions, generally below 500ft, and should visibility deteriorate, resort will be taken to reducing speed rather than forcing the pace with the aid of gadgets, the cost of which in this case is out of proportion to their value.

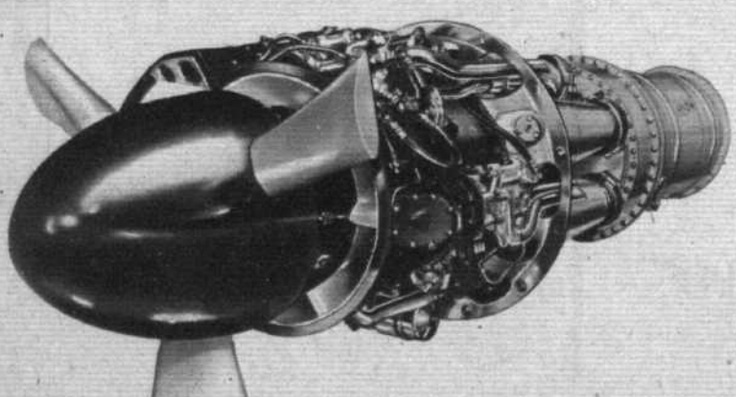


The Sea Vampire, first jet aircraft to operate from a ship at sea, follows into service the Sea Mosquito, first twin-engined aircraft to land on a carrier, and the Sea Hornet, the Royal Navy's new high-speed long-range fighter and strike-navigator.

DE HAVILLAND NAVAL AIRCRAFT

D'H AIRCRAFT D'H ENGINES D'H PROPELLERS

POWER FOR THE PLANES OF TO-MORROW



MAMBA

Gas Turbine Propeller Engines

ARMSTRONG SIDDELEY MOTORS LT

Parkside, Coventry

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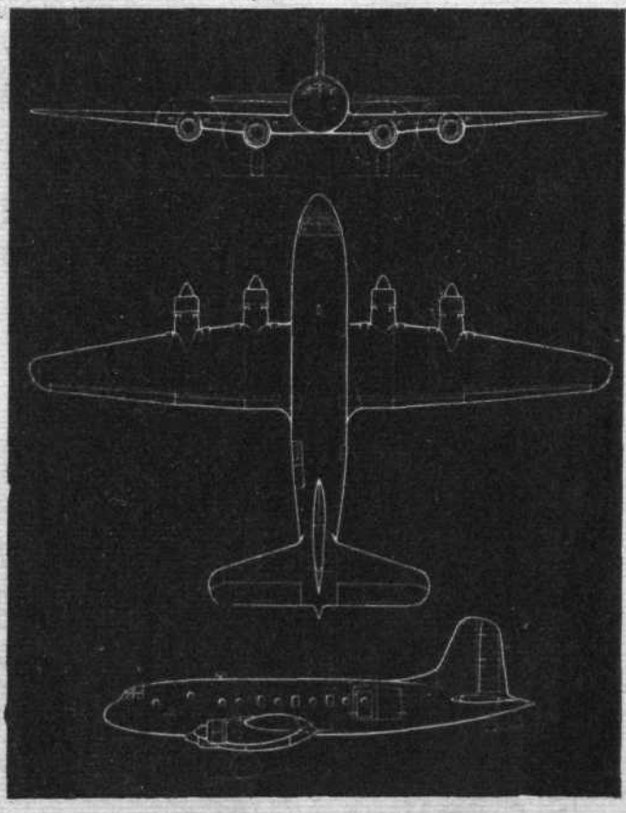
Handley Page HASTINGS

Britain's Largest and Fastest Military Transport : New Standards of Comfort and Safety

FOR some years past, the transport aircraft employed on air support duties in the Royal Air Force have been largely of American manufacture, though certain adaptations of British four-engined bombers, like the Halifax C.VIII and A.IX, have done excellent work within their capacity. Now, at last, British machines designed specifically for use as transports are becoming available. As a replacement for the Dakota, the Valetta C.I (two Bristol Hercules 230) is being produced by Vickers-Armstrongs, and to meet a requirement for a type of greater capacity and higher performance the Hastings C.I, with four Hercules 101, has been ordered in quantity from Handley Page, Ltd. This impressive machine is the subject of our description and of the special *Flight* drawing overleaf.



In all essential features the Hastings is identical with the Hermes I, a civil project which did not materialize, having given place to later marks with a lengthened fuselage and nose-wheel undercarriage, in keeping with the current requirements of commercial aviation. Structurally, the Hastings follows orthodox Handley Page practice and is characterized by extremely clean design. The fuselage is of circular cross section, and the low cantilever wing is very carefully faired into it. The wing is a two-spar structure, and the centre-section main spar comprises single-length, deep channel-section extruded booms with plate-web Warren-girder bracing. The rear spar is of I-section with extruded T booms and a plate web. Inter-spar ribs are of diaphragm type with angle extrusions on each side. The centre-section leading edge is skinned on open-diaphragm nose ribs and is removable for access to the "plumbing," electrics and engine controls. Likewise of open-diaphragm type, the trailing-edge ribs extend to the curved shrouding of the Handley Page slotted flaps.

In the intermediate wing section, the front spar is of T-section extruded booms, with a web plate, and the rear spar is of angle section. Both spars of the outer wing panels have extruded angle booms and plate webs.

The fuel tanks are located inboard of the inner nacelles, between the pairs of nacelles, and in the inboard sections of the outer wing panels. The tanks are installed from above, the hatch covers being attached along the spars and ribs. For jettisoning the fuel, which totals 1,400 gallons, flush-fitting ejector pipes within the wings are lowered pneumatically. Jettisoning can be accomplished at the rate of 466 gallons per minute and may

Handley Page HASTINGS

HANDLEY PAGE HASTINGS C. Mk. 1

Four Bristol Hercules 101 engines driving 13ft de Havilland four-blade airscrews.

Dimensions

Span	113 ft
Length	81ft 8in
Height	22ft 6in
Wing area	1,408 sq ft

Weights

Max take-off weight	75,000 lb
Max landing weight	70,000 lb
Basic equipped weight (freighter)	50,315 lb

Level Speeds (at 71,250 lb)

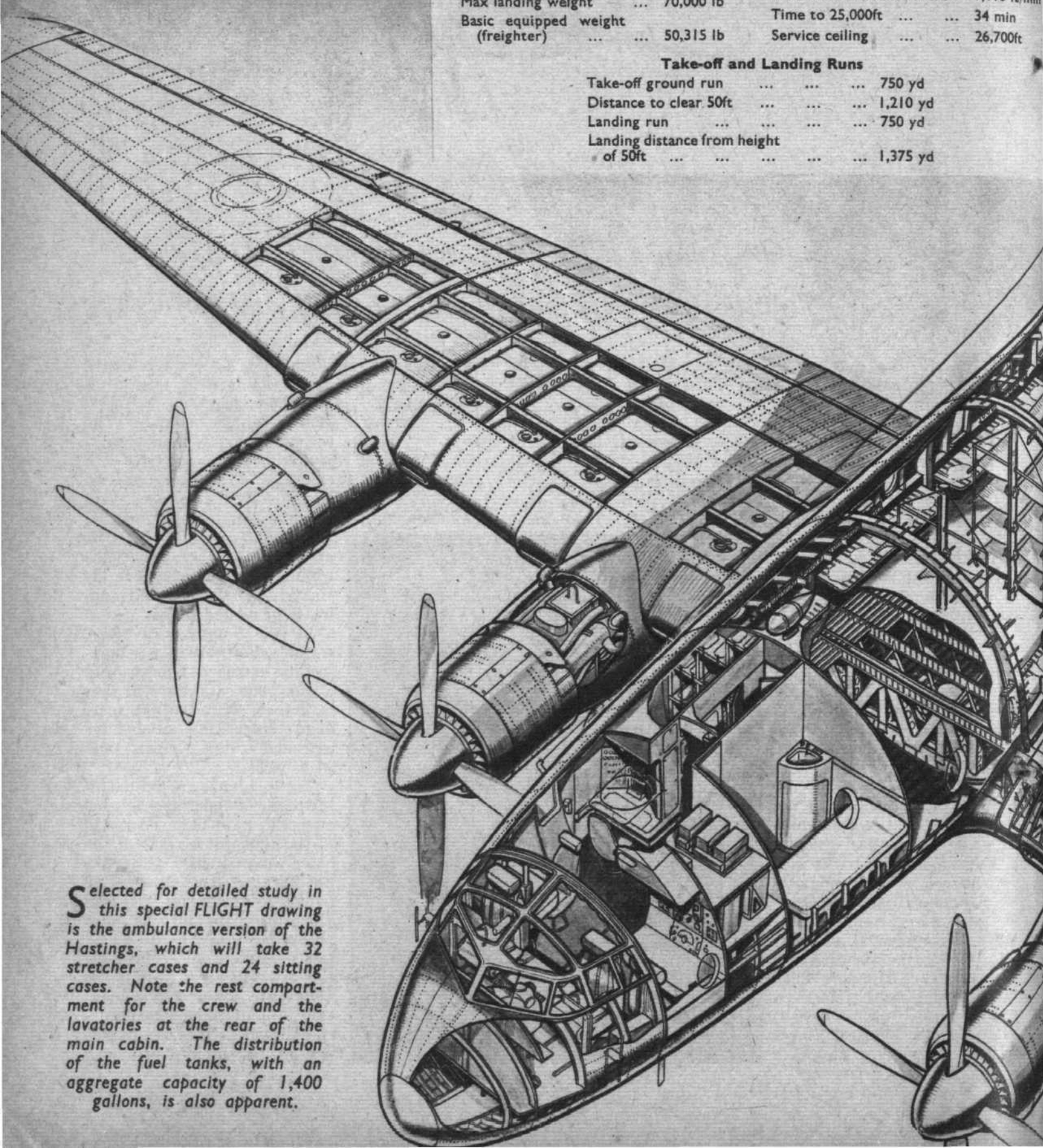
Max speed	354 m.p.h. at 23,700ft
Max W.M. speed at 10,000ft	276 m.p.h.
Max W.M. speed at 25,000ft	293 m.p.h.

Climb (at 75,000 lb)

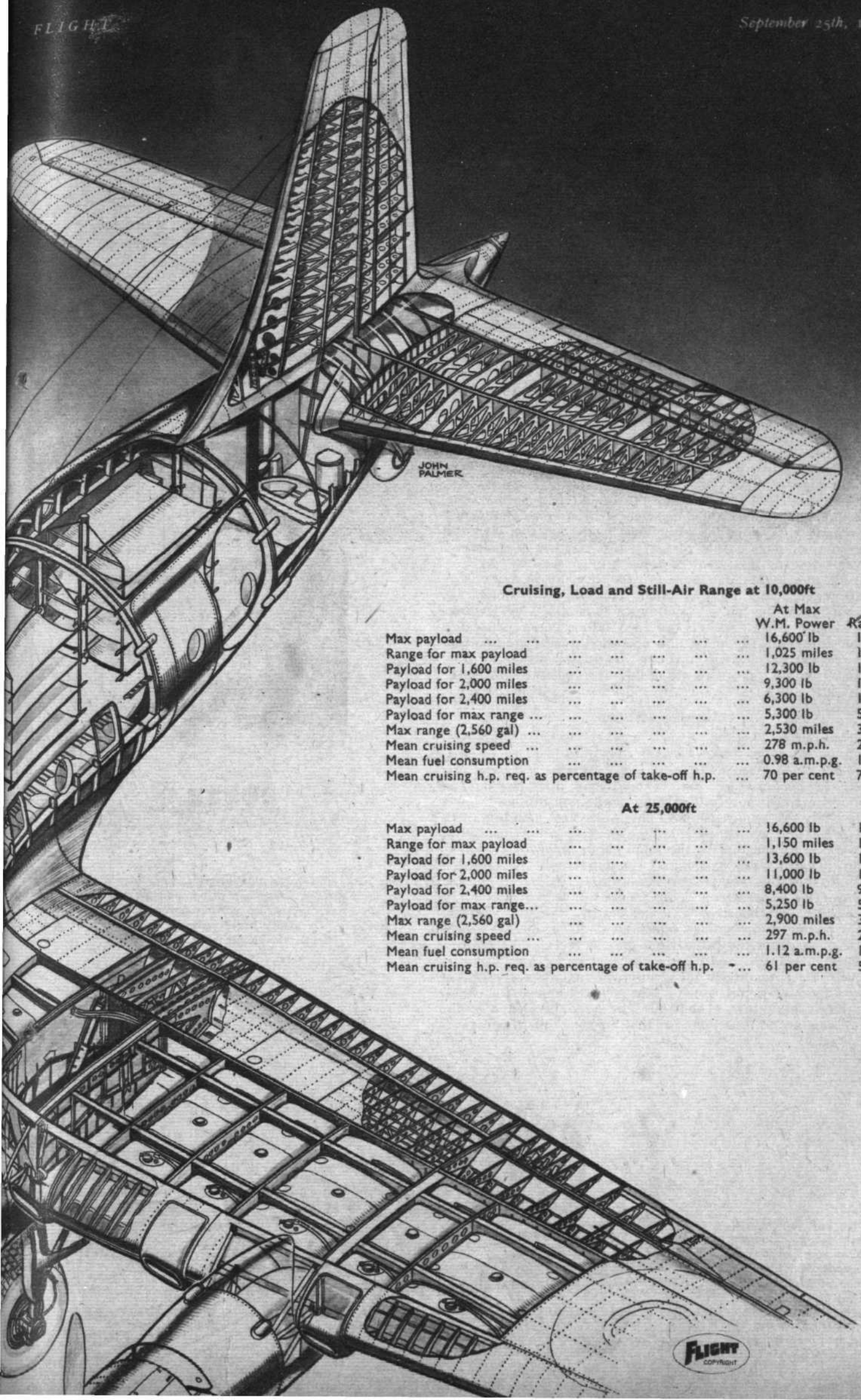
Rate of climb at sea level	1,110 ft/min
Time to 25,000ft	34 min
Service ceiling	26,700ft

Take-off and Landing Runs

Take-off ground run	750 yd
Distance to clear 50ft	1,210 yd
Landing run	750 yd
Landing distance from height of 50ft	1,375 yd



Selected for detailed study in this special FLIGHT drawing is the ambulance version of the Hastings, which will take 32 stretcher cases and 24 sitting cases. Note the rest compartment for the crew and the lavatories at the rear of the main cabin. The distribution of the fuel tanks, with an aggregate capacity of 1,400 gallons, is also apparent.



Cruising, Load and Still-Air Range at 10,000ft

	At Max W.M. Power	At Max Range Speed
Max payload	16,600 lb	16,600 lb
Range for max payload	1,025 miles	1,265 miles
Payload for 1,600 miles	12,300 lb	14,600 lb
Payload for 2,000 miles	9,300 lb	12,300 lb
Payload for 2,400 miles	6,300 lb	10,000 lb
Payload for max range	5,300 lb	5,300 lb
Max range (2,560 gal)	2,530 miles	3,260 miles
Mean cruising speed	278 m.p.h.	212 m.p.h.
Mean fuel consumption	0.98 a.m.p.g.	1.23 a.m.p.g.
Mean cruising h.p. req. as percentage of take-off h.p.	70 per cent	70 per cent

At 25,000ft

Max payload	16,600 lb	16,600 lb
Range for max payload	1,150 miles	1,190 miles
Payload for 1,600 miles	13,600 lb	14,100 lb
Payload for 2,000 miles	11,000 lb	11,700 lb
Payload for 2,400 miles	8,400 lb	9,300 lb
Payload for max range	5,250 lb	5,250 lb
Max range (2,560 gal)	2,900 miles	3,140 miles
Mean cruising speed	297 m.p.h.	262 m.p.h.
Mean fuel consumption	1.12 a.m.p.g.	1.17 a.m.p.g.
Mean cruising h.p. req. as percentage of take-off h.p.	61 per cent	51 per cent

Handley Page Hastings . . . . .

be stopped at will. The fuselage of the Hastings is built in three main sections, and features frames of rolled alloy Z-section with intercostal plate members. The stringers are of top-hat section, and the sheet covering is riveted to the stringer flanges. At the wing-spar stations the frames are massive I-section structures, made up of extruded T-section booms and plate webs, the spar attachment being by means of forged brackets. The maximum external diameter of the fuselage at this point is 11ft, and this diameter is maintained for some distance fore and aft of the wing.

A fully retractable Messier undercarriage, with conventional tailwheel, is used. Each of the main wheels is carried on a unit composed of an arch casting with two oleo-pneumatic shock-absorber struts to which are attached radius rods and jacks. These units retract rearwards into the inner nacelles and are enclosed by twin doors. Hydraulic operation is employed. The tailwheel which, like the main wheels, is a Dunlop, is carried in a fork on a rearward retracting shock-absorber leg.

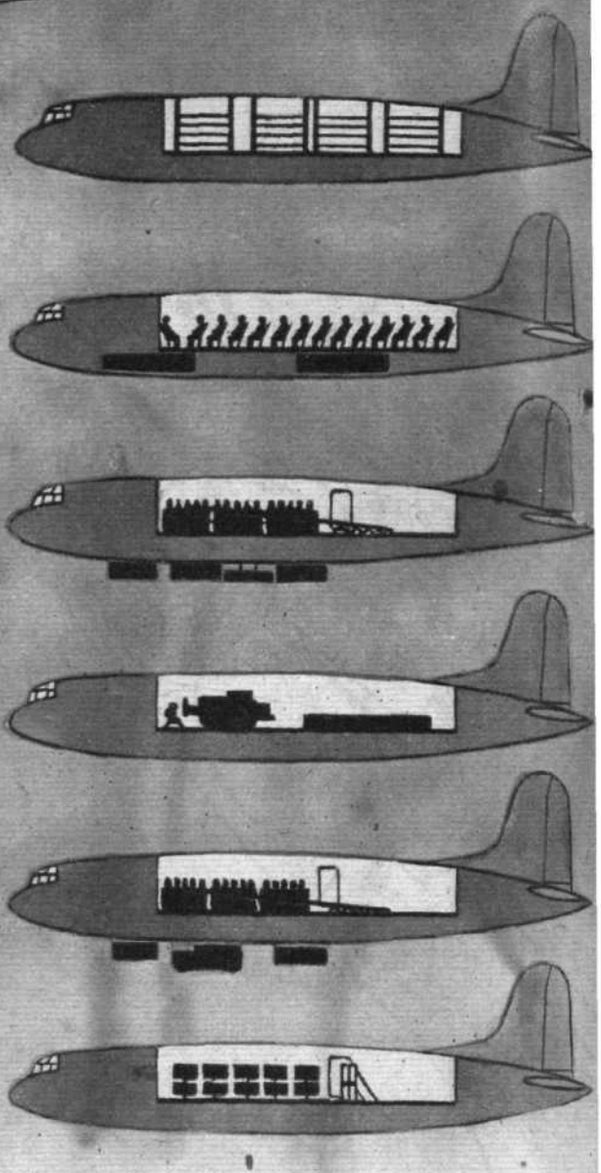
The four Bristol Hercules 101 14-cylinder sleeve-valve, fan-cooled engines are mounted on steel-tube bearers in completely interchangeable power eggs. This model of the Hercules delivers a take-off output of 1,675 h.p. and has a maximum power rating in M.S. gear of 1,800 h.p. at 9,000ft. In F.S. gear the corresponding figure is 1,625 h.p. at 19,500ft.

Air intakes and thermostatically controlled oil coolers are located inside the wing. Cooling air is supplied by leading-edge ducts. Each engine is provided with a Vokes air cleaner which automatically comes into operation during landing and take-off, but which may, of course, be used at any other time when required. Airscrews are of the de Havilland hydromatic four-blade, fully feathering type and measure 13ft in diameter.

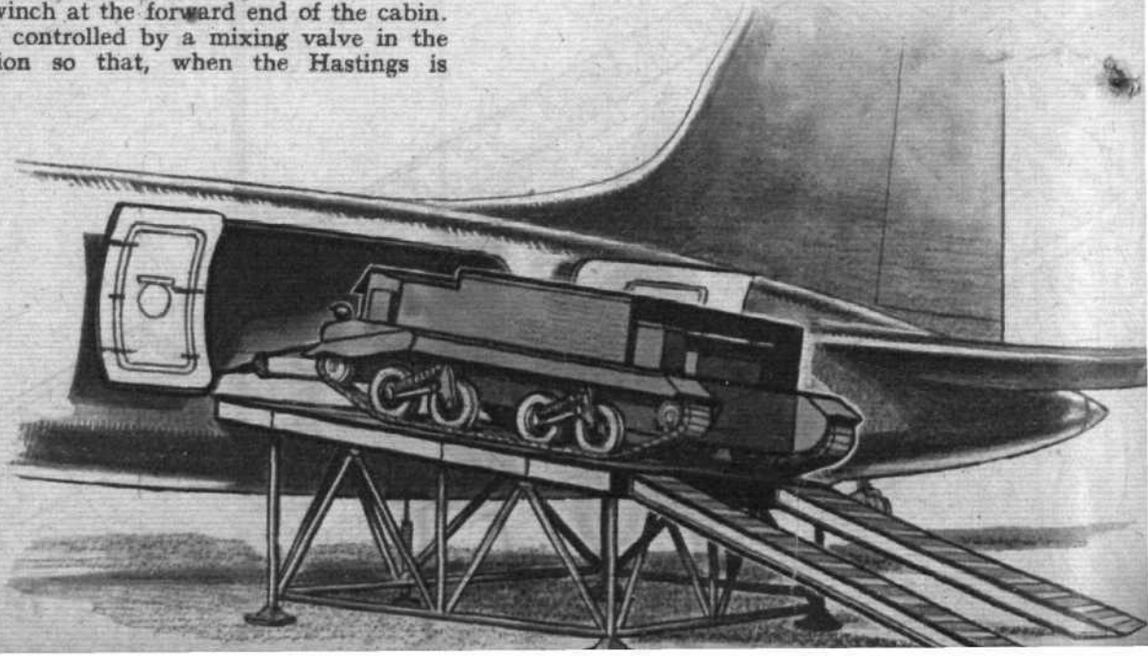
Stowage Space

Unrestricted stowage space in the fuselage aggregates 3,000 cu ft. The cabin is 40ft long and has an internal diameter averaging about 10ft 4in. At the centre of the cabin the height is 7ft 3in. The Plymax floor has built-in fore and aft channels, and lashing points and fittings to meet a diversity of requirements. The walls are sound-proofed, and for a distance of 2ft from the floor they are lined with plywood. At the rear of the main cabin are two lavatories, complete with wash basins and running water. Located on the port side, the freight door measures 9ft. 5in by 5ft 9in and incorporates a paratroop door. A second paratroop door is let into the starboard side. The sturdy, though relatively light, loading ramp enables vehicles and other wheeled freight to be driven into the cabin from ground level. The ramp is quickly dismantled and can be transported by air. Another feature which facilitates the loading of freight is a hand- or power-operated Gyral winch at the forward end of the cabin.

Cabin temperature is controlled by a mixing valve in the flight engineer's position so that, when the Hastings is

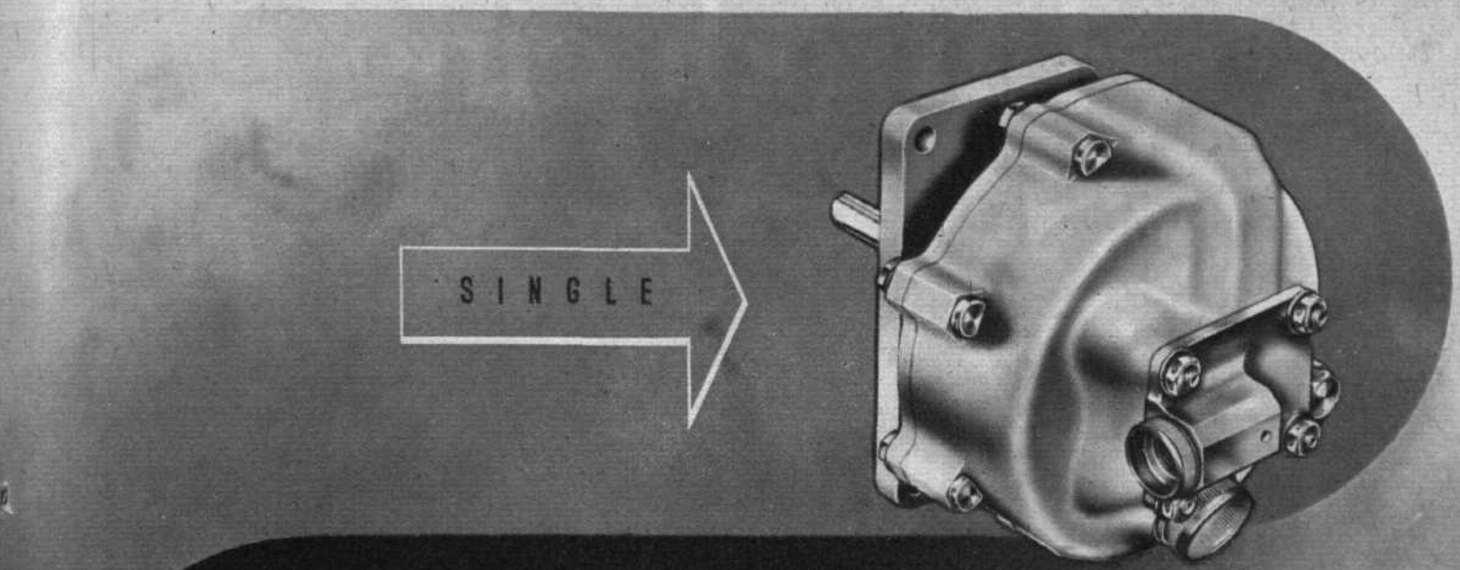


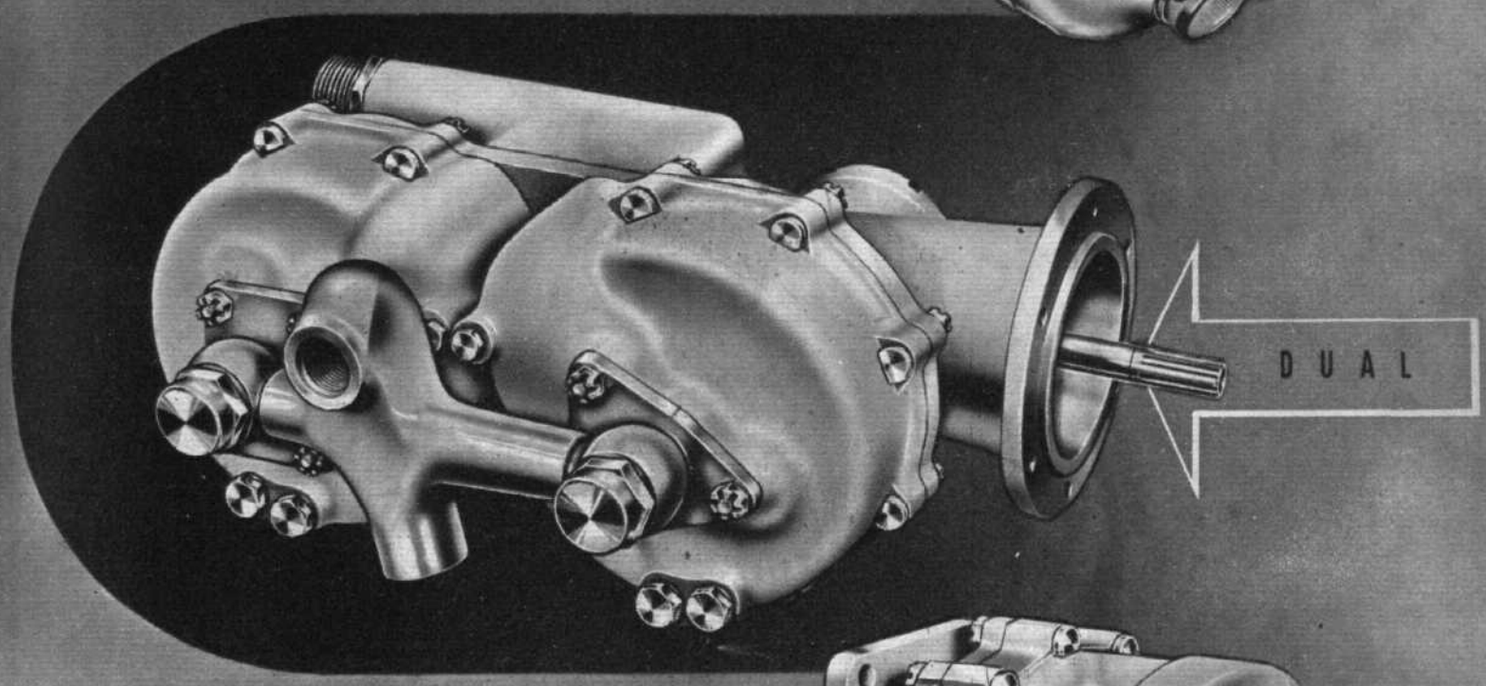
This series of sketches illustrates typical Service roles intended for the Hastings. From top to bottom these are : glider tug, ambulance, airborne-troop carrier, paratrooper (with external containers), freighter, heavy external stores dropper (with crews) and pannier and supply dropper.

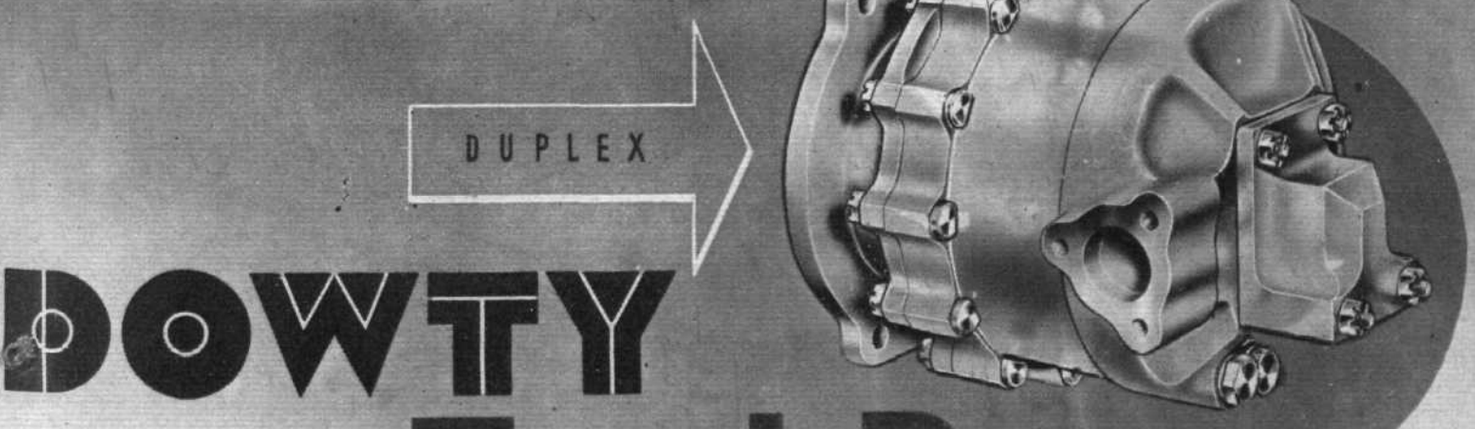


A tracked vehicle is seen being loaded aboard the Hastings by means of the special ramp, which can be quickly dismantled and is air-transportable. The door in the fuselage measures 9ft 5in by 5ft 9in.

Service of Supply for JET ENGINES





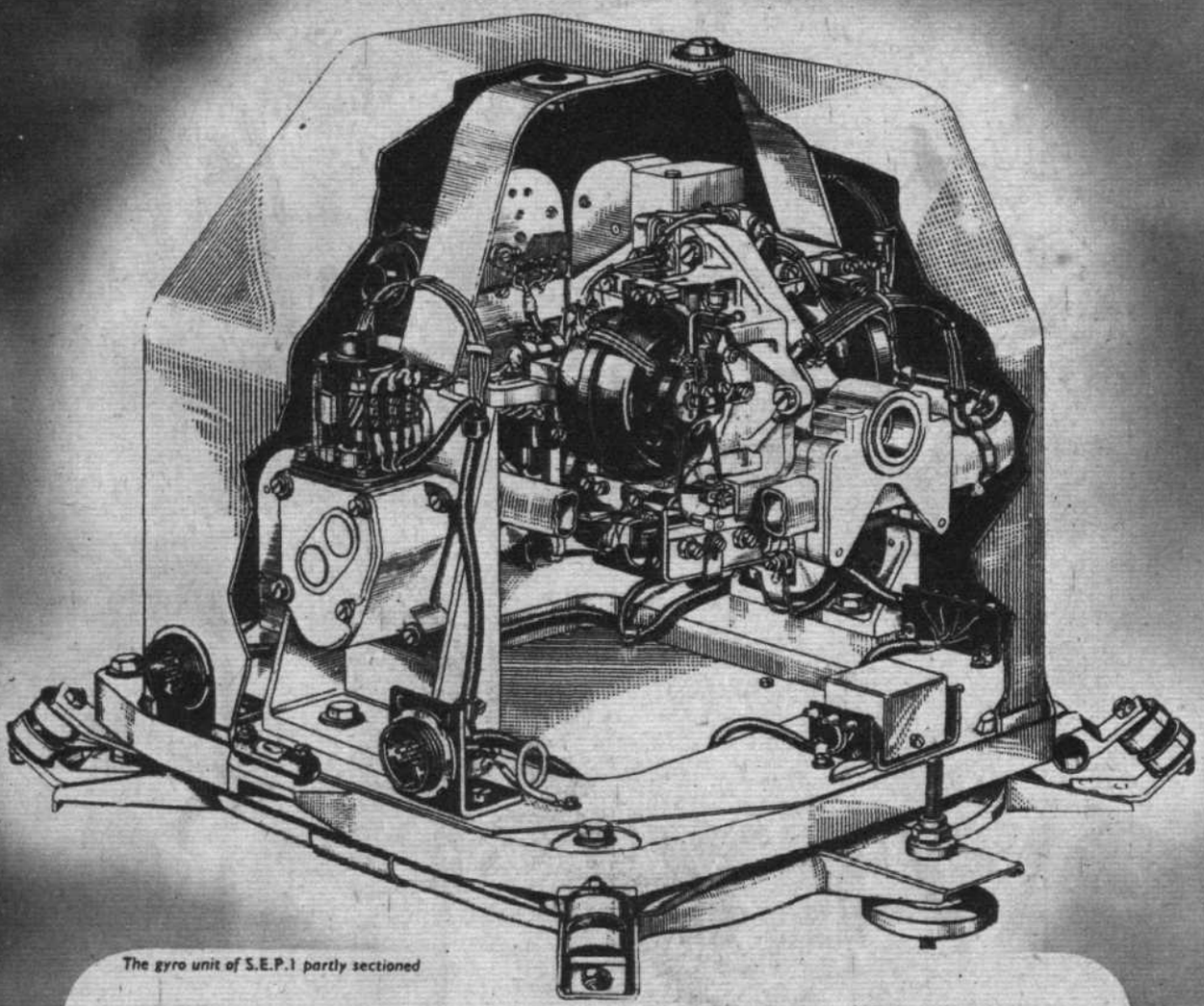


DOWTY Fuel Pumps

Dowty Fuel Pumps deliver 600 to 1,320 Imperial gallons per hour at 3,500 r.p.m. and 1,000 lbs. per square inch pressure

DOWTY EQUIPMENT LIMITED, CHELTENHAM, ENGLAND

Introducing S.E.P.1



The gyro unit of S.E.P.1 partly sectioned

SMITHS ELECTRIC PILOT

A new all-electric Automatic Pilot conceived, designed and produced by Smiths to meet the varied and changing needs of postwar aviation. Outstanding features of the S.E.P.1 Electric Pilot include:—*Smoothness and simplicity of operation · Safety and reliability in service · A minimum of maintenance for the operator.*

Full particulars on application from

SMITHS AIRCRAFT INSTRUMENTS LTD
CRICKLEWOOD · LONDON · NW2

A.129

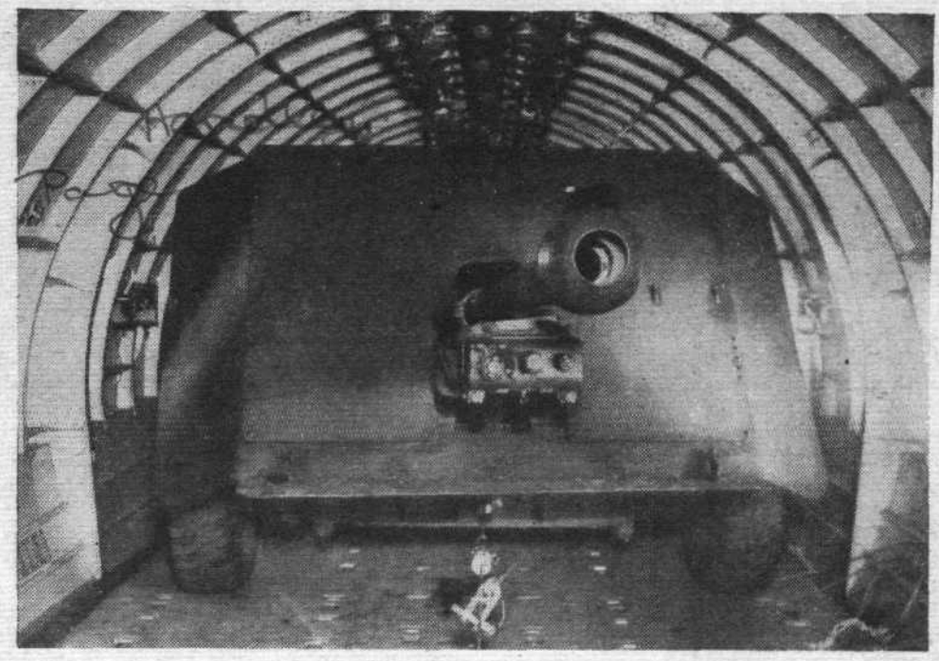
THE AVIATION DIVISION OF S. SMITH AND SONS (ENGLAND) LTD

Handley Page Hastings . .

operating in the tropics, cool air can be circulated and hot air expelled. There is also provision for air conditioning the cabin while on the ground.

The comfort and safety of the crew of five have received special attention. Sound-proofing, heat and ventilation is provided in the cockpit, and there is a rest compartment of adequate size. Apart from six emergency exits in the main cabin (three in each side) there are three in the cockpit. A point of special interest is that not only are the crew members supplied with full oxygen equipment but there are no fewer than fifty oxygen points in the main cabin for the use of its occupants.

Each of the four engines has three methyl-bromide fire extinguishers, and there are fire-warning lights in the cockpit. De-icing of the wing and tail surfaces is effected by the T.K.S. porous-metal method, and Dunlop slinger rings are provided for the airscrews. The air intakes are protected by flush guards.



A 17-pounder anti-tank gun—a weapon of no mean proportions—is readily accommodated in the Hastings. The gun is viewed from the front of the aircraft.

It will be evident from the foregoing description that the Hastings is suitable for a wide variety of military applications. In the R.A.F. it will not only carry freight, paratroops, airborne troops and casualties, but will drop supplies and tow gliders. As a freighter it will accommodate, for example, 25-pounder anti-tank guns or three-ton lorries up to a maximum weight of 7½ tons. In the trooper-transport role provision is made for 50 fully equipped airborne troops and for medium-sized freight in holds under the floor. For special purposes, chairs more comfortable than the seats, troops, for the use of, can be installed. As an ambulance the Hastings takes 32 stretcher cases and 24 sitting cases, four attendants and a ton of medical supplies. A representative load for the pannier and supply-dropping version is twenty-two 350-lb panniers, twenty 400-lb containers and two despatchers. When 30 paratroops are carried, 20 supply containers go with them.

For dropping heavy stores, such as jeeps and guns, the Hastings can be fitted with an under-fuselage carrier. Paratroop crews to operate this equipment are, of course, carried inside the aircraft in the normal manner. Finally, the Hastings, like the transport versions of the Halifax, is capable of towing gliders up to the size of the Hamilcar.

"Flight" photograph

The Hastings which performed so impressively in the S.B.A.C. Display at Radlett, where all aircraft of the type are tested. Military loads, being, in general, more concentrated than those carried by civil aircraft, do not demand the longer fuselage, as on the Hermes.

COL. DARBY RETIRES

ROLLS-ROYCE, LTD., announce with regret that one of the members of their senior executive staff, Lt. Col. M. Ormonde Darby, O.B.E., is retiring from active business life at the end of this month.

Col. Darby's association with aviation goes back to the early days. He served with the R.F.C. in the 1914-18 war. On demobilization he became managing director of the Aircraft Disposal Co., Ltd., a firm which took over all the aircraft and engines left as surplus after the war. The firm reconditioned large numbers of both and did good business abroad. When Cirrus Aero Engines was formed, Col. Darby became managing director of that firm also.

During the recent war Col. Darby represented Rolls-Royce as managing director of Phillips and Powis Ltd., which was at that time controlled by Rolls-Royce, Ltd. He was later loaned to M.A.P. as Controller of the South Marston Shadow Factory.

Col. Ormonde Darby, O.B.E.

DEATH OF JOSEPH NAVARRO

TO many of our older readers the name of Joseph Navarro who died suddenly the week before last, will be a familiar one. He was a designer with unorthodox ideas and somehow always seemed just to miss success. His "Chief," built at Heston, was underpowered with two Bristol Cherub engines. In more recent times he made plans for a small amphibian, the "Naiad," which was described in our issue of January 4th, 1946.

Lack of capital was always one of Navarro's great handicaps, and it seems a rather cruel stroke of fate that he was taken when the Navarro Aircraft Construction Co. was about to be floated with headquarters at Hanworth.

A New Autopilot

General Survey of the Smith's Electric Pilot : Entirely New Basis of Control : Maintenance Eliminated

THE place occupied by the automatic pilot in modern aeronautical practice has become so universally accepted that for any aircraft, Service or commercial, not to be equipped with an autopilot would now be unthinkable. Modern developments in electric technique have made possible the replacement of pneumatic and hydraulic principles of operation by all-electric means, this having brought with it an increase in flexibility, and considerably enhanced reliability.

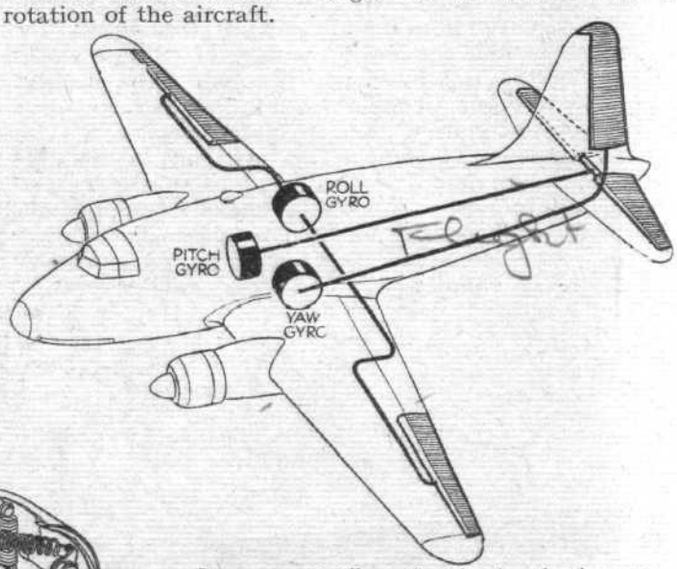
To meet the British Air Staff requirements both for civil and military aircraft, the Research Organization of Smiths Aircraft Instruments, Ltd. was entrusted with the development of an all-electric automatic pilot system. Under the leadership of Mr. F. W. Meredith, who has been connected with British automatic pilot development since 1925, the Smiths' team decided to approach the problem from an entirely new angle, starting afresh to take the fullest advantage of the vast electrical field plus anything that could be gained by a comprehensive survey of the latest American and German types. The result is the S.E.P. 1.

New Control System

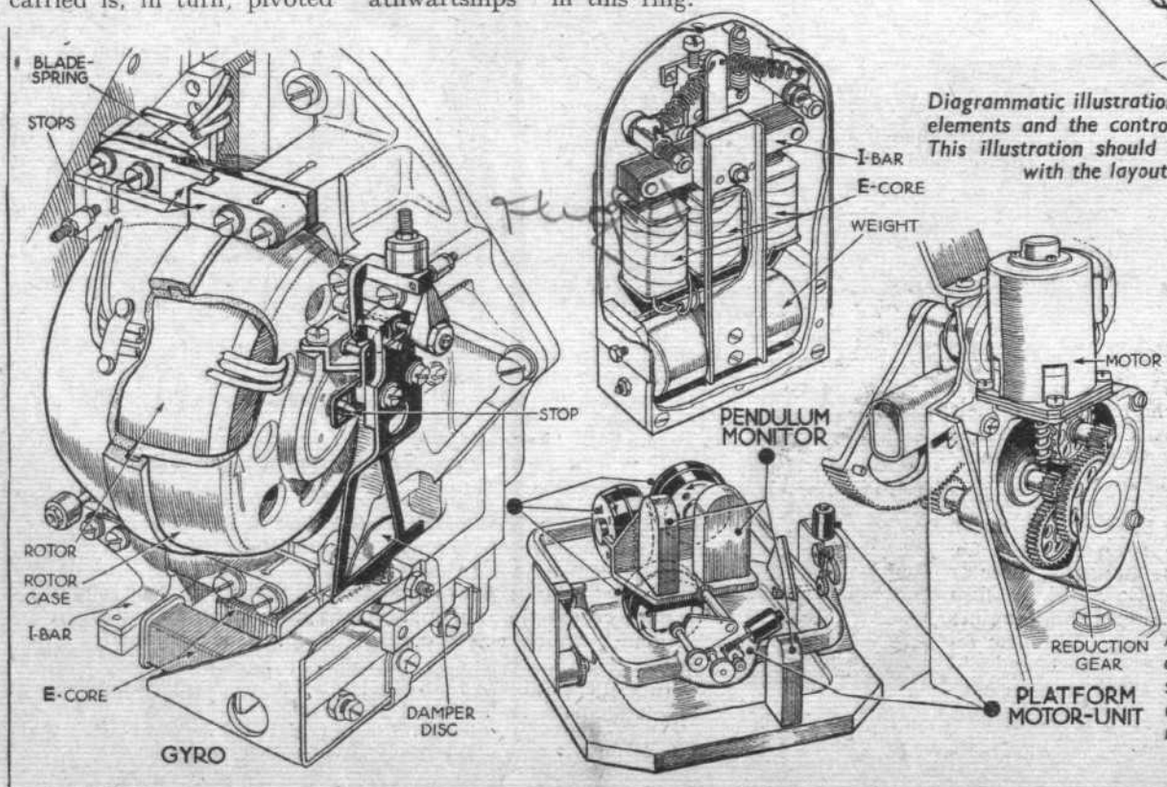
This autopilot is remarkable chiefly for its employment of what is known as a rate/rate gyro system of control as distinct from the conventional displacement method. Briefly, the rate/rate system provides for the servo-motors to actuate each control surface at a *rate* appropriate to the *rate* of rotation of the aircraft about the relevant axis of motion, rather than to an *extent* relative to the *extent* of displacement in yaw, pitch or roll. This permits a very high degree of response and a reduction in time lag such as to allow the use of high-geared controls without incurring "hunting."

The sole detecting and control-reference medium of the system is the gyro unit, the foundation of which is a base-plate carrying brackets in which a platform gimbal ring is pivoted. The central platform on which the gyros are carried is, in turn, pivoted "athwartships" in this ring. Each of the three gyros is precisely similar, taking the form of miniature hysteresis motors which run at 12,000 r.p.m. Each gyro-casing is supported by a pair of blade-springs and is restrained by positive stops within a movement range of roughly 2½ degrees on each side of the neutral plane. The air-dashpot usually associated with rate gyros has been displaced by an eddy-current damper consisting of a copper disc rotating between the poles of a magnet and so avoiding the fine clearances necessitated with a dashpot.

Electric supply to the gyro is made through three fine coil-springs whereby no restriction to movement is occasioned and, since the pick-off is purely inductive, no friction is associated with the gimbal movement. The absence of friction from gimbal bearings, dashpot and pick-off has resulted in such a high degree of sensitivity that laboratory tests show a positive response from the servo-motor for a rotation about the gyro's detecting axis of less than one hundredth of a degree for all normal rates of rotation of the aircraft.

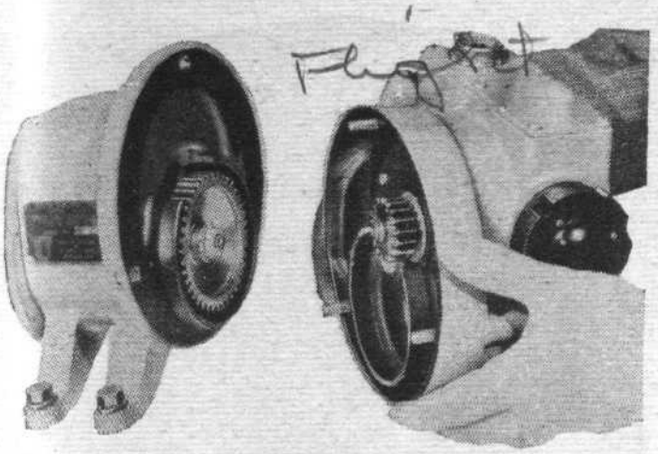


Diagrammatic illustration showing the three gyro elements and the control function they govern. This illustration should be read in conjunction with the layout on page 365.



Gyro detection of aircraft movement initiates the requisite signal to the appropriate servo-motor by means of a laminated I-bar carried direct on the rotor housing, which has angular freedom relative to an E-shaped core on each limb of which is a coil. Angular movement of the I-bar

A simplified schematic drawing of the gyro unit showing the disposition of the primary components which are illustrated in detail.



Servomotor in component halves, that on the left being the "permanent" aircraft part whilst that on the right is the motor and reduction gear unit.

results in a differential flux in the coils, thus inducing the requisite signal—proportional to the movement—to be sent to the servo-motor. In point of fact, the signal flow is by no means so simple as this; on the contrary, for those to whom electrical knowledge is something of a mystery the "electrics" of this system are complex. For this reason, and in view of space limitations, we propose to do no more than state the broad generalities of the circuits. Briefly, signals are sent out from the gyro unit and are fed to a junction box, whence they are passed on to an amplifier, there boosted as required and sent back to the junction box to be delivered to the appropriate control-surface servo-motor.

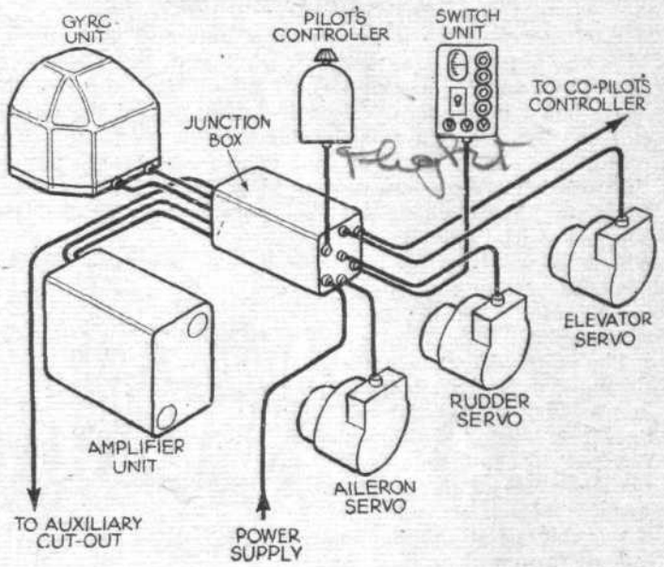
Coeval Functions

One must, of course, consider the autopilot in two guises; first, as a stabilizing control whereby flight *status quo* is maintained, and secondly, as a flight-attitude control unit through which the human pilot can, if he wishes, manœuvre his aircraft (within limited ambits of motion) by artificially disturbing the gyros. For the latter purpose the pilot is provided with a controller which, in effect, is a miniature two-control "stick." Fore-and-aft movement of this respectively gives diving to a limit of 40 degrees and climb up to 20 degrees, whilst rotation of the head initiates co-ordinated turns up to limits of 45 degrees of bank, port and starboard. The control "stick" is spring-centered and, to guard against accidental movement, is ineffective unless the head is held depressed.

When, for example, the aircraft is flying straight and level, if the autopilot "IN" switch is depressed, the autopilot will at once take over and maintain the flight condition. Should the pilot then desire, say, to climb, he depresses the head of the controller and moves the "stick" backward, the amount which he moves it governing the rate at which the "elevator" gyro will rock and, consequently the rate at which the aircraft attitude will change.

When the controller "stick" is moved backward, current is fed to a small two-phase squirrel-cage motor in unit with a tiny gear box mounted on the platform gimbal-ring. Rotation of the motor drives, from the gear box, a toothed segment anchored to the gyro platform so that the latter is tilted. This results in the "elevator" gyro rocking and, as we have seen, the elevator servo immediately moves the control surface upward. Pushing the controller forward would give opposite gyro platform tilt so that dive was produced, whilst rotation of the controller head energizes a second—entirely similar—motor and gear box to tilt the ring and central platform and so initiate actuation of the aileron gyro system.

In this latter connection must be mentioned the monitoring system. On the central platform are carried, in conjunction with the pitch and roll gyros, two pendulum-



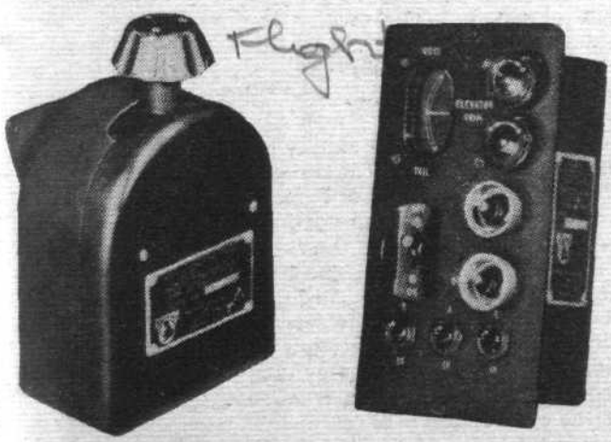
Diagrammatic layout of circuit connections between the respective units making up the system.

type monitors by which the gyros are policed for wander and precession, if from no other cause than rotation of the earth. The pendulum staff carries a cross-arm in the form of an I-bar which rocks relative to an E-shaped core to produce a signal in precisely similar a manner to that as described in the gyros themselves. However, for directional reference, the rudder gyro is monitored by a compass which can be any one of the several types available, capable of driving a signal generator.

The anti-wander gyro-policing function of the monitors is only one of their duties. Their chief function is to detect any change in aircraft attitude (it must be remembered that the gyros are keeping the platform horizontal in space) and to emit an appropriate signal to the servo-motors to counteract displacement. Thus the servos are signalled jointly by the gyros and the monitors.

Going back to consider the selection of a turn, say, to port, made with the pilot's controller, a co-ordinated turn necessarily calls for aileron action to produce bank, and rudder action to initiate the turn by yawing the nose of the aircraft to port. In the great majority of aircraft, application of aileron alone will merely produce bank and a side-slip will ensue.

In making the turn selection by rotating the controller head the gyro platform is caused to tilt, and this motion both applies the appropriate angle of bank and initiates a signal, proportional to that angle, which is fed to the rudder servo-motor to give co-ordinated control-surface action for a pre-selected cruising speed. Should, however, the aircraft not be flying at this particular speed, true co-ordination in the turn will not be achieved and, there-



Pilot's controller and switch unit. Work is at present going on to comprise these separate elements in a single unit.

A New Autopilot . . . . .

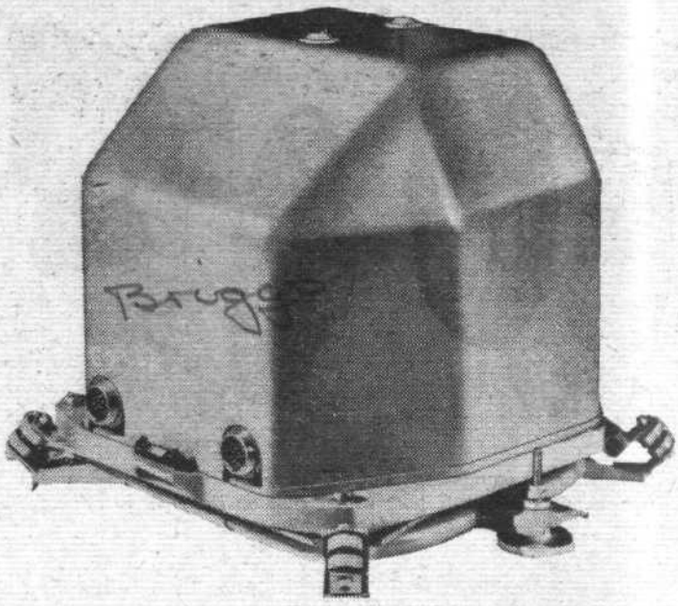
fore, a degree of slip-out or slip-in will be present. To detect this, a third pendulum monitor is mounted on the gyro-unit base-plate, this sending a signal to the rudder servo-motor to produce the requisite rudder correction.

Before leaving the pilot's controller it must be mentioned that the "stick" self-centring action and head-depressed contact are such that when the required climb or dive attitude is attained and the controller "stick" is released and allowed to self-centre itself, the aircraft will continue flying in the obtaining attitude. To resume level flight from a given pitch attitude opposite "stick" must be applied. When, however, an autopilot-controlled turn is being made, the controller must be held in the appropriate position so long as the turning action is required, for on release of the knob back to the self-centred position, the autopilot will bring the aircraft back to level flight.

Servo-Motor Details

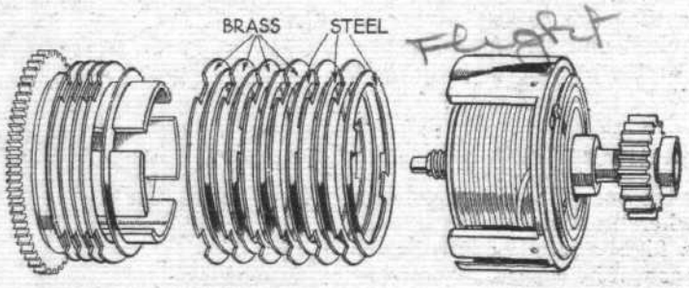
Each servo-motor is an identical unit and is composed of two parts, (i) a motor, clutch and reduction gear assembly; and (ii) a torque shaft assembly. Of these, the latter is a "permanent" aircraft fixture, whilst the former can be changed as a sub-unit for periodic overhaul. The motor element is novel in that it is an hysteresis motor, the rotational direction and speed of which is determined by phase displacement. These motors have high torque coupled with low inertia, which gives very high response and so contributes largely to the sensitivity of the system.

The motor drive is applied through reduction gearing, in which an electrically operated clutch is incorporated, to the torque shaft for operation of the control surface. Each servo-motor is capable of supplying an output torque of 60 lb ft at the torque shaft, which latter normally operates through approximately ± 60 degrees, although a larger or smaller angular range can be used. The transmission linkage between torque shaft and control surface can vary considerably, the torque shaft having a flange-terminal coupling for versatile linkage.



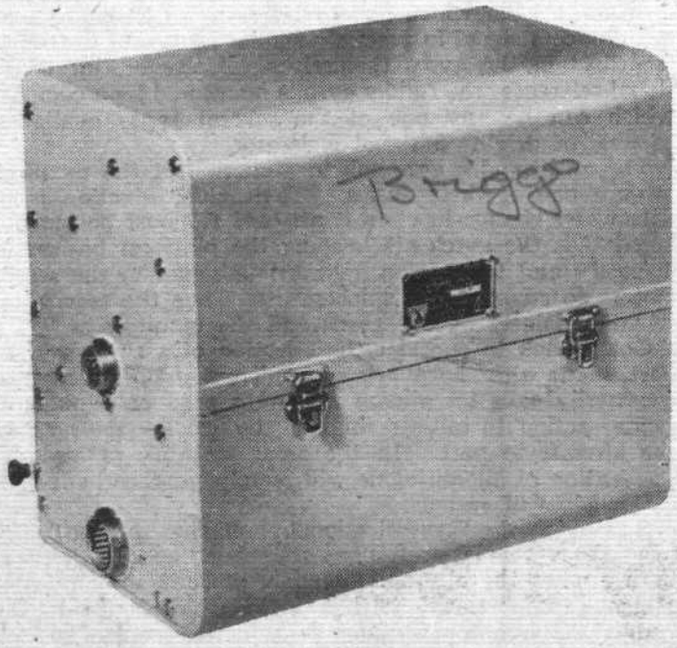
Gyro unit showing anti-vibration mountings and screw-jack point for levelling.

In tandem with and driven by the motor is a miniature generator which, according to the direction and speed of the motor, produces an appropriate feed-back output to give proportionality between the input signal and velocity by backing-off the input, this being effectively an electric follow-up system.



Break down detail of servo-motor clutch showing stack of plates, locking slots, return spring, energizing coil, etc.

The magnetic clutch consists of a stack of alternate brass and steel annular plates mounted axially and capable of being squeezed together by an electro-magnet housed inside the plate assembly. Operation of the clutch is instantaneous, and safety is assured in the event of disruption or failure of the power supply since disengagement is automatic with breaking of the circuit. The reliability of the clutches has been proven to be equal to that of manually operated systems.



Amplifier unit showing at bottom left the quick-release knob. When this is pulled, the whole unit can be unshipped from its mounting.

Amplifier and Junction Box

The amplifier unit is, of course, necessary to boost and translate the minute signals received from the gyro unit in order to provide sufficient working power to energize the servo-motors. The main amplification is attained by means of three magnetic amplifier sub-units, one for each control circuit. The great attraction of this system, and indeed, its novel aspect, is that the amplification is obtained through an inert means. There are no moving parts, the units are quite small, and there is no maintenance requirement.

The junction box is simply what its name suggests but has the refinement that it embodies potentiometers whereby the magnitude of control response may be adjusted to suit the requirements of the particular aircraft control characteristics. That is to say, the relative harmonization between the "weight" of the respective surfaces can be adjusted at the junction box. Additionally, the embodiment of reversing links allows the standard box to be used for any aircraft, the relation between the gyro rotation and rotation of servo-motor being antipathic or sympathetic as required for the particular aircraft. Thus, for example, if the rudder servo is to rotate anti-clockwise for a given surface movement due to the linkage employed, this can be fitted in with the uni-directional gyro rotation by connecting the reversing links one way or other. Another

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A New Autopilot . . . . .

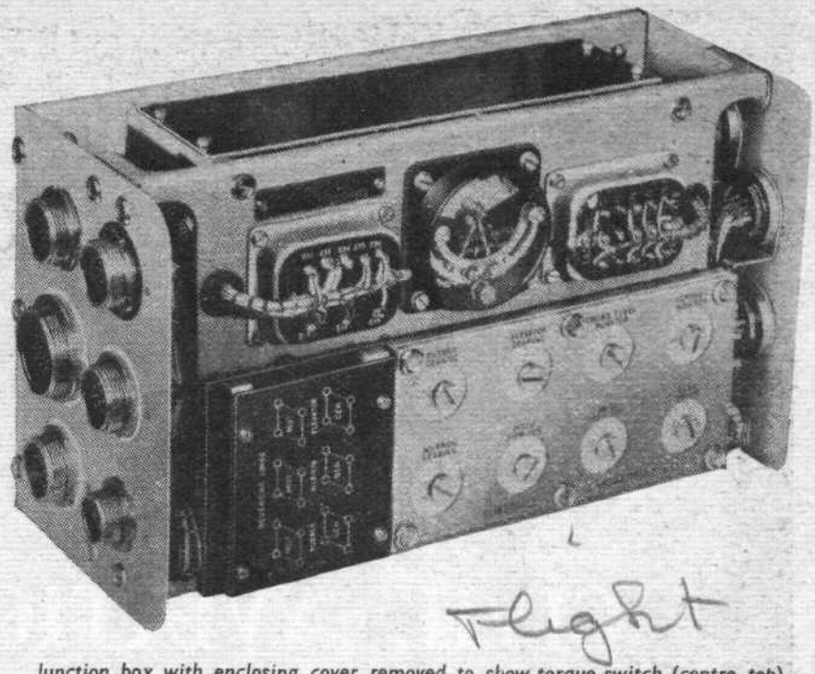
useful feature is the incorporation of a torque switch which automatically disconnects the autopilot when the voltage rises or falls beyond predetermined limits or in the event of fuse failure in any of the three-phase supply lines.

All the separate units are expressly designed for rapid installation and removal in order to facilitate servicing. In this connection, it should be emphasised that the policy is for any defective unit to be unshipped from the aircraft and replaced on the spot by a serviceable replica, the defective unit being returned to the makers for repair. As the designed maintenance-free life of the units is, at the moment, no less than 1,000 hours, whilst the intention is to make this 2,000 hours, such a servicing scheme has obvious advantages; not the least is that it is far better that any fiddling with the unit visceræ should be done by the makers alone.

To facilitate unit change, the junction box and amplifier are made with quick-action locking and anchor points giving three-point mounting. This is the static mounting of the enclosing case, the "works" being supported on a flexibly-mounted chassis inside the box. The gyro-unit base-plate is bolted at three points to a tubular sub-frame, which itself is carried on three anti-vibration mountings from a supporting frame. This latter is mounted in the aircraft by two bolts and a single jacking point whereby the base-plate may be levelled. The "permanent" (torque shaft) halves of the servo-motors have three mounting feet for attachment to the airframe, the motor side of the unit having a three-bolt attachment to the torque shaft sub-unit.

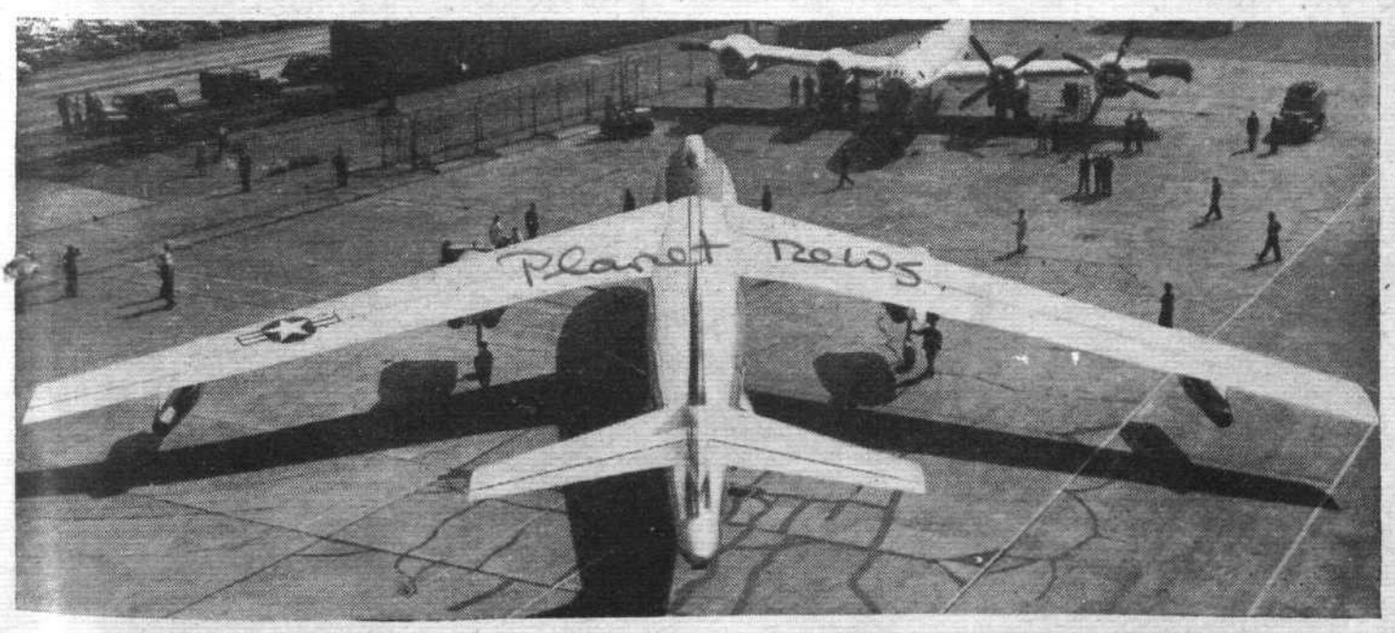
The switch unit has "IN" and "OUT" press button switches—supplemented by an "OUT" instinctive switch on the control column—and separate circuit switches for each of the three servos so that individual operation can be periodically checked by the pilot for trim accuracy. A system master switch incorporating a solenoid "hold-on" is also carried on the unit, the purpose of the hold-on being that the master switch can be maintained in the "ON" position only whilst a power supply satisfactory for correct operation of the autopilot is available. If anything goes wrong with the supply, the switch at once flies to "OFF" and will not hold at "ON" until the proper supply is restored. On the side of the unit are an amber and a green light, the amber light indicating that the autopilot is ready for use but not in operation, and the green light indicating that the autopilot is in use. Should one of the three servo-motor switches have been inadverently left at "OFF," both the amber and the green light will indicate the abnormal condition; these lights embody dimming control for day or night relative brightness.

An elevator trim indicator is also incorporated in the switch unit so that the pilot may see at any time the trim condition that obtains; he should, of course, make sure that the indication is in the zero region before disengaging the autopilot.



Junction box with enclosing cover removed to show torque switch (centre top), reversing links (bottom left) and sensitivity adjusters (bottom right).

Destructive Elegance



The first picture of the new Boeing XB-47 bomber prototype for the U.S. Army Air Forces. Six axial-flow turbo jets, the distribution of which is evident, are fitted, and the main wheels of the undercarriage retract into the fuselage. The most significant design feature, however, is the sweep-back on the wing and tail surfaces.

CIVIL AVIATION NEWS

LARGEST FLYING BOAT: The civil version of the Short-Saro Shetland which was launched at Rochester on September 15th and flown for the first time two days later. After further flying tests it will be handed over to B.O.A.C. to be used as a flying test-bed.

Equipment Tests on Interim Aircraft: Foreign Travel Ban: Meteorological Discussions: Installations at Gander

B.E.A.C. AND THE CURRENCY BAN

MR. GERARD d'ERLANGER, chairman of B.E.A., has explained the serious set-back experienced by the Corporation due to the Government's ban on tourist travel to the non-sterling areas. Although the figures of financial losses were not available, it was revealed that 85 per cent of passengers to the Continent had been lost through the currency embargo.

During the past twelve months of operation B.E.A. has been developed to cater for an ever-increasing expansion, but now the whole outlook has changed, and the organization, including 7,000 personnel, will have to be cut, and Continental services revised. The Scottish and English Divisions of the Corporation are to be amalgamated with a pooling of the staff of each Division. It is probable, however, that the crisis may affect the internal services favourably and people may be driven to using air transport because of the shortage and congestion of surface forms of transport, so that the domestic lines may return some, if not all, of the losses incurred on the Continental schedules.

In order to cut losses the company is also contemplating a development of routes to sterling areas such as Malta, Cyprus and Gibraltar, although the difficulties of accommodation in these places have first to be overcome.

Research and development for the future are progressing, and such problems as high level flight and the regular use of helicopters are being investigated. It is hoped that Miles Marathons will replace Dakotas on B.E.A. routes by 1949, and that Viscounts will replace the Vikings now in service by 1951.

INTERIM AIRCRAFT

SOME instances have lately been cited by the Ministry of Supply to show how experience gained by the use of British interim aircraft will assist in the development of entirely new designs. By the use of interim types manufacturers are enabled to test equipment on regular operations and gain valuable development experience. Were American aircraft to be used this experience would not be forthcoming and new equipment would have to be tried in advanced new designs such as the D.H.106, of which aerodynamic and airframe problems are already sufficiently difficult without adding incidental teething troubles.

It is disclosed that the radio equipment WT.1900, STR.12 intercommunication systems, etc., developed for the Hermes will be installed in the D.H.106 and the Apollo. Again, in the case of pressurizing equipment, the filters, blowers, silencers, valves, heaters, controls developed for the Tudors will be used on the Apollo. From the airframe aspect, it is particularly important that the technique of sealing the cabin should be thoroughly mastered before application to the new designs. In the same way, it is hoped that the new British auto-pilot (Mark IX) will have been thoroughly tested on interim types before fitting to the D.H.106.

COMMONWEALTH AIR FREIGHT NETWORK

LONDON Aero and Motor Services, Limited, of Stanstead Airport, Essex, has been amalgamated with Skytaxies, Limited, the holding company of Alpha Airways of South Africa. Three operating companies, L.A.M.S. (England), L.A.M.S. (Africa), and L.A.M.S. (Australia) will now be controlled by Dr. Graham Humby, who is appointed governing director for life of the amalgamated concern. The operators are expecting to begin flying their Pacific freight routes from Sydney, Australia, during October, and they will also operate from the Alpha Airways airport near Johannesburg.

L.A.M.S. will continue to operate converted Halifax bombers as the main aircraft of their three flights. The Halifaxes have already flown more than half a million miles while engaged on air freighting, chiefly in Europe, and have proved themselves efficient and economical.

B.O.A.C. PAYLOAD FIGURES

ACCORDING to statistics released by B.O.A.C., the company's Speedbird service across the Atlantic from America to U.K. led all others in passenger payload averages during the summer period April to August. From April 7th to August 23rd B.O.A.C. Constellations departing from La Guardia Airport for England carried more passengers per flight than either Pan American Airways or American Overseas Airways. June was the busiest month for trans-atlantic air travel out of New York. During this period B.O.A.C. averaged 39.6 passengers per flight whilst its nearest competitor averaged 37, and in July B.O.A.C. averaged 33.1 passengers and its nearest competitor 32.7. From April 7th to June 14th, a period of limited transocean travel, B.O.A.C. carried on the average 31.6 passengers as against its competitors' averages of 31.3 and 30. August was considered the "light" month for trans-

Civil Aviation News . . . . .

atlantic travel from New York, but even during this period B.O.A.C. operated most economically and produced the leading payload figures for airlines operating from New York.

GANDER INSTALLATION

JAMES H. SMITH, Atlantic Vice-President for Pan American Airways, has announced the appointment of Mr. P. R. Dickinson as liaison officer for the new all-weather radar landing system being installed at Gander Airport, Newfoundland. Mr. Dickinson will co-ordinate the operation of the unit which Pan American have been operating for all major American and foreign transatlantic airlines since last December, and operate in addition, a new unit which is being obtained from the American Army Air Forces.

The new device, a search radar unit with a range of about 150 miles, plus the present GCA system, should eliminate the necessity for "stacking" incoming aircraft ofter the airport in bad weather. The search radar unit will permit air traffic control to locate aircraft approximately 150 miles away and space their arrival time to allow uninterrupted landings. The unit is expected to be in operation by about November 1st. The Newfoundland Government is aiding in the installation cost and the Air Transport Association is sending engineers to Gander to train the GCA operators in the use of the search device. Airlines using the present GCA system which are expected to share in the use of the search unit include Air France, American Overseas Airlines, B.O.A.C., K.L.M., Sabena, Scandinavian Airlines System and T.W.A.

DANISH DECCA NAVIGATOR COMPANY

THE Decca Navigator Co., Ltd., have announced the formation of a Danish subsidiary to be known as the Dansk Decca Navigator Co., Ltd., with a capital of 1,000,000 kroner. The Danish company will be responsible for the construction and operation of the Danish chain of Decca Navigator Stations which are now being built, and which will come into operation early in 1948.

The chairman of the new company is Mr. E. R. Lewis; vice-chairman, Mr. H G. Garde, who holds a prominent position in Danish shipping circles. The Royal Danish Ministry of Marine will be represented on the board of directors.

BREVITIES

The site for I.C.A.O.'s Special Conference on the multilateral exchange of commercial rights in international civil aviation, which was to have been held at Rio de Janeiro on October 20th, has been changed owing to the Brazilian Government's inability to act as host. No new site has yet been announced.

* * *

The Chilean Foreign Office announced last week that a commercial air navigation treaty was to be signed between Britain and Chile.

* * *

Because night flying cannot be safely conducted over Central Europe owing to a lack of the necessary radar and radio aids, B.E.A. have withdrawn their night mail and freight service to Prague. The service, which has been operating since August 11th, now terminates at Brussels.

* * *

The Ministry of Civil Aviation announces that a civil aviation agreement between the United Kingdom and Chile was signed in Santiago on September 16th. The agreement provides for the reciprocal grant of facilities in their respective territories for the operation of scheduled air services.

Kearsley Airways, operating Dakotas and a Proctor, are now based at Stanstead Airport, having moved from Denham. Aircraft will be maintained by the L.A.M.S. Engineering Division. Flight Captain of the Kearsley organization is Mr. H. W. Waltham.

* * *

Sir Sholto Douglas and Lady Douglas attended the opening of the new Berlin office of British European Airways. At present the company is servicing the London-Hamburg-Berlin route with a return flight each day excepting Fridays. Dakotas carrying 18 passengers are being used until October 6th, after which 24-passenger Vikings will be employed.

* * *

In anticipation of a change in the equipment in use on B.O.A.C.'s Speedbird route between Bermuda and Baltimore, negotiations are now being conducted with C.A.U.S.A. (Compania Aeronautica Uruguaya, Sociedad Anonima) for the purchase of the Corporation's three Boeing 314 flying boats, "Bristol," "Berwick" and "Bangor." C.A.U.S.A. is considering the purchase of these aircraft for use on their Uraguayan services.

FROM THE CLUBS

The British Association of Aviation clubs which was formed recently to promote and encourage public interest in aviation (see *Flight*, August 21st) has announced an essay competition for young people under 21. The competition is the first of a series and the subject of the first essay is to be "Transatlantic Aviation." Three prizes consisting of half-hour flights in a Miles Gemini are to be awarded to the winners.

* * *

The Fairchild Argus bought by the W.J.A.C. out of voluntary funds has been busily engaged during the summer visiting a number of airfields and flying clubs to give instructional flights to members of the Corps. At one of the largest meetings held recently at Hooton Park, Viscountess Leverhulme, National Chairman of W.J.A.C., attended accompanied by Mrs. R. Spink, Director of the Corps, and Mrs. W. B. S. McIntyre, Regional Commandant for Cheshire. The R.A.F. co-operated with a fly-past of Spitfires, and the Fairchild Argus and an Auster belonging to the Wright School of Aviation provided instructional flights for over 100 cadets. On Saturday, September 27th, the Fairchild will be visiting Llandow in Wales and on Sunday, September 28th, it will be at Wolverhampton. In the London area the W.J.A.C. are arranging Link trainer instruction for some of their members, and it is hoped that this facility will be extended when more Link trainers become available.

* * *

With the beginning of a new academic year at Cambridge this month the Cambridge University Gliding Club is expecting to augment its membership and consequently to increase its activities. During the past two months keen interest has been shown both at Marshall's Flying School and at Bourne, and several outstanding flights have been accomplished. The club has extended its membership to include power and sailplane pilots who are not members of the University, and already several such members have been recruited. At the recent National Gliding Competitions at Bramcote the club gained third prize with twenty of its pilots covering distances of over sixty miles.

* * *

The Herts and Essex Aero Club at Broxbourne, which now has over 400 members, is able to look back on a successful summer season. Since June a steady increase has been shown in the monthly flying totals, the August figure indicating an increase of 236 hours flown over the total for June. Since the club reopened in May of last year, a total of 4,346 hours has been amassed. Sixty-six new "A" licences have been awarded and seven new "B" licences have been issued. Forty-five pre-war members have also been awarded new "A" licences.

S/L. Derek Taylor has recently joined the club as its Staff Instructor.

* * *

By the firing of a signal rocket, the Mayor of Hereford, Alderman T. Lindsey Price, declared open Hereford's new airfield on Thursday, September 18th. The airfield, which is situated within the perimeter of Hereford's racecourse, is being operated by Aircraft Hereford, Limited, who will provide flying and gliding instruction and flying club facilities. The company's seven Austers and one Tiger will also be available for air taxi and charter work.

Early arrivals at the opening ceremony included four Austers, a Messenger, Proctor, Fairchild and a R.A.F. Anson. Unfortunately, owing to bad weather, a comprehensive flying display by aircraft from R.A.F. Aston Down had to be cancelled, but demonstrations and height guessing competitions took place. After the opening the Mayor and Mayoress were given a flight in one of the company's Austers by Mike Edwards, one of the company's staff pilots. Proceeds of the afternoon's activities went to the Hereford branch of the R.A.F. Association.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

WORLD SPEED RECORD

Improvements Down to Split Seconds

"AN improvement of half a second is not much to shout about." Isn't it, by gum!

If someone were to knock *five tenths* off the record for the hundred yards (9⅘ seconds or thereabouts), there would not be big enough head-lines in all Fleet Street to announce the fact. H. M. Y.

HELICOPTERS OR AUTOGIROS

Would we have been in Front or Behind?

AS one who had the privilege and honour of working with the late Juan de la Cierva it gave me great pleasure to read the tribute to his genius in Mr. E. V. Hammond's letter.

I should, however, like to take this opportunity of correcting a mistaken idea of growing prevalence that de la Cierva's ultimate aim was the development of the helicopter, and that he invented his Autogiro solely as a half-way stage in the process. Such could not be further from the truth. In his quest for the ideal safe flying machine de la Cierva at every stage gave the helicopter his fullest consideration, and always discarded it in favour of his Autogiro.

I would, therefore, rather suggest that but for his untimely death, instead of "toddling along at the tail of the world in helicopter design," we should not have been led along this tortuous and narrow path at all, but on the contrary would have been able to provide the remedy for that lack of safety in private flying and air transport which is now causing so much concern in every part of the world.

G. H. CUMBERBATCH WILLINS, M.A., A.F.R.Ae.S.

EXECUTIVE AIRCRAFT

Right Size all Important

I READ with considerable interest the article by Sir Roy Fedden, as published in the issue of August 28th under the title "A New Ideal," and heartily agree with the view expressed that, to-day there does not exist the really ideal type of executive aircraft most of the present types being either too large or too small. There is little doubt that in the larger types of aircraft interior design can be and has been laid out to meet the requirements of the business executive with his office, etc, and other specific purposes, but it is clear that business firms and their executives do not want this larger and expensive type of aircraft with all its additional heavier running and maintenance costs, nor the intermediate or smaller aircraft of the present conventional type, offering the usual interior styles laid out in motor coach fashion.

It may be of interest to business firms and their executives to learn that this important subject of the executive aircraft has been receiving the very close attention of one of our well-known pioneer aircraft designers, responsible for many outstanding machines in the past, and that this party has planned an aircraft of the twin-engined, four-seater and pilot type as mentioned in the article "A New Ideal," an added feature being that the interior can be readily altered to suit special individual requirements, one of these being as a six-seater suitable for charter or feeder work. In fact it might be pointed out that this projected design compares very favourably with many of the requirements set out in "A New Ideal," in that this aircraft will have a gross weight of 4,000 lb and will seat four passengers and a pilot in a private car-like cabin with easy exit and entrance and with luggage accommodation for 50 lb per head. A duration of six hours is estimated at a cruising speed of between 160-170 m.p.h. on a total h.p. of 300, coupled with a low landing and stalling speed. There is little doubt, however, that the stipulated requirement of a cruising speed of 200 m.p.h. could be attained with suitable modifications and a slightly greater total h.p. than 300.

The question as to whether the conventional type of aircraft could be so constructed to fulfil all the requirements as laid down by Sir Roy Fedden is a matter for further discussion between aircraft designer and engine designer, but there would seem to be no reason why the necessary requirements could not be met in the careful selection of the right type of aircraft design.

In regard to the actual time and costs involved in producing this desired prototype executive aircraft it would seem that this need hardly take quite so long nor be quite so costly as outlined in "A New Ideal," but there again this factor is, to a very large extent, controlled by the method of construction to be employed and as to whether a new type of engine is to be designed or an existing type incorporated.

Being of the opinion that this ideal type of executive aircraft can be produced and that a greater opportunity is afforded by starting from scratch, in that the matter can be discussed between designed and potential users prior to the construction of the prototype and in view of the plans under consideration by the aircraft designer mentioned in this letter, to design and construct an aircraft of this type, it will certainly be most interesting to have your readers' views on the subject. S. H. HANDASYDE.

RUNWAY SIGNALS

A Case of Divided Authority

WHEN I read the letter in your issue of September 11th on the above subject I gave a "mirthless laugh."

Similar "Stop, Wait for Green" boards were in use, to my knowledge, on several R.A.F. airfields in 1944, probably earlier. There were also "Caution, Runway-in-use" boards at the upwind end of the runway. "No Entry" boards at runway intersections might be more trouble than their worth because there would be so many boards to move if a quick change of runway became necessary.

All contractors' drivers should be briefed daily by the Senior Air Traffic Control Officer or the Duty A.T.C.O., and no driver should be allowed to take a vehicle on the perimeter without previous briefing. I have had experience as Senior A.T.C.O. at several R.A.F. airfields where extensive constructional, repair, or maintenance work was in progress.

It would appear from the letter that the Runway Controller is an employee of the "airport authorities," whereas the Air Traffic Control Officers are employees (if they will forgive the word), of the Ministry of Civil Aviation. If this is so it is surely a ridiculous and inefficient system. The control of all traffic on the perimeter should be the primary responsibility of the Senior A.T.C.O.

It may interest you that I have over 5 years' experience as an R.A.F. Air Traffic Control Officer, under its varying titles, nearly four of them as Senior A.T.C.O., and I have a clean record. I was released in February this year. My applications for employment in civil air traffic control, the first made in 1945, have been rejected without even an interview. I am now 48 years of age, but far from decrepit. The normal upper age limit for engagement is 35. C. C. ALLINSON.

BOOK REVIEW

Immortal Memory. By Air Commodore E. L. Howard-Williams. C. D. N. Bamber and Co., Ltd. 2s 6d net.

AN earnest and, on the whole, successful attempt is made in this unpretentious little book to explain how the Battle of Britain came to be fought. The author outlines the happenings after Munich, notably the actions fought by the R.A.F. at Dunkirk, which were, in effect, dress rehearsals for events of even greater significance. An interesting point is that the only illustrations are of the Battle of Britain Memorial window in Westminster Abbey and of Air Marshal Sir Keith Park who, Air Commodore Howard-Williams suggests, will be acclaimed by historians as the victor.

Though the revised figures for R.A.F. claims and *Luftwaffe* losses are included there are technical inaccuracies which, at this late date, are hardly excusable and which, regrettably, are in danger of being accepted as accurate. For instance, more than once the author makes reference to an aircraft known as the "He 113." Beloved of war writers, this spurious type is credited with having functioned both as a fighter and as a bomber. The fact is that the He 113 never really existed. Photographs purporting to portray it show a machine which was officially designated as "He 100," but which was, in fact, never used operationally. Another fabulous machine is the "Dornier 211," mentioned twice as having been in action at Dunkirk. Moreover one is strongly inclined to question the veracity of a statement by one of the author's friends living in Kent, that within one mile of her house lay no fewer than eight German wrecks.

SERVICE AVIATION

BATSMAN'S VIEW OF A CATCH: A Supermarine Seafire 47 touches down during deck-landing trials aboard H.M.S. "Illustrious." The top speed of this mark is about 450 m.p.h. at 20,000 ft.

The D.A.F. Reunion

THE only cause for regret at the D.A.F. Reunion, held in the Royal Albert Hall last Saturday night, was that by a misunderstanding some reunionists arrived with their womenfolk to whom admittance could not be allowed. There was a strong A.T.C. representation and a total of 3,000-odd guests heard the C.A.S. and Mr. Anthony Eden deliver themselves of stirring speeches, well leavened with reminiscences. At one time the air was thick with sand, and paper aircraft.

Appointments

THE Air Ministry announces the following R.A.F. appointments:

Air Marshal Sir Hugh W. L. Saunders, K.B.E., C.B., M.C., D.F.C., M.M., to be Air Council Member for Personnel.

Air Vice-Marshal Sir Hugh P. Lloyd, K.B.E., C.B., M.C., D.F.C., to be Air Commander-in-Chief, Air Command, Far East; and is granted the acting rank of Marshal.

Air Vice-Marshal Sir Arthur P. M. Sanders, K.B.E., C.B., to be Air Officer Commanding-in-Chief, British Air Forces of Occupation (Germany); and is granted the acting rank of Air Marshal.

Air Vice-Marshal A. B. Ellwood, C.B., D.S.C., to be Air Officer Commanding-in-Chief, Bomber Command; and is granted the acting rank of Air Marshal.

Air Marshal Sir Hugh Saunders has been A.O.C.-in-C., Bomber Command, R.A.F., since January 16, 1947, prior to which he was A.O.C., R.A.F. in Burma from August, 1945. Formerly he was Director-General of Postings at the Air Ministry from November, 1944, after having been A.O.C. No. 11 Group, Fighter Command for two years, and before that Air Officer (Administration) at H.Q., Fighter Command, for nine months. From January, 1939, until February, 1942, he was seconded for special duty with the New Zealand Government.

Royal Air Force and Naval Aviation News and Announcements

Air Vice-Marshal Sir Hugh Lloyd has been R.A.F. Instructor at the Imperial Defence College since November 15, 1945, prior to which he was A.O.C. Very Long Range Bomber Force from April, 1945, having been A.O.C. Planning Force, for V.L.R. Bomber Force. This force was to have taken part in the air assault upon Japan. Sir Hugh Lloyd was A.O.C. of the North-West Africa Coastal Air Forces from March, 1943, to November, 1944, and while in that post organized the air escort operation covering the Salerno landings. He was previously Senior Air Staff Officer to M.R.A.F. Lord Tedder at H.Q., R.A.F., Middle East, and from May, 1941, was A.O.C., R.A.F. Malta, at the height of the enemy attempts to neutralize the Island as an offensive base. For his work in this Command Sir Hugh received the C.B. and K.B.E., and a congratulatory message from the Secretary of State for Air spoke of his "brilliant leadership."

Air Vice-Marshal Sir Arthur Sanders has been in the Department of the Assistant Chief of Air Staff (Training) for duty with the Committee for Revision of R.A.F. Manuals. Formerly he was Commandant of the Royal Air Force Staff College, where he was appointed in November, 1945. Before that he was Air Officer in Charge of Administration at the Headquarters of Bomber Command from January, 1943. He had been Senior Air Staff Officer, No. 333 Group, Middle East, and before taking up this appointment in August, 1942, he was for over two years Director of Ground Defence at the Air Ministry, when the R.A.F. Regiment was being formed.

Air Vice-Marshal Ellwood has been a Director-General of Personnel, Air Ministry, since August, 1945. He was formerly Senior Air Staff Officer at H.Q. Coastal Command, where he went in March, 1944. He previously commanded No. 18 Group, Coastal Command, and in 1941 was appointed Deputy Director of Bomber Operations at the Air Ministry.

Navy Day at H.M.S. Fulmar

ON September 6th R.N.A.S., Lossiemouth and Milltown (H.M.S. *Fulmar*), opened its gates to several thousands of the Scottish public. The display was officially opened by Rear Admiral L. D. The Mackintosh of Mackintosh, C.B., D.S.O., D.S.C., R.N., Flag Officer, Flying Training, who arrived from Donibristle by Expeditor. Before the admiral's arrival some of the public were able to fly over their own countryside in Allied Airways' machines, while others harassed one of the station instrument flying instructors, in a Harvard, by ordering him by R/T to perform sundry known and unknown aerobatics. Seafire XVIIs, piloted by two of the Operational Flying School instructors, aerobatted impressively, and Lt. Leahy, of 801 Squadron, demonstrated a Sea Hornet. There followed the "ranging-up," take-off and forming-up of a mock carrier striking force (five Seafires, six Fireflies) which attacked a "submarine" on the airfield. The sub put up a stiff defence of smoke puffs, but was soon engulfed by a series of photoflashes. The crew paddled across the airfield in a dinghy before their parent craft blew up with an alarming crash. Later a fire-fighting crew rescued a dummy pilot from a blazing Firebrand. Contrasting with this turn was comic relief in the form of a demonstration of how a Tiger Moth should not be flown. Lt. Logan, of 803 Squadron, put up a fine individual display in a Sea Fury, and was followed by Lt. Larkin in a Swordfish. W/C. O'Neill then flashed by in a Meteor III, and Cdr. H. P. Bramwell, R.N., who is

Service Aviation . . . . .

Commander Flying at Lossiemouth, ably demonstrated the Seafire 46. The flying programme was wound up by Mr. Herd (flying instructor of the O.F.S.) in a German-made Olympia glider. The static exhibition was of high standard.

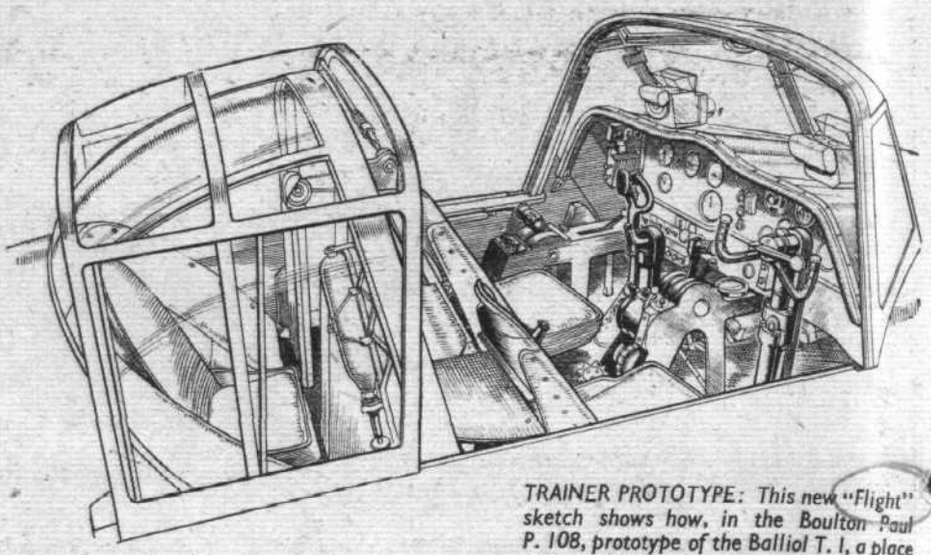
Sea Furies for "807"

NUMBER 807 Squadron of Naval Aviation, based at the Royal Naval Air Station, Culdrose, Cornwall, are to be equipped with Hawker Sea Fury Xs and are scheduled for further service in the Far East. The squadron operated three Seafires from Middle Wallop for the Battle of Britain Victory Fly-Past. Since returning from the Far East in November, 1945, after operating with H.M.S. *Heron* during the campaign in Burma and Malaya, the squadron, commanded by Lt. Cdr. S. J. Hall, D.S.C., R.N., has taken part in flights on the occasions of the King's Birthday, V-day and last year's Battle of Britain commemoration.

Air Public Relations Association

THE first annual reunion dinner for those who, during the war, were largely responsible for reporting the operations of the R.A.F., takes place at the Mayfair Hotel on October 18th. Early in the year present and former officers, airmen and civilian staff of the Directorate of Public Relations, Air Ministry, formed the Air Public Relations Association and between 150 and 200 are expected to attend the dinner. The idea of banding together past and present members of the Directorate was first thought of by the late Mr. C. P. Robertson, O.B.E., former Deputy Director, who died early this year.

In its Patron and joint Presidents, the Association has the political head, the Chief of Air Staff and the Civil Service head of the Ministry—Mr. Philip Noel-Baker, M.P., Marshal of the R.A.F. The Lord Tedder, G.C.B., and Sir James Barnes, K.B.E., Permanent Under-Secretary of State for Air. Vice-presidents are former Directors of Public Relations or R.A.F. and Air Ministry heads who have been closely connected with the Directorate. They are Sir Richard Peck, K.C.B., O.B.E., Sir Arthur Street, G.C.B., K.B.E., C.M.G., C.I.E., M.C., J.P., A/Cdre. Harald Peake, A/Cdre. Lord Willoughby de Broke, M.C., A.F.C., J.P., Mr. C. G. Caines, C.B., O.B.E., and Air Commandant F. H. Hanbury, M.B.E., Director of the W.A.A.F. The Chairman is Air Chief Marshal Sir Philip Joubert de la Ferte, K.C.B., C.M.G., D.S.O.; Hon Secretary, Mr. Thomas Cochrane, present Deputy Director; Hon. Treasurer, F/L. Reginald C. Moody; Assistant Hon. Secretary, Mrs. M. C. Morton; and the Committee are G/C. F. C. Gillman, O.B.E., W/C. S. Bishop, M.B.E., W/C. Norman Lloyd, Mr. H. D. Blow, Miss M. I. Lee, S/L. F. Crouch and Flt/O. D. Nelson.



TRAINER PROTOTYPE: This new "Flight" sketch shows how, in the Boulton Paul P. 108, prototype of the Balliol T. I, a place is provided for a passenger or navigator behind the side-by-side seats for the instructor and pupil.

W.A.A.F. Stewardesses

SELECTED W.A.A.F. are to be trained as air stewardesses and will hold the rank of corporal. They will draw aircrew pay and will undertake duties in aircraft of No. 24 V.I.P. Commonwealth Squadron of Transport Command. Having passed the aircrew medical examination they may travel all over the world. No. 24 Squadron, it may be remembered, is to be located at Bassingbourne and will be under the operational and administrative control of H.Q., No. 46 Group, Transport Command.

Royal Viking Crash

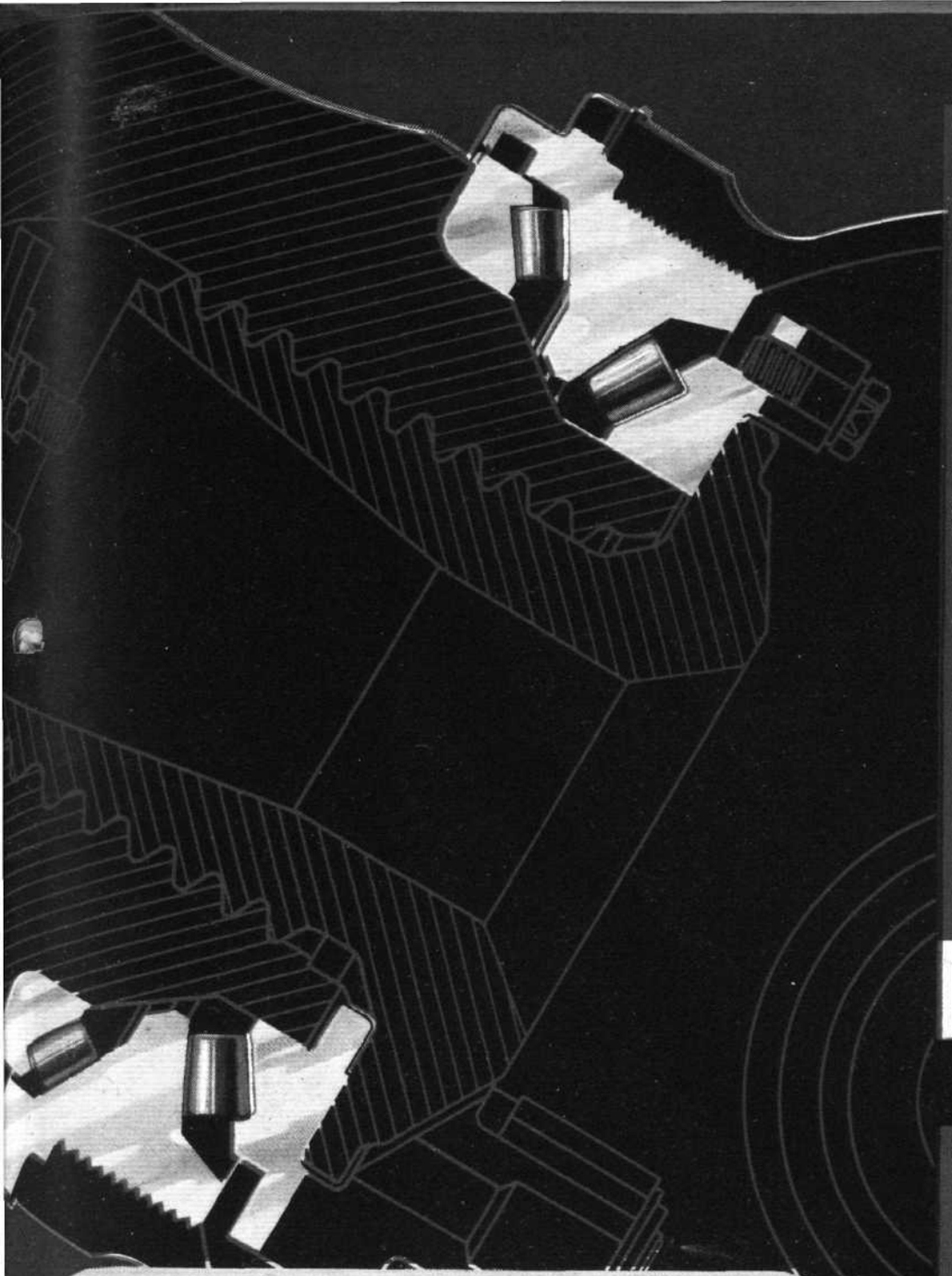
THE Air Ministry announces that one of the Viking aircraft of the King's Flight—that normally used by the staff and for training purposes—made a forced landing as a result of mechanical trouble shortly after taking off on September 12th from Dyce to fly the King's mail to London Airport. The pilot made a good landing but there were two stone walls in the path of the aircraft.

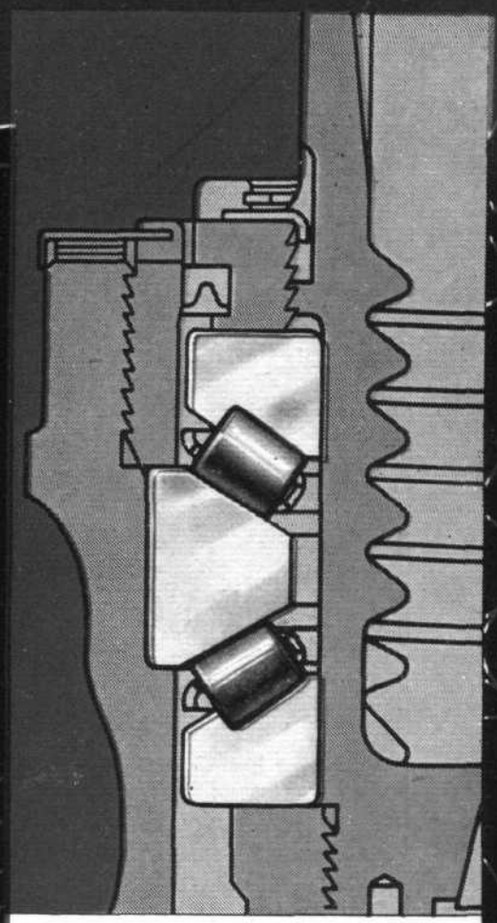
The three members of the crew, S/L. H. F. Payne, A.F.C. (Captain), F/L. A. Knapper, A.F.C. (Navigator), and F/L. F. Myers, A.F.M. (Wireless Operator), were injured and were detained in hospital.

Reunion

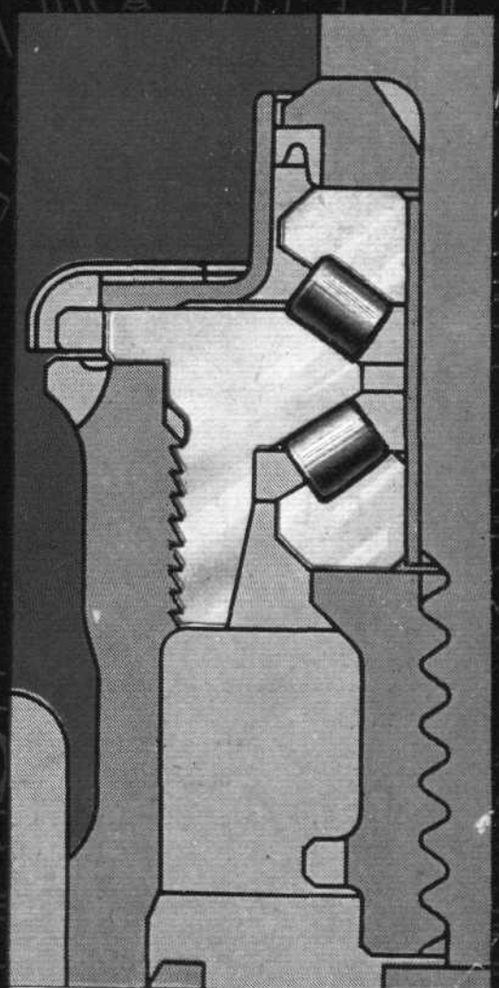
THE Old Comrades' Association of No. 208 Squadron has now been put on a firm basis and it is proposed to hold one reunion each year. The anniversary of the squadron's birthday is October 26th and reunions will be held as near as possible to that date. This year it is to be held in London on Saturday, October 25th. Members or ex-members are invited to apply for particulars from F/L. B. Champneys, D.F.C., Barnham Vicarage, Bognor Regis, Sussex.

NIGHT FIGHTERS: W/C. M.F.G. Pedley, D.S.O., D.F.C., A.F.C., Officer Commanding R.A.F. Station West Malling (left) with the crews of Mosquito Mk 36 night fighters which formed the leading element of the longest stream of aircraft to pass over London during the fly-past on August 15th. S/L. J. Singleton, D.S.O., D.F.C., A.F.C., who led the formation is in the centre.





The first type of Timken 'special' for Rotol Ltd.



Type used at intermediate stage.

Compacting

A basic necessity in variable pitch propellers is freedom of rotary movement.

This must be combined with absolute 'rigidity' in all other directions despite the heavy and complex loads on the bearings, and for these reasons Rotol Ltd. have used Timken tapered-roller bearings for many years.

In a recent design, shown above, a great advance in compactness has been achieved by the use of a still more 'special' Timken bearing, an excellent example of the far-reaching results of a bearing designed expressly for a given duty.

BRITISH TIMKEN LTD., BIRMINGHAM AND DUSTON, NORTHAMPTON.
Telephone: East 1321. Telegrams: 'Britimken, Birmingham.' Associated Company: Fischer Bearings Co. Ltd., Wolverhampton, makers of FBC ball and roller bearings and transmission equipment.

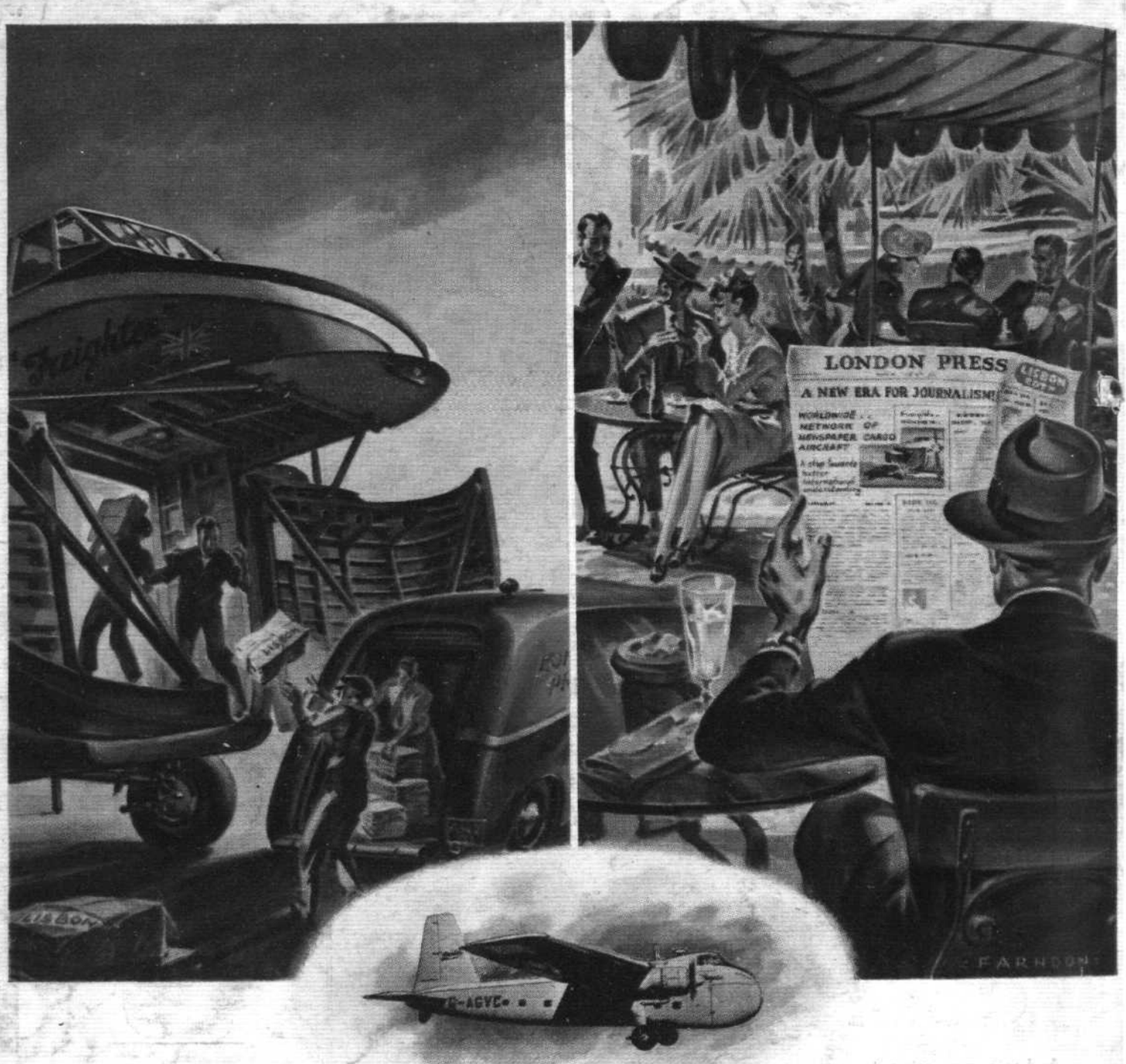
Registered Trade Mark: Timken.

TIMKEN

tapered roller bearings

FLIGHT

SEPTEMBER 25TH. 1947



International Journalism . . . by "Freighter"

On a rough analysis it is computed that one "Bristol" Freighter—capable of carrying nearly five tons of freight—could transport, in one trip, a print run sufficient to supply each of the six main capitals of Europe with more than 30,000 newspaper copies. This interesting fact points to the possibility of national journalism becoming international; with aviation thus serving to promote better understanding between the nations of the world. For the European news-round, the "Bristol" Freighter is the perfect aircraft. It has a commodious cargo hold of 2,360 cu. ft. capacity, easy and rapid loading is facilitated by the nose-opening doors, and its rugged design characteristics combined with the reliability ensured by the two "Bristol" Hercules engines make it particularly suitable for regular routine services of this kind.

THE *Bristol* AEROPLANE COMPANY LIMITED

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