Technical article on crew, rules and ~~also~~. Aviation, March, 1939

ican then, as a result, was assured of base facilities in Canada, Newfoundland, Ireland, England, and Bermuda, in France, and in Germany.

When, in 1933, the French lost their rights in the Azores through non-performance, Pan American and Imperial stepped in to press for action on their applications. When, three years later, the Portuguese government saw fit to approve them, the last base was checked off the list of "things to be done".

On July 2, 1935 President Roosevelt set up an Interdepartmental Committee composed of Assistant Secretaries from the departments of State, Commerce, Post Office and the Treasury to consider "the development of American air transport lines in foreign territories."

In December of that year, a delegation arrived from Great Britain, Canada and Ireland to discuss the North Atlantic with the newly formed committee.

Exactly what then transpired has never been revealed since the proceedings were largely of the "behind locked doors" variety. But this much is clear: (1) In spite of an invitation for "anyone interested" to turn up, Pan

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How the Atlantic Will Be Flown

I—A Bow to Andre A. Priester

There is a common denominator recognizable in every well-practiced action of a Pan American flight crew; in every P.A.A. maintenance routine; in the spic and span orderliness of every P.A.A. base from Hong Kong to Lisbon, from Nome to Buenos Aires. It is obvious even to the casual observer.

The men seem to be working, not at trades, but at professions of which they take pride in being the well-equipped masters. The tools and gear with which they work, the equipment upon which they lavish their efforts seem as new as the day they were purchased. The pattern of their actions, no matter how strange the circumstances, gives an overwhelming impression of preparation long ago for just this or that situation.

A professional outlook, a regard for equipment almost akin to worship, a quality of pre-planning for any conceivable contingency—a world scattered force of some 5,000 men became uniformly imbued with such qualities not by accident, but by design. And the design is that of a magnetic, intense little Dutchman named André Priester who has been Chief Engineer of Pan American Airways since that air line acquired its first airplane from another Dutchman named Anthony Fokker.

A complete exposition of the Priester philosophy of air transportation would fill a bulging, though fascinating book. It would start with an im-

ANDRE A. PRIESTER
Chief Engineer

passioned sermon on Safety, Conservatism, and Responsibility. It would proceed with a hard-headed, realistic analysis of the difficulties faced and the hazards involved. Then proceed to forestall each difficulty and each hazard—not en masse, but one by one. Men; machines, bases; technique, maintenance, order; character, quality, completeness. No program of preparation is too long, no process of development too difficult; no goal too visionary, if transport aviation by adopting it can move toward safety.

Priester, himself, would explode if you ascribed to him the credit for making Pan American by far the safest big international airline in the world. That, he would tell you, belongs to the thousands of hard-working men representing P.A.A. over half the surface of the globe. He would tell you of the technical contributions of such P.A.A. department heads as Hugo Leuteritz, who developed the line's unique radio direction finders. Of the work of Division heads and engineers, of operations managers, of pilots and mechanics. He could tell of progress made on Pan American problems by almost every unit in the American aeronautical industry— sometimes on urgent appeal; frequently on their own individual initiative. But any crusade must have a leader to set and keep alight its fire. And, these men in turn, would tell you he is Priester.

When you step down the beautifully glistening dockway for your first trans-Atlantic voyage by Pan American Clipper, remember some of this. The ship you board will be huge and rugged for all its interior luxury. It can remain aloft indefinitely on any two of its four engines. Five men of the crew of eight upon its flight deck, can fly it, navigate it, run its radio or its four engines. Mechanics can reach every foot of fuel line or make repairs upon its power plants in flight. Fuel will be ample to carry the ship great distances beyond each objective. A foot-long list of emergency boats, and flares and gear takes 1,100 pounds from the plane's precious payload rating. Other hundreds are willingly expended on de-icing shoes. Each minute of the flight, a half dozen radio stations stand steady guard, to warn of storms, to give a path, to dispatch rescue. As far as unsparing human effort can make it so, your flight will be a safe one. These things trace directly back to André Priester, now one of America's most useful citizens.

American was the only American group to send representatives. (2) Our own government seemed to be learning for the first time of the tremendous value placed upon aerial operating rights by the rest of the world. (3) The incident decided Washington to take up negotiations for American companies to operate abroad, as a direct governmental function. That same winter Germany and France both sent delegations to Washington for similar conferences.

As one result each of the four nations was granted "experimental" privileges by the others to cover whatever "survey" or "training" flights it felt necessary. That summer Germany was first to take advantage of this arrangement and made a number

(Turn to page 36)

How the Atlantic Will Be Flown

II—The Crew

The men on the "flight deck" of a trans-Atlantic Clipper form one of the most unique groups on earth—and one of the hardest to get into.

Not counting the stewards in the big passenger cabins, a trans-Atlantic crew will consist of at least seven men: a Captain; a First Officer Pilot; a Second Officer Pilot; a Third Officer Pilot-Navigator; an Engineer Officer; a Radio Officer, and a Junior Flight Officer.

The Engineer Officer and the Radio Officer are specialists, long-trained in the operation of power plants and radio, respectively. In addition they have been equipped with ample theory and shop-experience to enable them to trace trouble and rectify it whenever it is possible to do so in flight.

The Third Officer Pilot-Navigator is in direct charge of charting the plane's position by celestial navigation, by dead reckoning, and by radio bearings taken on the plane by surface stations or by bearings taken from the plane on surface stations.

The First and Second Officers Pilot share the bulk of the flying duties. The Junior Flight Officer may be sitting in the co-pilot's seat, helping with the navigation, serving the Engineer Officer by inspecting fuel tanks, fuel lines, or the big engines themselves.

Over it all, or rather behind it at a desk-table, lords the Captain in executive charge of the plane, its flight and every one upon it. He might handle the plane's controls as little as an hour on an entire ocean crossing—or even not at all.

But this is more than a mere subdivision of continuous labor. Note that five of the seven—that is, all but the Engineer and Radio officer—are pilots fully qualified to take the ship off, fly it, and land it. In addition all these five have been thoroughly trained in navigation, in radio and in handling the engines. As a result, a simple schedule of duty rotation gives each officer one hour of rest in every four—and there are bunks in a crew cabin behind the flight deck to permit complete relaxation.

There is no royal road to the Captaincy. All pilots entering Pan American service are college graduates, most also are graduates of Army or Navy flight training centers and have had a year or two of active military or naval duty. Their first rank with P.A.A. is that of Apprentice Pilot. As such, for two years, they work in maintenance shops, serve turns of duty in Pan American offices to acquaint themselves with the work of all departments, and qualify for both Airplane and Engine Mechanics certificates.

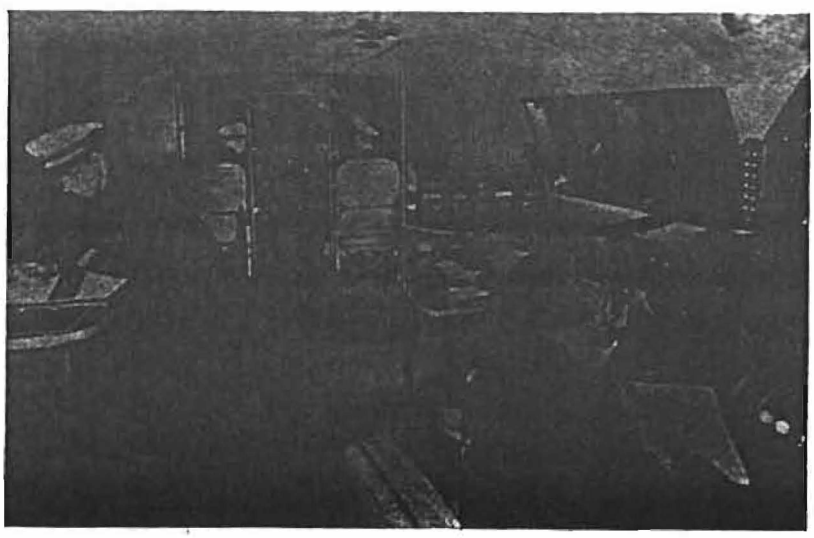
Meanwhile they have begun a course of study toward examinations for advancement in grade. Most take correspondence courses prepared for their special benefit by P.A.A. technicians and administered through one of the big correspondence schools. As one specific objective he must qualify for a Second Class Radio License. Then, after handling a stiff set of written and practical examinations, the apprentice graduates to the rank of Junior Pilot, Second Class.

As he checks out in dead reckoning and radio navigation, basic meteorology, the Link trainer, and amasses flying time, he can move up to Junior Pilot, First Class.

At least one year later, he may face another set of examinations for rank as Senior Pilot—this time in subjects including international law, basic celestial navigation, seamanship, and the history and cultural background of countries served by P.A.A.

Even then he is not through. After 2,500 hours in command of P.A.A. aircraft (at least 500 in flying boats of more than 17,000 lbs. gross) he may sit for further examinations in advanced navigation and some eighteen other subjects—and if, meanwhile, he has had an excellent record and shown outstanding ability as a leader and manager, he *may* win through to the rating: Master Pilot of Ocean Flying Boats.

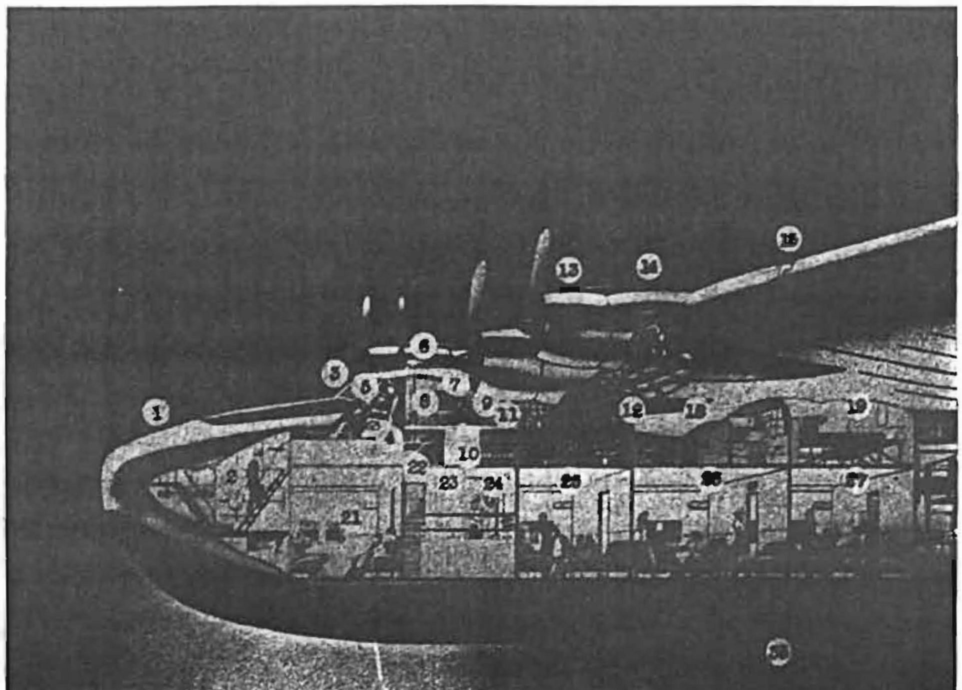
You'll find one on the bridge of your trans-Atlantic Clipper.



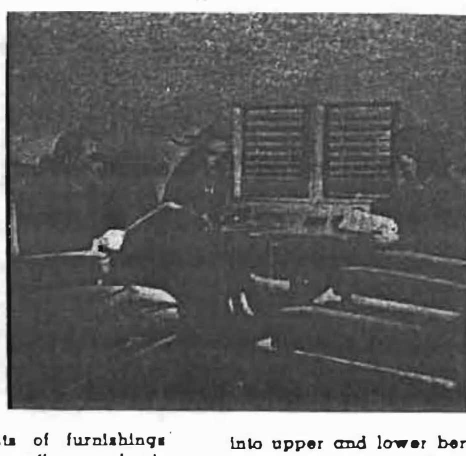
How the Atlantic Will

IN SPLENDID ISOLATION: A Boeing test crew rests on the flight deck after a final check flight. To keep down fatigue on long crossings, this compartment has been as elaborately sound-proofed and upholstered as the passenger quarters on the deck below. Note the simplicity of the pilots' panel in the bow.

THE HUGE HULL—is 106 ft. long, has a beam of 12 ft. 6 in. and a maximum depth of 19 ft. It has an athwartship main step and a pointed rear step equipped with a water rudder.



BY THE NUMBERS: (1) Anchor Hatch. (2) Seaman's Compartment. (3) Bridge. (4) First Pilot. (5) Second Pilot. (6) Radio Loop. (7) Navigation Compartment. (8) Radio Officer's Post. (9) Chart Room. (10) Navigator's Equipment. (11) Engineering Officer's Post. (12) Captain's Office. (13) 1500 hp. Wright GR-2600-A2 Cyclone Engines Equipped with Hamilton-Standard Hydromatic Propellers. (14) Mechanic's Wing Station. (15) Controllable Landing Lights. (16) Wing Spread



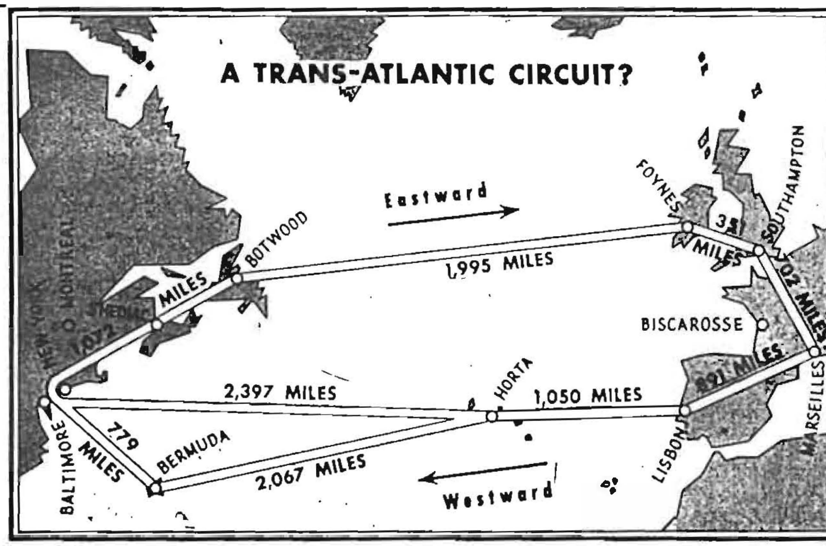
7,200 POUNDS—of the planes gross 82,500 consists of furnishings installed for the comfort of its occupants. Sound-proofing, and air conditioning is well-nigh perfect. Big triple-seat davenports make up into upper and lower berths, 75 inches long, 32 inches wide. A galley serves hot meals. Six seating-sleeping compartments and a dining room-lounge in the United States. As shown on the chart on page 28 the great bulk of it has its opposite terminal or origin in England or France. Now the most practical American service might well be one which touched say France and England, or even France, Germany, and England on a single trip. In return, on a trip-for-trip basis, each of these countries could run a flight to the U.S. and return. There is a great deal to be said therefore upon an insistence by our government that trans-Atlantic service should be allocated on a basis of the traffic each country actually contributes to the total North Atlantic flow.

Be that as it may, the Atlantic drama swept on through its laborious haggling over the script and trial rehearsals toward the lifting of the curtain. Contributing equally to the delay was the fact that none of the nations involved was actually prepared—granted all the rights in the world—to set up a permanent scheduled air line to carry mail, passengers and cargo. Germany could have carried only mail in its catapult planes. Great Britain might have set up a mail-only service in its Empire boats in its weird Mayo Composite or in one of its four-engined land planes—and probably will do so this summer. Pan American could carry a considerable mail load across the Atlantic in its Sikorsky S-42s, but short of halting the Pacific completely and shifting its Martins to the Atlantic, it could not have set up even a pioneering service for passengers.

Now swiftly in the past few months, the last parts of the picture fall into place. Pan American takes delivery on the first two of its big new Boeing-314 flying boats. Its crews are ready, trained through a decade of over water experience and some 269 crossings of an ocean three times the Atlantic's width. It has bases ready on Long Island, at Baltimore, at Shediac in Canada, at Horta in the Azores and Lisbon in Portugal. It has permission to use British bases at Botwood in Newfoundland, at Foynes in Ireland, at Southampton, England and the French base at Marseilles. So sure is it of its technique, it has told the Civil Aeronautics Authority it needs but a single shakedown cruise of the Yankee Clipper across to Europe and return before it will be ready to offer complete service for passengers and express, as well as mail.

Late in January, France announced it would welcome a Pan American service to its shores provided only,

(*Turn to page 40*)



How the Atlantic Will Be Flown

IV—The Route and the Weather

It is all too easy to look at a map showing the great circle lengths of the various "practical" trans-Atlantic air routes and arrive at an obvious but highly inaccurate conclusion that there is one "best" one; that between New York and England via Newfoundland and Ireland. Its total length is substantially shorter than the Azores route; the longest uninterrupted over-water gap is only 1,995 miles, a little shorter than Bermuda-Azores and some 400 miles shorter than the direct New York-Azores crossing.

The error arises from the fact that trans-oceanic Clippers don't fly routes on great-circle charts but on weather maps—and upper-air weather maps at that. In the Pacific, for example, a flight along the "shortest" great circle course between California and Hawaii is a distinct exception—and flights routed 100, or even 300 miles or more to one side of that course (to take advantage of favoring winds or to avoid bad weather) are the common practice.

And on weather charts, such as those prepared daily by Pan American weather men for the past three years, the northern trans-Atlantic route loses much of its initial allure. Especially in the winter season, it is frequently torn by gales, menaced by icing conditions, laid deep in fog over Newfoundland, Ireland and England.

Swinging far off the Great Circle, and rising high "over the top" of the mess beneath does permit a plane to avoid many of these troubles—on eastward crossings. But, and its a big but, winds along this northern route are fiercely westerly in their habits. As altitudes increase, they increase in speed (frequently a 40 mile surface wind means one of 100 m.p.h. at little over 1,000 ft.) and are almost invariably from the westerly quadrant.

The Azores route, in contrast, is far more uniform the year around. The Atlantic off our own Eastern coast, of course, has its storms and occasional icing areas, but it is rarely unflyable. And its winds are neither so high in velocity nor so invariably tough to buck on western crossings.

Much is still to be learned. Consistent reporting of even surface conditions from North Atlantic vessels is hardly ten years old. Exploration of upper air conditions by pilot balloon is only now getting underway, although it is, fortunately, rapidly on the increase.

Until our basic "facts" should be proven wrong or until some new development renders weather hazards much less formidable, expect (1) A marked preference for the Azores route for winter service, (2) Some winter use of the northern route under good conditions, especially for eastward crossings, (3) Possibly even a circuit route: the Newfoundland route for a fast trip east; the Azores route for a longer but more certain return journey.

that when its own air liners were ready, the service would have to be adjusted to France's satisfaction or be discontinued. Britain, too, replied to a query from our government that it would have no objection to Pan American initiating a trans-Atlantic service using its territory as soon as practicable—a very sporting move on the part of a nation which had every right to insist on a wait until its own preparations were completed.

As we go to press, nothing remains, then, save approval by our own Civil Aeronautics Authority, and the fixing of mail rates by that body.

Once those are forthcoming, we turn to another bright new page of what Kipling once called "the chapter of endless possibilities."

J. CARROLL CONE
Manager Atlantic Division

CLARENCE H. SCHILDHAUER
Division Operations Manager

How The Atlantic

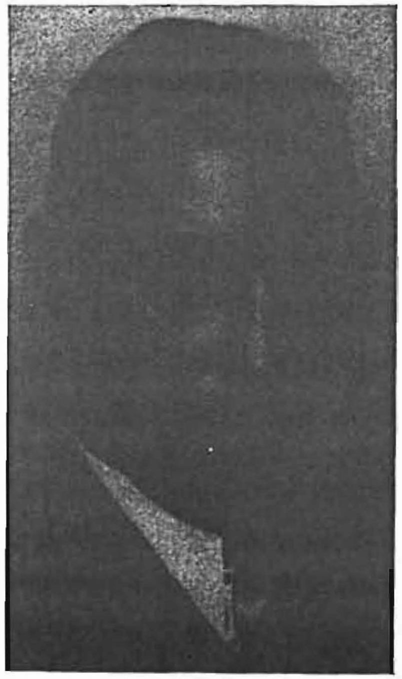
THE EQUIPMENT in the new Boeings is remarkable for its completeness, and at the same time for its simplicity. Two duplicate transmitters for use in cw telegraph service are available for the basic communication needs, and in addition a small radiotelephone transmitter for work within 30 miles of the surface stations. Likewise two duplicate cw receivers are provided for use in telegraph communication and for loop direction-finding. A telephone receiver, a companion to the telephone transmitter, is also aboard and is rigged up with an automatic switching system, for simultaneous use with the telephone transmitter.

The two telegraph transmitters, being identical, are thus available for alternate use in emergency. The frequency range covered is very wide; definite operating frequencies include 333 kc, 500 kc, 1638 kc, 3082.5 kc, 5165 kc, 5692.5 kc, 12,330 kc (the latter two for Atlantic service only) 8220 kc, 8240 kc, 8280 kc (this last for raising marine vessels). With such a wide variety of frequency service, crystal control would be very cumbersome. Consequently the transmitters are of the master-oscillator power-amplifier type, containing but two tubes, and delivering 80 watts output to the antenna. The master oscillator circuit is a special development of the PAA radio engineering staff and provides frequency stability comparable with crystal control.

Trailing antennas (which leave the ship through a retractable fairlead in under the bow) are used for the lower frequencies, but on the high frequencies, the great size of the ship makes possible efficient fixed antennas since an appreciable fraction of a wavelength can be strung from the wings to the tail.

Power for the transmitters is obtained from dynamotors, operated on the 12-24 volt system. The supply consists of 120-ampere hour batteries, charged from 15-volt 100-ampere generators driven directly from the plane's engines. On the water, a gasoline-driven generator may be used for charging. Kites are available in the plane for raising a long antenna from the surface of the water.

Until a few years ago, it was standard practice on all PAA ships to employ cw (code) communication only.



HUGO C. LEUTERITZ
Chief of Communications

But a modification of this regulation was introduced in 1937 to allow radio telephone communication for purposes of speeding up operations at or near the airport terminals. The range of the radio telephone equipment is limited to approximately 30 miles. The telephone equipment aboard the Boeings is of standard manufacture. The transmitter is a Western Electric Type 25A transmitter, which employs two 6L6 tubes, one as modulator, the other as crystal controlled oscillator. The nominal output power is 16 watts. The transmitter is operated on 2870 kc for Atlantic service, 3082.5 kc on the Pacific. The companion to the radiotelephone transmitter is the receiver, an RCA AVR-7G superheterodyne, a combination communication and beacon receiver, covering the range from 250 to 400 kc and from 2000 to 6000 kc. This receiver is operated as a unit with the 26A transmitter, the two being connected alternately to the same antenna through a remote-controlled relay switch.

The two communication receivers permit simultaneous cw telegraph and d-f work, act as companions to the two telegraph transmitters, and ensure duplicate reliability. These receivers, developed by PAA engineers,

Will Be Flown V — The Radio

are outstanding examples of simplicity. Each receiver weighs but six pounds and covers, through the use of seven plug-in coils, the entire frequency range from 250 kc to 25,000 kc. The circuit employs a stage of untuned r-f, a regenerative detector, and two stages of audio frequency amplification.

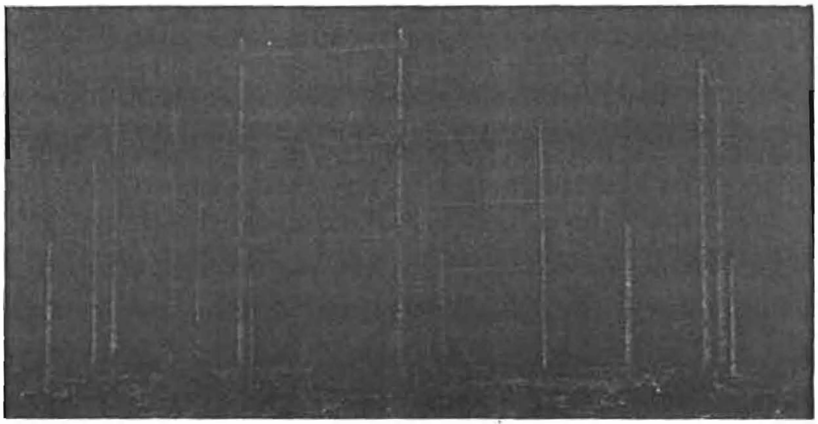
Direction-finding equipment

Two methods of direction finding are available: one involving a rotatable loop on the plane, the other using bearings taken on the ship's transmitter by Adcock-system ground station direction finders. The rotatable loop system is used primarily as an adjunct to the Adcock system, and is of course subject to night effect and is limited to use over comparatively short distances. The Adcock system, on the other hand will give bearing accurate to within a degree over distances well over 1,000 miles, and is in addition practically immune to night-effect errors.

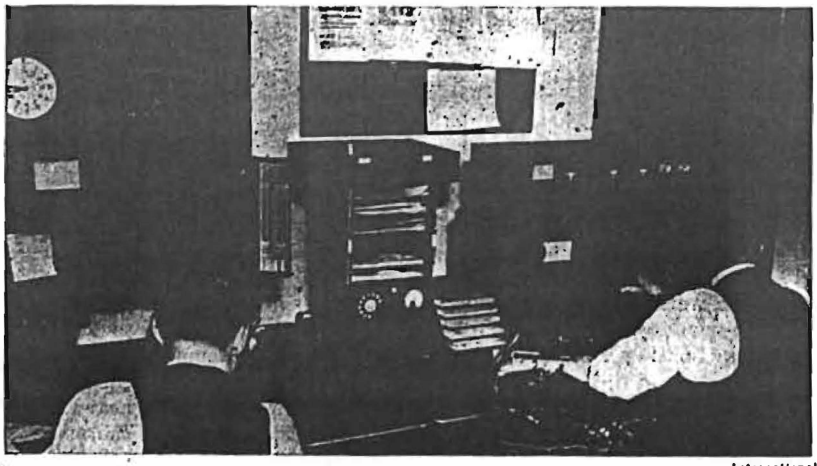
The direction-finding system on the plane consists of a rotatable loop mounted in a streamlined housing. The output of the loop is fed first to a single stage of tuned radio frequency amplification, and then to the input of either of the two standard communication receivers. The extra r-f stage is required to introduce additional sensitivity, to make maximum use of the capabilities of the loop itself. The indications of the bearing direction are taken by the aural-null method, using the headphones in the output of the receiver, while rotating the loop. The ground stations are provided with intermediate frequency transmitters and "T" antennas of symmetrical dimensions producing uniform field patterns for d-f approaches. The loops are much used for taking bearings on marine vessels, and for homing purposes.

The Adcock direction finder works on the output of the cw telegraph transmitter in the planes. Three Pan American Adcock installations are already available for Atlantic operations: one on the East coast of the United States, one in the Azores, and one at Lisbon in Portugal. Each installation consists of four vertical di-pole antennas, whose outputs feed carefully balanced receiver circuits. By detecting the phase differences in the signal received by the four di-poles, the direction of the incoming signal may be readily found, and radioed at once to the plane from which the signal is coming. The Adcock system covers readily any frequency in the range from 5 to 8 megacycles.

Elaborate radio installations are also carried aboard two big sea-going launches which are now stationed at the Azores.



From company stations on Long Island and at Horta and Lisbon, already equipped with such sets of di-pole antennas as this, Pan American operators . . .



International

. . . can take bearings on Clippers in mid-Atlantic accurate to one degree. Comparable equipment will be available at several British stations.

The Clipper's Radio Officer can take bearings on any surface station.