1967 was a year of progress and the most significant event was possibly the opening of the first permanent Decca Chain in the Far East—the Hokkaido Chain. This is the forerunner of chains to cover the whole of Japan. In Europe the Finmark (our most northerly chain) was opened, followed soon after by the Skagerrak Chain. It is appropriate to report, as we go to press, that two more Norwegian Chains have just come on the air—the Vesterålen and Bergen Chains—whilst further South the Frisian Island Chain has been opened.

Many more ships have, of course, been fitted with the Decca Navigator, particularly fishing vessels (of many nationalities) taking advantage of the North Norwegian coverage. Arkas Autopilot orders during the year included large tankers such as the 300,000-ton vessels of National Bulk Carriers, Inc. A new Arkas 'Interphase' unit was demonstrated enabling a ship to be steered automatically along a Decca position line. 1967 (June) saw the start from Gibraltar of m.v. Navigator's long cruise to the United States and Canada; by the time the vessel returns in May of this year, she will have covered some 13,000 miles.

Among the noteworthy contracts for airborne equipment were those from Seaboard World Airlines Inc., The Flying Tiger Line Inc. and from BEA for their new BAC 1-11/600 series fleet. The Eastern Airlines evaluation of the Decca-Omnitrac Flight Log was initiated and continues most successfully. Lastly, our Doppler 72 was chosen for the French Air Force for their Anglo-French Jaguar aircraft.

Our Survey activities expanded considerably in 1967. In Australia a new company has been set up jointly with Amalgamated Wireless (Australasia) Ltd. In the United States, through Decca Survey Systems, Inc., many important and interesting projects have been undertaken—including the anti-pest (Fire Ant) operation.

1967 has seen important developments, but 1968 is expected to be equally significant. Among other things, it will see the completion of the first (and perhaps the second) of the five South African Decca Chains.
DECCA in the Great Lakes

Last November a demonstration Decca Chain was set up on the south shore of Lake Erie to coincide with the visit of the Decca sales and research yacht Navigator to Cleveland, Ohio.

In bringing a Decca Chain and demonstration vessel to Cleveland, the opportunity was given to interested parties to see at first hand the Decca Navigator System in relation to the specific navigational problems of the Great Lakes region. Eighteen separate demonstration trips were made over a period of one week from the 9th Street Pier at Cleveland. A final total in excess of 150 people saw the system demonstrated.

Each demonstration lasted for about one and a half hours and included a practical demonstration of the Decca Navigator System, its application to traffic routing, traffic reporting and its value to operating economies ensured by more precise navigation and more accurate E.T.A. forecasts. A film was also shown outlining the severe environmental tests of Decca marine products. In addition to this programme, Decca radar equipment and Decca Arkas Autopilots were also demonstrated.

The establishment of this Chain with the Red Slave station at Lorain, Ohio, the Master station at Twinsburg, Ohio, and the Green Slave at Geneva, Ohio, was due to the combined efforts of Decca Navigator, London; Decca Systems, Washington D.C.; Decca Survey Systems, Houston, Texas; Decca Radar, New York; Lorain Electronics Corporation, and Computing Devices of Canada. The transmissions from the stations were authorised by the United States Federal Communications Commission for the standard Decca Chain frequency 4 which permitted demonstrations using regular production marine receiving equipment.

Among the many distinguished visitors to board m.y. Navigator were Rear Admiral Charles Tighe, Commander 9th Coast Guard District; Mr Russell Harder, North Central Division, Corps of Engineers, Chicago; Mr Oliver T. Burnham, Vice-President Lake Carriers’ Association; Mr Riley O’Brien, Fleet Manager Inland Steel Company; Mr John Manning, Marine Superintendent, The Hanna Mining Company; Mr John Wedow, President Cleveland Tankers Inc.; Mr David Buchanan, U.S. Steel Corporation, Great Lakes Fleet and Mr C. S. Smith, Marine Manager, The Shenango Furnace Company.

The Great Lakes area was the first in the world to which marine traffic routing was introduced, and a system of traffic reporting is about to be initiated. To obtain the full benefit of such systems and permit their continuing development to provide the highest standards of safety and efficiency, the best available navigation aids are essential. We believe from discussions with our visitors that it is now generally appreciated that the introduction of the Decca Navigator System into the Great Lakes would be of great benefit to all vessel operators. Deep sea vessels could immediately come under effective control if the Decca System were set up, as about 60% of these vessels already carry the Decca Navigator.
1. Air Marshal Sir Thomas Prickett, AOC Air Support Command with Air Commodore C. A. Bell of E.E.A. and the Editor.

2. The Navigator's position in the C190K Decca Navigator, Loran C/A and Doppler Readouts can be seen.

3. Two views of the exhibition of electronic equipment.

4. The Hercules in service—during Operation "Jacobin Two".
In Decca Navigator News No. 49 we announced that all Hercules aircraft to be supplied to the Royal Air Force would be to be fitted with a wide variety of Decca equipment. To be precise, a total of 66 aircraft were to be equipped with Decca Navigator, Decca Doppler, Decca Loran C/A, together with their related computers, ancillary equipment and displays.

No. 36 Squadron, under the command of Wing-Commander J. Paling, stationed at Lynham, Wiltshire, was the first squadron to receive the new aircraft. The Squadron has operated in a variety of roles since its formation in 1916. It was the first Royal Flying Corps unit specifically allocated to home defence, and defended the Forth, Tyne and Tees areas during the first world war. In 1919 the Squadron was disbanded, to be reformed in July 1928, for naval co-operation and reconnaissance duties. By October 1942, the Squadron had moved to India, flying Wellingtons for anti-shipping operations. The squadron continued maritime operations in the Mediterranean until October 1944, when it moved to Chivenor under Coastal Command, and spent the last few weeks of hostilities operating from Benbecula in the Hebrides. After the war the Squadron had two more periods in Coastal Command and was reformed into Transport Command in September 1958; it has subsequently been absorbed into the newly formed RAF Air Support Command.

The Squadron has recently carried out yeoman service with its new Hercules aircraft in Operation ‘Jacobin Two’ evacuating troops from Aden.

The Lockheed Hercules C130K is replacing two long-service aircraft, the Hastings and Beverley, which have flown in all parts of the world for many years. It can work from small unprepared strips and also possesses the endurance to mount long-range strategic lifts.

The aircraft is basically similar to the C130E used by the United States Air Force, but it is fitted with British avionic equipment and a roller-conveyor system for heavy cargo air dropping. It has more powerful engines. The aircraft will be used for paratroop dropping, air dropping of supplies, troop-carrying and, if required, in the aero-medical role. The Air Support Command Hercules Squadrons will also operate a regular freight service to the Far East, reaching Singapore in 27 hours flying time. Air Support Command Hercules aircraft will in due course have the capacity to deliver supplies with great accuracy from heights of only 20-30 ft. The aircraft is of course pressurized and can operate at heights above 30,000 ft. In June a team of RAF parachute instructors made a free fall jump from a Hercules flying at 41,800 ft. The normal operating crew is five—two pilots, a navigator, a flight engineer and an air quartermaster.

On 26th September the Royal Air Force held a press day to introduce their new aircraft, in which the aircraft was introduced by the Air Officer Commanding in Chief, Air Support Command, Air Marshal Sir Thomas Prickett, KCB, DSO, DFC. Despite bad weather the aircraft were demonstrated to the press who attended in large numbers. The display was also accompanied by a static exhibition of the British avionic fit to the Hercules, sponsored by The Electronic Engineering Association and designed and constructed by the Publicity Department of this Company.
THE ARKAS autopilot has now been in use in the fishing industry for over five years and has met with tremendous success. In a previous issue of this journal we have seen how the British fishing industry has put ARKAS through its paces (see Navigator News No. 49, Spring 1967).

The equipment recently received approval by U.S. government authorities and some of the vessels fitted with ARKAS in America are of advanced design. Two of these merit special mention, the Blue Pacific and the Mary Ann.

The Blue Pacific is a tuna seiner, 177 ft in length and of all steel construction. She is the largest vessel of her type built in the United States and can boast of a 2575 b.h.p. engine which gives her a speed in excess of 14 knots and a total fish capacity of 925 tons in 16 brine wells. Her seine net is 550 fathoms long and weighs over 30 tons. Apart from a three drum seine winch, she has a series of matched tuna fishing winches. These are a cork line winch, a brailing winch, a sacking winch, a topping winch and two vang winches.

The Mary Ann is the largest fishing vessel built in the Gulf of Mexico and has a host of unique features. She cannot be said to fit into any vessel class since to quote her skipper owner she is laid out 'to do all kinds of trawling, seineing or hand lining'.

Named after the owner’s daughter, Mary Ann, she has a 24,000 mile, 100-day range and even the radio channels have been set up from Miami to Australia so that she can sail far and wide in quest of catches. Her design includes such novel ideas as stopping the catch from hitting the deck thus keeping the vessel immaculate. This is achieved by emptying the twin trawls into open grid metal platforms which are hung overside. Here high-pressure hoses remove debris and the trash is sorted before the catch is put aboard.

Both these vessels are equipped with the ARKAS autopilot and their skippers speak very highly of its economic value.

The financial returns from the use of the Decca ARKAS autopilot in a merchant ship are well known. When fitting the equipment in a fishing vessel, however, owners do not always appreciate where the savings come from.

The economies arise from:
(1) Increased efficiency in fishing operations by simplifying the steering task of the skipper.
(2) Reduced steaming time to and from the grounds due to more accurate course keeping with a consequent reduction in fuel consumption.
(3) Release of the helmsman for other duties.
Since the greater proportion of every voyage is spent fishing, Decca have designed an autopilot which copes with the basic task of automatically controlling the steering of a trawler during this task. Due to this advantage, the savings are greater since this is the most critical period in terms of profitability in a trawler's life.

Every available man is needed to stow the catch from the previous trawl and/or to prepare for the next. Also, if the vessel is to be left to the skipper to steer manually and if he is also to perform his prime function of fish finding and catching, then the steering operation can only be carried out to the detriment of the others.

The major steering problem is countering the drag of the trawl. Since this drag is a force acting to turn the ship in a circle around the trawl, it is overcome in the autopilot by the use of a 'permanent helm' control which carries out electronically what a good helmsman does manually. The autopilot sets the electronic midships position of the rudder to one side or other, so that the vessel automatically carries helm in the same way as the helmsman 'carries a couple of spokes'.

This control can either be used manually or left in 'Automatic', when it will assess and apply, on its own, the amount of helm required to counteract the trawl's drag. In addition, as the drag changes due to variations in the load of the trawl, the autopilot applies corrections as necessary.

A serious problem associated with conventional autopilots is their inability to make large course alterations whilst in autopilot control. This problem has been overcome in ARKAS by the design of a course setting unit which does not suffer from these limitations.

Furthermore, most autopilots work on proportional rudder, i.e. the bigger the alteration, the greater the rudder applied. These large alterations are carried out far too rapidly for safe and efficient fishing operations. However, in the ARKAS autopilot a rudder limit switch is provided which allows any rudder angle to be selected irrespective of the amount of course alteration ordered.

Since smaller ships without gyro compasses are now fitting autopilots as basic equipment, the ARKAS is designed to also operate from its own transmitting magnetic compass. This compass is supplied as part of the outfit and transmits heading information to the autopilot in a similar fashion to the gyro repeater. With the increasing volume of electrical and electronic equipment in a trawler's wheelhouse, it is often difficult to choose 'a safe compass distance' for the magnetic compass. The ARKAS transmitting magnetic compass can be remotely sited in the best possible magnetic area and be repeated to the wheelhouse and therefore this difficult problem is overcome.

Furthermore, with ARKAS there is no ambiguity, to alter course to starboard the autopilot course setting control is turned to starboard and vice-versa, thus overcoming the previous disadvantages of magnetic autopilots.
In brilliant sunshine, the Shinto priest blessed the chain of stations in Northern Japan before a table strewn with fish, fresh vegetables and sake as tokens to the gods. The occasion was the ceremonial opening of the first Japanese main chain which took place at Biel, the master station of the Hokkaido chain.

This new chain of stations, built under licence from Decca, London was constructed by Kobe Industries with Hitachi Shipyards as a sub-licencsee. The 670 ft. mast formed a most impressive centre for the chain and the well planned buildings provided a modern setting for the sleek transmitting equipment.

Japanese dignitaries, including the Vice-Governor of Hokkaido and the Director General of the Maritime Safety Agency, presented themselves before the offerings whilst the priest waved olive branches to seek the gods' blessing. The ceremonies completed, the party returned to nearby Asahikawa where the Maritime Safety Agency had arranged a reception. Speeches were made and a special certificate of appreciation of cooperation was presented to Decca on behalf of the Japanese Government. Sir Edward Lewis, in a speech read by Admiral Sir Edmund Irving, expressed his appreciation of the work which had gone into the project and spoke of the plans to provide Decca coverage throughout Japan, referring to the Hokkaido chain as the "cornerstone of the Far Eastern network".

DECCA in the far east
This was followed by a cocktail party featuring local specialities such as Hokkaido salmon and hairy crab.

Following the ceremonies, guests were taken to a nearby hot spring where, clad in yukata (a masculine version of a kimono) everyone was entertained by the Hokkaido sponsors of the scheme at a banquet with a cabaret featuring local maidens performing, most appropriately, Hokkaido’s traditional “Song of the Fishermen” ballet.

The following day, the party visited Josankei, a spa near Sapporo, the capital of Hokkaido. Here a party was held by Sena, the marine receiver distributors for Japan, and formed a fitting farewell to the visit to the northern island.

On returning to Tokyo the next day, a reception was given by Kobe Industries and Decca for those who had been unable to attend the earlier celebrations. At this reception, silver medals were presented by Decca to the Director-General of MSA, the President of KIC, the President of Sena and the Chairman of Cornes and Co, the Decca Tokyo agents, as souvenirs of the opening of the chain and in recognition of the work in extending Decca main chain coverage to the new area of the Far East.
Doppler Flight Trials
Demonstrate The Accuracy And Operational Effectiveness Of Decca Helicopter DOPPLER 71

The fixed wing version of the Series 70 Doppler, the Type 72, was successfully evaluated by the French Air Force at Bretigny in early 1967, and by A. & A.E.E. at Boscombe Down a few weeks later. At the time of writing the helicopter version, Type 71, is now about to demonstrate its capabilities.

With the Doppler 72, the evaluations were concerned with the Doppler sensor itself, together with its associated ground speed and drift meter. In the case of the Doppler 71 the evaluations and demonstrations cover not only the Doppler sensor, but the computer and display which go with it to make up a navigation system. So far three separate systems have been prepared for evaluation: one system is now installed in a Wessex II helicopter of A. & A.E.E. Boscombe Down, the other two systems having been successfully demonstrated: one to the West German Ministry of Defence, the other to the Swedish Navy.

A considerable amount of proving flying has been carried out in the Decca Bell 47G helicopter, to ensure that the various components of each system continue to work together satisfactorily. It was also necessary to gather sufficient data to establish the effectiveness of the system as a whole.

Scope of Tests
There were three systems to test. Each system contained a Type 71 Doppler with its associated hovemeter, its ground speed and drift meter, and a computer Type 1770. As navigational displays, one system had a modified Type 9478 Control Box with numerical read-out; the other systems had Roller Map pictorial displays. The 9478 display counters show distance to go and distance across track, or grid co-ordinates of present position, as selected.

The proving flights covered two main aspects of equipment performance.
(a) to check the operating parameters of the doppler sensor and its read-outs.
(b) to check the basic accuracy of the navigation system, and to look for any limitations in its operational effectiveness.

The object of the doppler tests was to establish the overall capability of the basic sensor and the general handling characteristics in the helicopter environment, with particular reference to the equipment behaviour over smooth water.

Apart from the general handling qualities we required to make certain measurements of performance, and to do this a mast gyro was fitted to the floor of the helicopter and accurately aligned, with electrical 'pick-offs' to calibrated instruments showing angle of pitch, nose up and down, and angle of bank. Two Rascal type electronic counters were also fitted to count pulses along and across heading.

Over land and water (in sea states above 2) it is possible to obtain continuous indication of speed and drift without the equipment going to memory even at extreme attitudes within the design configuration of the helicopter. Reversals of bank from 25° left to 25° right, and throughout changes of pitch angle from 30° nose down to 30° nose up the indicators operated correctly.

Many transitions into the hover and pull aways (at varying pitch angles) were made in sea state 1. Starting from zero forward speed, the doppler would accept a nose-down angle of 17° before unlocking, and from an initial speed of 5 knots it would accept up to 23° nose down.

There was no loss of lock and the hovemeter moved smoothly at pull away. On some of these accelerations from the hover, bank angle of 15° was applied without detrimental effect. In sea state 2 and over, transition into the hover and acceleration from it at nose down pitch angles of 30° was found possible.

With pitch angles in excess of 30° the equipment went into memory within 5-8 seconds, re-acquiring on resumption of level flight. Over 'glassy' water the equipment would go to 'memory' re-acquiring immediately good signal returns were obtained.

Effect of rotor downwash in the hover over water was not conclusive as the amount of downwash produced by the Bell 47G is not representative of that produced by larger and more powerful helicopters. However, some tests were done at a height of two to three feet above water at which the ripples produced as a result of downwash were no higher than 2 in. It was found that these ripples did not have any adverse
effect on the hovermeter indications, and it was possible to maintain a hover, move forward, backwards and sideways with normal response on the hovermeter.

Using the electronic counters, the along and across heading accuracies were found to be rather better than 0.3%. Timed runs over fixed distances at speeds varying from 10 knots to 70 knots were made. These runs showed that the ground speeds shown on the ground speed indicator were within specification (3%) and indeed four runs out of six were within 1%.

Before discussing the methods and results of the navigation system flight trials, it is necessary to mention some of the limitations imposed by the helicopter and some of its basic equipment. The requirement for a gyro-magnetic compass with a synchro output for the computer had already been anticipated and a Sperry CL2 was already installed, but some doubts were felt as to the accuracy we could reasonably expect from it in a small helicopter, with the detector unit in close proximity to a lot of black boxes all using varying amounts of electricity. The other unknown quantity which could cause trouble was the expectation of transient peaks throughout the electrical system. In fact, the compass behaved with remarkable consistency throughout and with an accuracy better than we had expected. The inherent stability of the doppler and computer circuitry was able to cope with any interference which the helicopter electrical system may have created. Nevertheless, the environmental conditions in a small helicopter imposed limitations on our ability to check the extreme accuracy of the system.

The other limiting factor was the accuracy with which one could measure the distance between known points of visual reference. The limited endurance of the helicopter restricted us to runs of not more than 15 to 20 miles, in order to obtain an adequate number of runs per flight. Whenever possible we used railway stations, which were easy to pick out even in the worst visibility, and whose positions were clearly shown on the Ordnance Survey inch to the mile maps.

The plan for proving the navigation system was to record the readings of the counters, or the position shown on the roller map at the moment that the helicopter passed over a designated check point. These results gave a measure of the performance of the whole navigation system, including the compass which was not under test.

To get a true assessment of what each part of the system was doing, it was necessary to take further measurements, and one of them was to measure the output from the doppler into the computer. Two electronic frequency counters were fitted, and runs were made over various known distances. The 'along' and 'across' heading output from the doppler was recorded, and this told us what was actually being fed into the computer. However, since the relationship between 'along' and 'across' pulses was a function of drift we were not able to prove the doppler scale factor by this method. This was done by flying the helicopter along a straight stretch of railway over a known distance, keeping zero drift on the driftmeter, and counting the 'along heading' output from the doppler. The 'across heading' output was more difficult to measure, since the helicopter had to be flown sideways over a known distance, with no forward or backward component. This was achieved by proceeding sideways along a straight stretch of the Gatwick perimeter track.

A further test was to check the rate at which the digitizer in the computer would follow the rate of turn of the helicopter. A helicopter can turn 360° in about 10 seconds, and if the digitizer cannot cope the resolvers will be in error until it has caught up. This test was in fact a very simple process. The 'Track Required' was set to 360°, the doppler was set to memory, registering 180 knots, and the helicopter hovered on a heading of 360°. On a given signal the computer was switched from 'Stand-by' to 'Run', and the helicopter was turned through 360° in 10 seconds. When the counters stopped at zero, this showed that the digitizer had completed its turn. After several turns in either direction we established that the digitizer never fell more than two seconds behind.

Results
The doppler frequency counts established the scale factor of the doppler outputs and indicated that their speed was within the specified 0.3%. As a
matter of interest, the distance of 19.8 nautical miles between South Nutfield Station and Paddock Wood Station corresponds to 2,507,435 cycles of the doppler 'along heading' output. If you care to work it out you will find that this corresponds to about 63 cycles/ft.

The analysis of navigation results required a certain amount of interpretation since they included compass errors which could have been greater than the errors of the rest of the system. As soon as we had plotted a reasonable number of readings, however, it became obvious that the compass was behaving with remarkable consistency. almost without exception, all readings for a given point fell into a tight little group to one side of the actual position. After all of the obvious corrections had been applied, a residual systematic error of about one degree remained. This implies no criticism of the compass; the compass card is marked only to the nearest five degrees, and this type of compass was never intended for the sort of accuracy we demanded.

The chart (Fig. 1) shows the grouping of plotted counter readings in relation to position of the actual check points. The fact that is brought out very clearly is that all plots for the same run made on different days fall into very small groups, and consistently show the same sort of errors. In other words, the spread was remarkably small, showing very good repeatability. After the initial installation flight, no delays were caused by unserviceability of the equipment.

The doppler sensor was mounted on rails below the engine, as shown in the photograph, and could be changed in less than 10 minutes, together with its associated ground speed and drift meter and hovermeter. Since we had three systems to test, and they were all changed fairly frequently to cover different aspects of testing the 'instant installation' capability proved its value time after time.
On 25th September 1967 the following joint press release was simultaneously issued in London and Paris by Decca and Electronique Marcel Dassault:

'The Doppler navigation system proposed by Electronique Marcel Dassault (EMD) has been selected by the French Air Force for fitting to the Anglo-French Jaguar aircraft.

'This Doppler radar, Decca Type 72, has been engineered to meet the requirement of the French Air Force through the close co-operation of the Decca Company in the United Kingdom and EMD in France. The Decca-EMD doppler equipment will be manufactured in France by EMD under licence.

'It is a further example of technical and industrial collaboration between a British company and a French company in the aviation and electronics fields.'

This was the culmination of an exhaustive series of flight tests at C.E.V., Bretigny, during which time the prototype equipment was thoroughly checked throughout its performance range over both land and sea.

Final preparation of the equipment to meet the most stringent requirements of the flight trials programme was carried out by a team of Decca and EMD engineers who worked together in close harmony. This co-operation continues in the preparation of plans for the quantity production of the equipment in France by Electronique Marcel Dassault.

The French decision and the experience which we gained during the test programme indicated the suitability of the fixed aerial Type 72 equipment for application in small, high performance aircraft having considerable manoeuvrability characteristics. We look forward to developing considerable future business in both this field and the more conventional military transport and civil aviation markets.
SURVEY DOWN UNDER

NEW COMPANY FORMED IN SYDNEY PROVIDES DECCA SURVEY SERVICES IN AUSTRALIA

Part of the camp at Cape Keradren. Caravans are air-conditioned

Amalgamated Decca Surveys Pty Ltd. headquarters in Sydney

Cabin of the sounding launch showing Echosounder, Hi-Fix and Plotting Table

One of our surveyors, Mr Jan Hup, geodetic graduate of Delft University, using a Tellurometer MRA101 for surveying-in the position of the Hi-Fix Stations
Surveying has had a vital part to play in the development of Australia, both on land and offshore. The sheer size of the continent, with a coastline extending to hundreds of thousands of miles, has presented a formidable challenge to those seeking to develop and exploit its vast natural wealth.

In this environment, the benefits of electronic positioning in lieu of optical methods were quickly appreciated and it is more than 10 years since the Australian Hydrographer acquired his first Two-Range Decca System for offshore surveying. In later years, this was followed by Lambda and Hi-Fix installations and today Decca Survey Equipment plays a dominant role in the hydrographic activities of the Royal Australian Navy.

With the discovery of gigantic mineral deposits, usually in the more remote parts of the country, came the problems of finding and building new ports and harbours which would be capable of loading the huge bulk carrier ships which are necessary to make such a venture profitable. At the same time interest was increasing in the possibilities of finding offshore gas and oil so, in conjunction with our Agents, Amalgamated Wireless (Australasia) Limited, we decided, several years ago, to make available Hi-Fix equipment and personnel in Sydney.

Before long, Decca teams were operating at points scattered between Papua and Sydney on work ranging from conventional hydrographic survey to seismic operations, not forgetting the many contracts involving the guidance of dredgers engaged on deepening port approach channels.

Our engineers became familiar with the aspect of Australia rarely mentioned in the glossy brochures—the lonely deserts, the empty beaches and the fact that your nearest neighbours might be several hundreds of miles away while your operating headquarters might be anything up to two thousand miles distant.

Early in 1967 it was decided that the volume of business warranted the setting up of a self-contained Decca survey company similar to those operating in other parts of the world. Accordingly, in December last year, Amalgamated Decca Surveys Pty. Ltd. was formed jointly by The Decca Navigator Company Limited and Amalgamated Wireless (Australasia) Limited, with the object of making available all the normal Decca Survey facilities and capabilities based on a headquarters in Sydney.

Current projects include a hydrographic survey in New Guinea using the Decca Survey Vessel Martinetta, three dredging operations and a long series of Hi-Fix Chains under hire for oil exploration. We look forward to a period of great activity and growth for this our newest Survey Company.
The number of vessels to be Decca equipped rises steadily. On this page we publish details of some recent and interesting vessels, both large and small, to be fitted.

1 The 112,000 ton BP tanker British Argosy arriving at BP's Angle Bay Ocean Terminal, Pembrokeshire. British Argosy is one of the latest of the 100 Decca equipped BP tankers. She is also fitted with a Decca Arkas Autopilot and steering gear control. Total gross tonnage of this Decca equipped fleet is 2,050,508 tons.

2 Another new trawler, the 71 ft Crystal Sea is pictured here passing through the Caledonian Canal on delivery to her owner Edmond McCullough of Annalong, Co. Down. She is equipped with Decca Navigator Mk. 12.

3 The 104 ft yacht Kakki M is one of the most outstanding yachts to be built in the United States. Designed in Seattle, Washington, for Powell MacGregor Jr. of Rochester, Michigan, the vessel is kept in Florida and the West Indies during the winter and on the Great Lakes during the summer. She is equipped with an Arkas Autopilot and a Decca 426 radar.

4 The 54 ft Isleman recently completed for Mr. A. MacLean of Stornoway, was built under the Highlands and Islands Development Board Scheme in association with the White Fish Authority. She is equipped with Decca Navigator Mk. 12.

5 The 50 ton trawler Helene built at Buckie for Messrs J. S. Smith of Portsoy, is fitted with Decca Navigator and Decca D202 Radar.

6/7 An interesting Arkas fitting is the container vessel Frank H. Brown, built by Canadian Vickers Shipyard Limited for the trade route connecting Vancouver with the Yukon. She has a capacity for 933,000 gallons of fuel oil in addition to 200 containers measuring 8' x 8' x 25' suitable for sea, road or rail transport.
Increasing traffic in terminal areas calls for revised route structures providing separate departure and arrival tracks and sufficient duplication of both to prevent slow traffic from impeding the progress of faster aircraft. The problem of obtaining the necessary airspace to permit this development is aggravated by the large volume of airspace now considered necessary to protect holding patterns based on point-source aids. It is possible to make drastic reductions in the size of these huge holding areas, and to free valuable airspace, if the holding pattern is flown by reference to a pictorial display with an input from an accurate navigational aid. Thus in areas where it is essential to make the most economical use of the limited airspace available, accurate navigational information and the manner in which it is presented to the pilot is of paramount importance.

Figure 1 shows a holding pattern and area based on a VOR which has been calculated in accordance with ICAO recommendations for aircraft holding at 240 kts at FL 200. Superimposed is the holding area and pattern required for an aircraft operating at the same speed and flight level but equipped with Decca/Harco. For ease of comparison the two patterns are based on the same point. In practice the Decca pattern can be sited at any point and readily re-sited to meet changing operational needs.

The remarkable reduction in size stems from the accuracy of the navigational input and the continuous knowledge of position provided by the Decca flight log. This enables the pilot to dispense with timing procedures and to correct for drift throughout the holding procedure excepting only in those circumstances where to do so would increase the angle of bank beyond the desired limit (allowance for such circumstances is made in calculating the dimensions of the Decca holding area).
ADVANTAGES OF HOLDING AREAS

The Decca Navigator system also permits the pattern to be entered smoothly on either the inbound or outbound leg, thus obviating the need to overfly the datum before commencing the orbit and thereby saving the airspace otherwise required to protect the entry pattern. An additional advantage, which stems from continuous knowledge of position whilst holding, is that the pilot is able to adjust his flight path to achieve the required datum leaving time with a high degree of accuracy. This permits the controller to establish a closely sequenced flow of traffic throughout the approach pattern and thereby ensure maximum runway utilisation.

Figure 2 is a section of an Omnitrac chart showing a Decca holding pattern and area. The area was calculated assuming a wind speed of 30 kts, the actual wind velocity experienced when the pattern was flown was 270°/30 kts gusting to 35 kts. The aircraft entered cloud at 3500 ft in conditions of turbulence and the 2⅓ orbits were flown in cloud. The recorded trace demonstrates the accuracy with which a Decca-equipped aircraft can adhere to a given holding pattern and remain well within the associated holding area even when operating to the limits for which the area was designed. It also offers an example of how the pictorial display assists in applying corrections for wind effect. It will be seen that on the first orbit the aircraft drifted off the pattern at its eastern end under the influence of the westerly wind; on the second orbit this was counteracted by commencing the inbound turn earlier thus enabling the pattern to be maintained without increasing the rate of turn. After two orbits of the pattern the pilot turned off the outbound leg early so as to cross the holding datum as instructed. From this point an intermediate approach, followed by a smooth turn onto final approach, was made by reference to the flight log which served also to monitor the radar vectors given by A.T.C.