

Annual Review of Helicopter Activities

The third review of the helicopter activities of firms from whom the Association receives support

AIR SERVICE TRAINING LTD, HAMBLE

The two Hiller 12B's acquired by A S T in June, 1955, and now modified to the latest standard, amassed over 1,200 hours flying between them in their first year of operation. Despite their hard life as training aircraft, with a major proportion of their flying time being spent at hovering power and the large number of autorotations in the hands of pupils adding to the normal wear and tear, they have shown a very high rate of serviceability. A total of 35 R A F and Army fixed-wing pilots had been converted onto the Hiller by the end of July this year, under a series of contracts awarded to A S T by the Air Ministry. Each Service course consists of 20 hours flying, together with the associated technical instruction, and lasts three weeks,



average time to solo has worked out at 4 $\frac{1}{4}$ hours. After leaving A S T pilots are given a further conversion onto the S 51 and/or Sycamore before joining their operational unit, and the effects of sound basic training are already making themselves felt in a number of overseas theatres. A few 18-hour Private Pilot conversions have also been undertaken, and considerable interest is now being shown from abroad, Belgium, Sweden and Kuwait will be among the first countries to be represented in A S T's helicopter unit which has just taken delivery of a third aircraft, this time a Hiller 12C.

BLACKBURN AND GENERAL AIRCRAFT LTD

The helicopter applications of the engines designed by Blackburn and General Aircraft Limited have included both the Cirrus Piston Engines and the Turbomeca Gas Turbines. The Cirrus "Bombardier" (180 horse power) was installed in the Saunders Roe "Skeeter" Prototype and is at present in production for the Auster A O P aircraft. The use of direct fuel injection not only eliminates icing problems and ensures rapid throttle response but the fuel consumption is most economical—9 $\frac{1}{4}$ gallons per hour at maximum weak-mixture power.

In the Gas Turbine range the two units developed for helicopter applications

are the "Palouste" and the "Coupled Turmo". The former is flying in the Fairey Ultra Light and the air is bled to the rotor tips from the combustion chamber of the "Palouste". Weighing only 200 lb, the "Palouste" is 18 inches in diameter and 33 inches long, giving an air output of $2\frac{3}{4}$ lb/sec at 56 lb/sq in absolute at 15°C.

The "Coupled Turmo" was developed for the Westland Helicopter and gave twin engine reliability. It consists of two "Turmo" units driving through a common gear box whilst retaining the ability to operate independently. "The Coupled Turmo" weighs 598 lb, develops 900 Horse Power and has the overall dimensions of $54 \times 42 \times 18$ inches. Unfortunately work on this Helicopter was suspended early this year due to Ministry of Supply reduction of programmes.

The other Blackburn product associated with Helicopters is the giant "Beverley" Transport which has flown "Sycamores" and "Whirlwinds" to Cyprus. For this airlift the "Sycamores" were carried in pairs and the "Whirlwinds" singly, but of course the payload was well below the "Beverley's" maximum of 22 tons. The unobstructed freight compartment, which is $40 \times 10 \times 10$ feet, is ideal for such operations.

BRITISH MESSIER LTD

In addition to their helicopter landing gear activities, British Messier are actively developing control mechanisms for rotating wing aircraft. This development work includes electro-hydraulic units for the Bristol twin-rotor helicopters.

Each helicopter is fitted with four such units that cater for all control axes—either by manual, power or auto-pilot operation. Three units are identical, the fourth however has a different emergency valve breakout load.

The control unit basically consists of a hydraulic jack and control valve, with a special linkage enabling signals to be fed in either from the pilot or from the auto-pilot. The auto-pilot signal is relayed through a torque motor. Change-over from pilot to auto-pilot operation is achieved by a switch in the cockpit.

Manual Control

With the hydraulic supply off, the linkage makes a rigid connection between the pilot, jack and output, with the fluid in the jack being automatically by-passed.

Power Control

With the hydraulic power on and the by-pass valve closed, the pilot's input movements operate the control valve to move the jack and output. The completion of jack movement automatically cancels the signal.

Auto-pilot Operation

With hydraulic power on, the electrical signals from the auto-pilot reference gyro are fed through an amplifier and the torque motor to operate the control valve and give jack movement.

The linkage is such that in the event of an incorrect signal, the pilot can take immediate control. In the event of total electrical failure, the mechanism automatically reverts to pilot's power control.

BRISTOL AIRCRAFT LTD

To provide additional floor space for Britannia production at Filton and permit expansion of the helicopter programme, all Bristol helicopter activities are now being concentrated at Weston.

Transfer of work was begun last autumn and extensive rebuilding and modification of the existing factory layout has been put in hand. The Production and Planning Department has already taken over full responsibility for Sycamore assembly and manufacture of most of the aircraft's components.

Other departments scheduled to move in the latter half of the year include Mechanical Assembly and Flight Test. All future development and production flight testing will be located at Weston, and provision has been made for the expansion of research and development programmes. The Helicopter Design Office will also be centred at Weston when new office accommodation is completed.

Production of the Sycamore Mark 14 has been steadily expanded to meet sub-



stantial orders from the Services and the hundredth machine was delivered to the Joint Experimental Helicopter unit, Middle Wallop, in June. It was the fifth Weston-built helicopter to be delivered.

The extreme versatility of the aircraft has been demonstrated on a number of occasions in the last year. During February's disastrous floods in New South Wales, five Australian Naval Sycamores flew ninety sorties in four days, rescued seventy people and carried some 8,000 lb of medical supplies and stores to the stricken areas.

In April a Sycamore was successfully operated as an "aerial crane" in the erection of a new Trinity House navigation beacon on a windswept outcrop of rocks 400 yards offshore from Penmon Point, Anglesea. A topmast and topmark, with a combined weight of more than half a ton, were flown and positioned on a 25 ft granite plinth. Had this operation been carried out by conventional methods it would have involved weeks of difficult and hazardous work.

More recently, the first "live" search and rescue operation using "SARAH"—Search and Rescue and Homing—equipment was successfully carried out with a Sycamore.

In Western Tasmania a Sycamore of Australian National Airways, flying on charter to a copper mining company, has sought out and surveyed neglected copper mines staked out half a century ago by prospectors working on foot through the mountains.

Detailed research into the civil and military applications of the twin engine tandem rotor configuration has continued with two Type 173 machines. Three more prototypes are being prepared for flight testing and the first of these will be fitted with Alvis Leonides Major engines of 850 b h p.

In July a Type 173 was handed over to British European Airways for a short programme of extensive flight handling trials, the forerunner of faster and larger commercial types now under development, it was the first multi-engined helicopter to be delivered to an air line.

Details of a military development of the Type 173, the Bristol Type 192, which is on order for the Royal Air Force, were announced in May. It will be used for troop and freight transport, ambulance duties, and search and rescue operations. The first 192s will be powered with Alvis Leonides Major piston engines, later Napier Gazelle gas turbines will be fitted.

THE DECCA NAVIGATOR COMPANY LTD

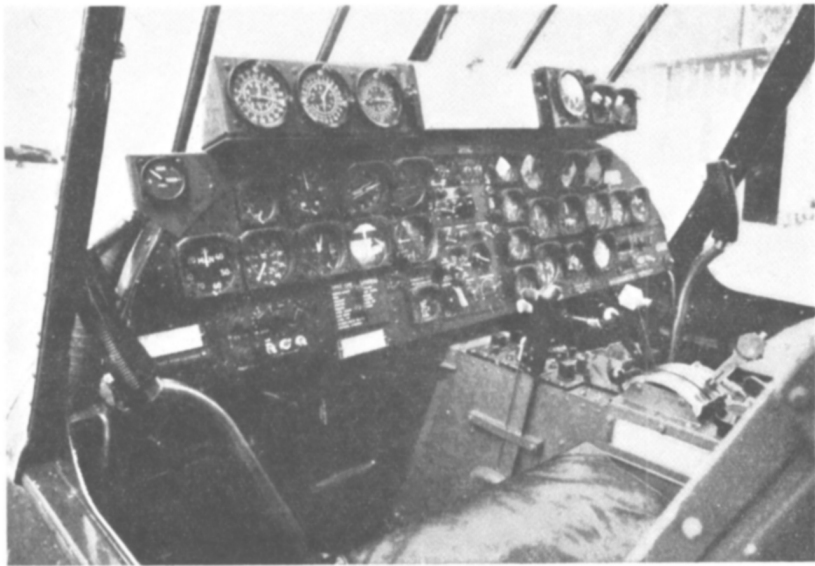
The Development of Decca for Helicopter Operations

For a number of years to come helicopter operations will mainly take place at operating altitudes between 500 and 2,000 feet. Due to the inaccuracies of existing pressure altimeters vertical separation less than 1,000 feet cannot be applied and therefore maximum use will have to be made of lateral and longitudinal separation possibilities if the development of helicopter operations in high density areas is not to be impeded.

It is, therefore, essential that the navigational aid system on which Air Traffic Control base safe separation is one which enables the helicopter pilot to adhere strictly to his predetermined track and also provides him with an accurate measurement of progress along that track. Quite apart from the Air Traffic Control aspect, since the helicopter flies low, frequently in poor horizontal visibility and low cloud base conditions, accurate track keeping is essential from the standpoint of avoiding obstructions or high ground in the vicinity of the route being flown. Accurate and solid coverage over a wide area at low altitude are therefore important requirements of any helicopter aid system, particularly in a high traffic density area such as Western Europe.

So far as the United Kingdom is concerned the Decca Navigator System provides solid area coverage over the entire country with the exception of the western side of Ireland. Similar coverage is available over most of Western Europe, the accuracy available being adequate for the *en route* phase of helicopter flight between cities. In the London area, for example, the system is capable of giving a fixing accuracy of better than ± 100 yards.

At locations where the accuracy available from the existing chains of stations is not sufficiently high to meet the A T C requirement or the final approach function it is possible to provide a two-slave low power chain giving high accuracy local cover. With such a chain the accuracy is better than ± 50 feet over an area of approximately 20 square miles. No permanent operating staff is required. To achieve the necessary reliability, automatic changeover facilities are incorporated and the transmissions are



Decca Installation in a W S 55

coded so that the operating staff at the nearest main chain station are informed immediately when a changeover has occurred

It is possible to provide the Decca Navigator airborne equipment in many forms, the size and weight depending entirely on the facilities required. In the simplest case where an aircraft is required to fly at all times within the coverage of one chain, a single chain receiver without lane identification with a flight log display can be provided at a total installed weight of approximately 40 lb. At the other end of the scale, an airborne receiver with lane identification and all chains available with a larger flight log giving more scale change and pattern selection facilities is available at a total installed weight of approximately 100 lb. Whatever the future requirement may be it can be met within this weight range.

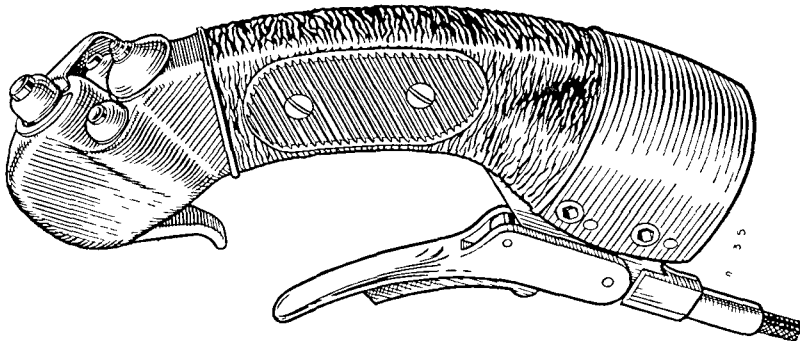
A number of developments of the existing equipment are proceeding. In an advanced stage of development there is a technique whereby a route can be plotted to a large scale on a continuous roll, any pattern changes required throughout the length being automatic.

Development work is also proceeding in connection with the use of Decca for final approach purposes. The Decca Navigator System has many advantages over other aids for this application, particularly in built up areas. Even in areas which do not suffer from serious permanent echo problems, helicopter approach trials recently carried out have shown that a higher approach success rate was achieved using air interpreted Decca than by a ground radar talkdown. The technique employed when using Decca as an approach aid is to select a suitable lattice line passing through the desired landing area and position the aircraft for an approach along this line. A left/right homing procedure is then followed using the appropriate decometer as a deviation indicator. By the use of a precomputed approach chart showing the height the aircraft should be at intersecting lattice lines, a step down approach is carried out.

Flight Log charts are also available which provide complex flexibility for let down purposes regardless of pattern configuration.

DUNLOP RUBBER COMPANY LTD

The equipment of the Aviation Division of the Dunlop Rubber Company is well known on fixed wing aircraft, and a growing variety of this equipment is to be found incorporated in modern helicopter design. Tyres, tubes, wheels and brakes are probably the most common items fitted, together with supplementary units such as control valves, rotary joints, etc.



Helicopter Control Handle

Of particular interest is a range of straight control handles, specifically developed for helicopter use, incorporating a number of miniature switches which can be used for trim control, cyclic pitch control, winch operation, or any similar purpose.

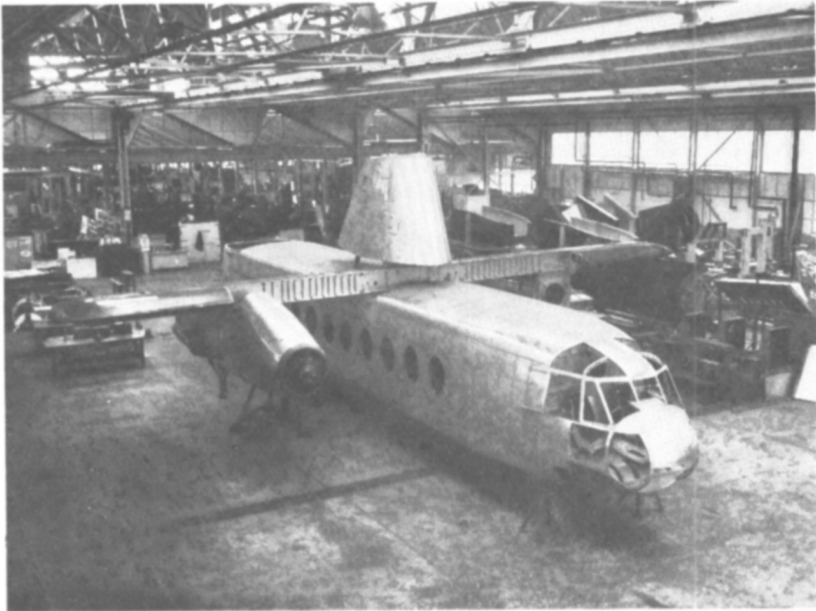
The Westland Whirlwind Helicopters used on the Arctic exercises with H M S *Theron* were fitted with Maxivue windscreen wipers which were the subject of enthusiastic reports.

THE FAIREY AVIATION COMPANY LTD

The pressure jet helicopters designed by the Company have made notable progress in the period under review

The Rotodyne is a major engineering venture, probably the most advanced large helicopter in the world. The first prototype, as shown by the photograph, is nearing completion and is scheduled to begin ground running at the end of the year. This large transport helicopter is designed to carry forty passengers over stage distances in excess of 200 n miles. It exploits the tip pressure jet drive for take-off, then for cruising flight it makes a transition to the autogyro state, the propellers delivering thrust. By this means high power is made available for take-off coupled with economical fuel consumption for cruise. A notable performance feature is that the aircraft can maintain height following failure of one engine. It has great development potential and considerable increases in payload and range are planned in line with the development of the Eland engines.

The tip jets are developed on static rigs, they are already delivering their predicted thrust. In parallel with this "conventional" development, a programme



of research is directed towards noise reduction. Present results are very encouraging, they indicate that the problem has been solved in principle. Considerable noise reductions have been achieved for small thrust loss so that the Rotodyne will be at least as quiet as existing helicopters.

An extensive wind tunnel programme has been carried out on models with and without rotors. Critical flight conditions have been simulated and the design laid out for optimum flying qualities. The structural integrity is being confirmed by a comprehensive programme of fatigue tests on rotor and airframe components. Another major test facility comprising the complete power plant, rotor and controls is approaching completion. On this rig pilots and engineers will simulate almost every aspect of flight operation. The test pilot on his first flight will in effect be handling thoroughly familiar controls.

Ministry of Supply support for the Ultra Light Helicopter has been withdrawn but the confidence that the Fairey Company place in this aircraft is such that it is being continued as a private venture. In recent flight tests a very high performance has been achieved with a rate of climb that can fairly be described as spectacular.

An assessment is being made of the potential market for a commercial version of this aircraft

Meanwhile the jet Gyrodyne continues to fly satisfactorily It is now used for training M O S pilots on handling of pressure jet helicopters in readiness for the main flight test programme on the Rotodyne

FISON-AIRWORK LTD

The Company was formed a year ago as a joint venture by Fisons Pest Control Ltd and Airwork Ltd Formerly, it operated under the name of Fisons Pest Control Ltd which was in fact the old aviation department of Pest Control Ltd, under which name it began helicopter operations in 1947

Helicopter activities during the past year have in the main been concentrated on overseas operations Two new operations were commenced in Pakistan, firstly, on behalf of the Sui Gas Transmission Co on survey and communication work for a new gas pipe line, and secondly for the Pakistan Development Corporation for the detection of pipe line failures, maintenance and repair These operations are conducted over terrain virtually impossible for surface transport, due to the fact that such terrain is chiefly swamp or desert Temperatures in excess of those recorded



in the Persian Gulf, where the Company previously operated, have frequently been experienced The Hiller helicopter is being used in this area

Operations have continued in Nigeria on oil exploration work Westland S 55 helicopters have been introduced this year with the retention of one Hiller In this area the Company has exceeded 4,000 hours mainly with Hillers, over jungle and mangrove swamps Despite the six months rainy season, during which difficult and changeable weather conditions are encountered, with frequent tropical storms, it has been found possible to keep a percentage of regular flying throughout the year Flying is done under visual flight conditions

Hiller helicopters were again used this summer on crop spraying work in this country Fertiliser application was also assessed

Experimental spraying will be undertaken in the West Indies this winter and possibly in West Africa early this coming year

SAUNDERS-ROE LTD

There has been continued development by the Saunders-Roe Helicopter Division of the Skeeter Mark 6 two-seat light helicopter. During the year Skeeters were evaluated in flight and on the ground by the Army Helicopter Unit at R A F Station, Middle Wallop, where an appreciation was made of the suitability of the Skeeter for army duties.



Saunders-Roe Skeeter fitted with Napier rocket booster system gives outstanding vertical flight performance for operations at altitude and in the tropics

A substantial order for Skeeter Mark 6 helicopters has been placed by the Ministry of Supply for the air observation post squadrons provided by the R A F for operation with the Army.

A quantity of Skeeters has also been ordered by the West German Government.

The Helicopter Division has also made further development of Redux-bonded metal rotor blades. Blades of this type have undergone comprehensive fatigue tests and are being tested on a Skeeter.

In conjunction with D Napier and Son, a rocket booster has been applied by Saunders-Roe to the Skeeter helicopter.

The whole installation is very simple, and this is clearly indicated by the fact that there are no moving parts.

The fuel, which is High Test Peroxide, is stored in a tank mounted above the rotor hub and is pumped to the Napier rocket motors by the centrifugal action of the rotor blades. On entering the rocket motors, the liquid H T P is decomposed into super-heated steam and oxygen by means of a catalyst. The generated gases then pass to a nozzle at the tip of each rotor blade which causes the gases to be ejected at high velocity to provide thrust reaction.

As the booster power is supplied by thrust at the rotor tips, no additional torque is imposed on the existing transmission system.

The rotor speed is not increased, and the power is absorbed in greater lift on the rotor blades.

TEDDINGTON AIRCRAFT CONTROLS LTD

The contribution of Teddington Aircraft Controls to the Helicopter Industry to date is confined to the development of units which, although not originally designed specifically for rotating wing aircraft, find application in helicopter designs

The more important of these developments concern large timed contactors for the distribution of electrical supply to de-icing mats on rotor blades. These contactors take two forms (1) self-contained switches having their own driving unit in the form of an electric motor, and (2) contactors which take their drive from the differential movement between the rotor head and the non-rotating structure of the helicopter. As may be imagined this latter arrangement is considered to be the ultimate design scheme on account of its weight saving and simplicity, but development towards this is largely based on motor driven units.

Although individual installations differ, these contactors are all three phase A C units rated at 20/40 amps at 208 volts approximately. The problems involved are many, but worthy of mention is the difficulty of designing a contactor capable of withstanding the vibration frequencies met with at the rotor head and the need for special protection of a mechanism which is called upon to operate in such exposed positions. Slip rings are, of course, used at the head, and rigid conductors carry the current up the motor shaft.

The Company's hot air valves are used in some current helicopter designs in connection with gas producers supplying reaction drive for rotors. It has been found that, generally speaking, standard designs are adaptable to helicopter installations with little change.

Finally it is of interest to note that the Company's stainless steel bellows are used generally in helicopters providing, as they do, a light and convenient method of catering for vibration and expansion in ducting.

BRITISH EUROPEAN AIRWAYS

Helicopter activities at B E A during the past year, as in previous years, have covered scheduled operations, development flying, training and charter.

A scheduled service was operated between London Airport and the South Bank helicopter site in Central London from July 25th, 1955, to May 31st, 1956. The route into London followed the Thames so that in the event of an engine failure an emergency landing could be made on the river. Westland S 55's equipped with engine exhaust silencer and emergency flotation gear were used. Experience was gained in single engine operations into a city centre and in the integration of helicopter with fixed wing traffic at a major airport. Nearly 4,000 passengers were carried and over 500 hours flown. On July 2nd a new service was inaugurated between Elmdon, Leicester and Nottingham, designed as a feeder to fixed wing services from Elmdon to the Continent. Westland S 55's with seven seats are being used.

Major development effort has been directed to the problems of instrument flying for cruise and approach. In addition to pure instrument flying, extensive quantitative trials have been conducted with two types of ground controlled approach radars. A programme of approach trials using the Decca Navigation System is under way. Instrument approaches have been made at a number of airfields in different parts of the country using the Decca Navigator with alternative forms of presentation of information to the pilot. Night flying has been continued and an approach light system and a ground lighting system developed. Further work has been done to determine the size limitations for sites used by single engine helicopters. Before the South Bank service was started, extensive site trials were carried out with the W S 55 at the South Bank to determine safe take-off and landing paths under various wind and temperature conditions.

The second prototype Bristol 173 was loaned to B E A at the end of July for a brief spell of handling trials. This is the first multi-engined helicopter available to B E A or, it is believed, to any operator in the world.

A third W S 55 was purchased to carry out a charter from the Home Office for Civil Defence exercises. 365 hours were flown during the first year on a programme which was designed to show the potential of the helicopter for Civil Defence work in different parts of the country.

For the year ending June 30th 1956, total flying amounted to 1,548 hours with a fleet of three W S 55's, two Bristol 171 Mark 3 A's and one Bell 47 B 3.

WESTLAND AIRCRAFT LIMITED

Westland Aircraft Limited continue to devote expanding resources to the development, design and production of helicopters, in which field the Company has emerged as the largest single constructor in Europe. Westland helicopters are now in service with the Royal Navy and the Royal Air Force, and deliveries of the Whirlwind to the Army Experimental Establishment have been made.

The Whirlwind, has, in fact, come to the fore as the largest and most widely-used helicopter of British manufacture. During the last twelve months it has featured prominently in widely diverse activities in many countries. It has often been a vital agent in successful rescue operations off our shores, which have sometimes been carried out in severe weather. It has shared in the success of the whaling season, hauled men and material to off-shore oil drilling rigs, and is active with the French Forces campaigning in Algeria. Whirlwinds have been delivered by air to the Royal Dutch Shell Group, and the flight from the United Kingdom to Doha, a distance of 3,300 miles included 250 miles sea crossing, set up a British long distance record for helicopters.

Using rubber pontoons instead of the normal undercarriage, a change-over which took only 6 hours to complete, the Whirlwind has undergone water trials at Calshot to determine its handling characteristics while fitted with floats, and its stability on the water. These successful experiments included 48 engine-off landings.

As a result of demonstrations at Yeovil before Air Registration Board representatives, Whirlwind aircraft have now had their Certificates of Airworthiness extended to cover night operations. Apart from the conventional landing-lamp technique, an emergency measure using special flares was also demonstrated for use in the unlikely event of engine failure.

On the development side, the Whirlwind Mark V with the Alvis Leonides Major engine, has been undergoing intensive flight trials. The Leonides Major, which confers greater load-carrying capacity and increased ceiling upon the Whirlwind, will shortly be available as the standard power plant.

The private-venture Widgeon has completed its development programme. Hitherto seen only in passenger carrying role, it now appears as a winch rescue and ambulance aircraft. Westland envisage a great future for the Widgeon, and accordingly a production line has been laid down in anticipation of that demand.

Licence Agreements have been signed in respect of larger helicopters of which the Wessex and the Westminster will be the British versions powered with gas turbines. Production decisions for the former, which is destined for service with the Royal Navy, have been completed. Designed primarily for anti-submarine operations, the Wessex will also be suitable for search and rescue, communication and supply, casualty evacuation and training. The tempo of demand at Westland has necessarily involved expansion, and large new drawing offices and a machine shop have been opened. The accent is very strongly upon increased production at Yeovil.

SPERRY GYROSCOPE COMPANY LTD

The Sperry Helicopter Flight Control System, developed as the result of four years' intensive research into the unique flying characteristics of rotating wing aircraft, has successfully completed its flight evaluation trials and is now in course of production. Provision has been made in the design for adaptability to most types of helicopter and the first version of the equipment is being produced for the Sikorsky S 58. Other versions are expected to follow according to requirements.

The system provides five channels of automatic control, operating through the normal pilot's control levers. The five channels comprise fore-and-aft cyclic-pitch, lateral cyclic-pitch, collective-pitch, yawing and rotor-speed control. Either partial or fully automatic stabilisation can be provided. One version of the equipment which provides partial stabilisation and allows "hands-off" flying for extended periods, weighs only 23 lb. The complete equipment weighs approximately 60 lb and allows fully automatic hovering to be accomplished including remote control from the ground.

Among other new instruments, designed specifically for helicopter use, the Sperry Helicopter Flight Director has reached an advanced stage of development and is expected to go into production shortly.