ENGLISH AND DANISH DECCA NAVIGATIONAL CHAINS

FOREWORD.

The following details regarding the English and Danish DECCA Navigational Chains have been extracted from information supplied by the Hydrographic Offices concerned, from "International News Letters-Radio Aids to Marine Navigation" published by the British Ministry of Transport and from pamphlets received from the DECCA Navigator Company Limited, London.

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From time to time the International Hydrographic Bureau has published information regarding the "DECCA" System of Radio-navigation, and in this article it is assumed our readers have a genreal working knowledge of the System (*).

This information is however scattered and therefore the essential details from a Navigator's point of view which have been received in the International Hydrographic Bureau to date are embodied herein.

At the time of going to press (March 1949) two chains of DECCA Stations, one in Southeastern England and the other in Denmark, have been brought into operation for general marine use. Fig. 1 shows diagrametrically the coverage of these two chains. Definite proposals have now been put forward to establish two additional chains situated in Scotland and in South-western England respectively ; it is expected they will be completed in 1949 and when brought into operational use the coverage will be as shown in Fig. 2.

The following details of the Transmitting Stations of the English and Danish Chains have been received :

English Chain	*Position*		*Frequency*
	Lat.	Long.	
A) Master Station, in vicinity of Puckeridge.....	51.54.33 N.	00.00.05 E.	85.000 Kc/s
B) Red Slave, in vicinity of Norwich.....	52.33.08 N.	01.20.00 E.	113.333 »
C) Green Slave, in vicinity of Lewes.....	50.54.33 N.	00.08.44 E.	127.500 »
D) Purple Slave, in vicinity of Warwick.....	52.11.49 N.	01.21.53 W.	70.833 »

Service : Continuous.

Coverage : Area within radius of 240 nautical miles (276 statute miles) from London.

(*) Attention is called to the following articles published in our *International Hydrographic Review*, Vol. XXIII, 1946, pages 61-65 "The DECCA System of Radio Navigation" and Vol. XXIV, 1947, pages 166-175 "General principles and use of the DECCA Navigator"; also to the article "The DECCA Navigator as an aid to Hydrographic Survey", on page 13 of this Volume.

Danish Chain.	*Position.* Lat.	Long.	*Frequency.*
Master Station, situated at *Samsø*	55.56.38.325 N.	10.35.01.908 E.	85.3650 Kc/s
Red Slave Station, situated at *Klintholm, Møn*	54.57.24.385 N.	12.27.59.697 E.	113.8200 »
Green Slave Station, situated at *Højer, South Jutland*.....	55.01.16.490 N.	8.42.09.629 E.	128.0475 »
Purple Slave Station, situated at *Hjørring, North Jutland*.....	57.26.55.417 N.	10.03.10.275 E.	71.1375 »

Red Lattice. Base Length. 162.0448 k.m. Lane width on Base Line : 438.485 Metres.

Green – – 157.1210 k.m. 584.646 Metres.

Purple – – 170.6574 k.m. 350.788 Metres.

Service : Continuous.

Coverage : Area within radius of 278 nautical miles (300 statute miles) from Master Station.

The bringing into operation of these two Chains was preceded by a period of extensive operations by both Danish and British Surveying vessels and by the British Sloop *H.M.S. Fleetwood.* As well as making a preliminary check on the accuracy of the theoretical lattices the Danish Surveying Vessel *Freja* carried out an extensive survey to determine the corrections to be eventually made to the Chart lattices in order to allow to a very great extent for systematic and geodetic errors. By courtesy of the Danish Government the *Fleetwood* also carried out a fundamental scientific investigation in Danish waters to study the systematic errors in various parts of the coverage of the Danish Chain. The analysis of systematic errors of the English Chain have shown that the average phase velocity of the radio waves is substantially higher over the sea than over the land. The Danish Chain is particularly interesting and suitable for this study for whereas the large and rapid changes in the land-sea composition of the radio wave-paths occur only in the Lands End region of the English Chain the topography of the coverage area of the Danish Chain is such that there are several regions where there is a similar change in the nature of the radio wave-paths. Some 400-500 fixes were taken and have now to be computed before any analysis can be made ; but when it is available, this analysis will be of great value to both the British and Danish Authorities and should enable a further advance to be made in the theory of systematic errors.

With the setting up of the Danish Chain it was considered necessary to determine the extent to which the reception of the transmissions of one chain is subject to interference from the transmissions of the other, and it was decided that operational trials were desirable before the Danish Chain was officially made available for general use. The trials were carried out during a three weeks cruise of H.M.S. *Fleetwood,* and it was found that at positions well within the coverage area of the Danish Chain and outside that of the English Chain, torque was lost on the Decometers of the English Mark IV Receiver (see Fig. 3) while the Mark V Receiver (see Fig. 4) operating on the English Chain retained strong torque and gave consistent readings. No interference with the operation of the Mark IV Receiver by the Danish transmissions was observed during a night of observations at Cuxhaven.

A warning has however been issued by British Admiralty Notice to Mariners N° 102 of 1949 as follows "that transmissions from the Danish Chain may have an adverse effect on the operation of Mark IV receivers used on the English Chain, particularly by night, within the part of the coverage area to the north and east of a line joining Amsterdam and Latitude 55°15'N. Longitude 1°15'E. The Purple pattern is the one subject to the greatest potential interference ; the Green pattern may be affected to a lesser degree ; and it unlikely that the Red pattern will be disturbed at all.

"This adverse effect may cause errors in the readings of the decometers of Mark IV receivers due to sluggish response, or no response, of the meters to a change in the ship's position ; the meters may, however, give inaccurate readings without any such indication that they are not working normally. The effect is expected to occur only when any of the English Stations are working on reduced power (*e. g.* on a reserve aerial) and the Danish Stations are working on full power. As the Mariner will not necessarily know when this condition obtains, this type of Receiver should, until further notice, be used with particular discretion at all times in the part of the coverage area specified in the above paragraph.

"This warning is given as a result of theoretical considerations. A further Notice on this subject will be promulgated when an operational investigation has been made.

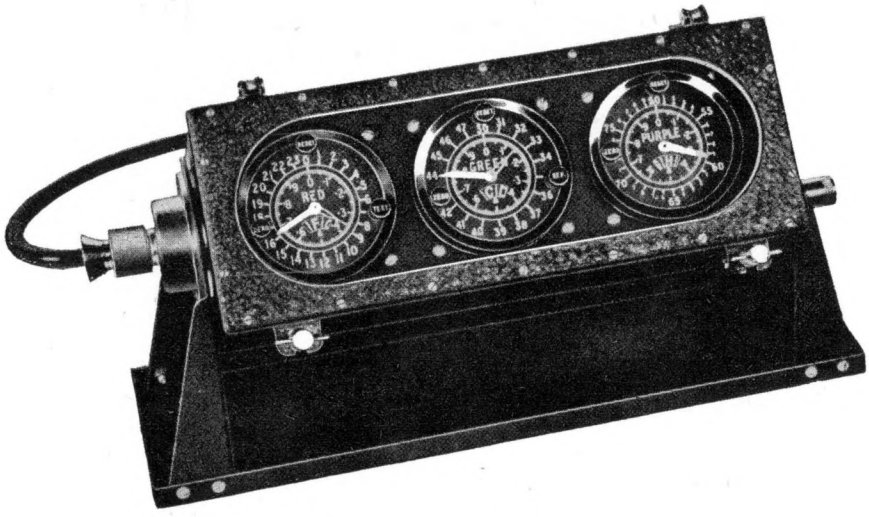
"Notice N° 2188 of 1948 stated that it was not expected that Mark V receivers when in use on the English Chain within its coverage area would be affected by the transmission from the Danish Chain. Operational experience has confirmed that Mark V receivers in such circumstances are in no way affected by Danish Chain transmissions".

In general, loss of torque on a Mark IV Decometer took place abruptly during passage towards the Danish Transmitters, the zone of inaccurate readings being very narrow.

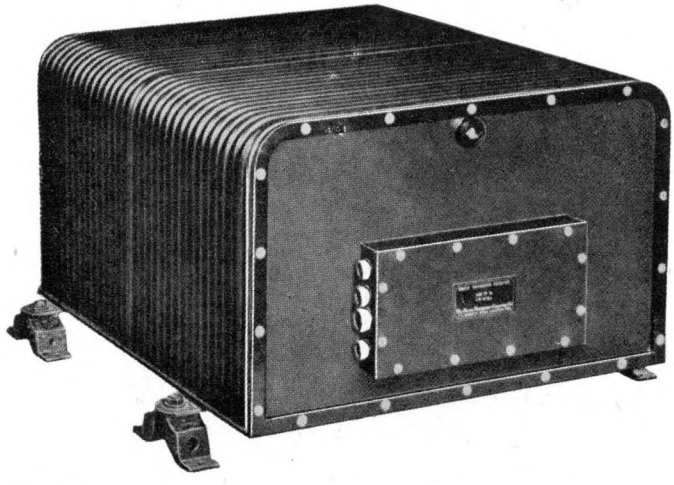
On completion of the analysis of field strength and interference measurements it should be possible to specify accurately the areas in which interference may be experienced when using the Mark IV Receiver. These areas will not, in practice, have any detrimental effect on the continuing use of Mark IV Receivers. Ships passing through them will generally be passing from the coverage area of one Chain to that of the other, and will be likely to be equipped with the Mark V set. Ships on coastal routes within the coverage area of one Chain (*i. e.* those ships having a continuing requirement for Mark IV Receivers) will not touch the possible interference areas.

The Danish Surveying Vessel *Freja* has carried out further trials with the DECCA Chain during the months of August to October 1948 and besides trying to control the pattern along the Swedish and Norwegian Coasts in co-operation with the Swedish and Norwegian Hydrographic Offices and with the DECCA Navigator Company, London, has controlled the mine swept routes. "DECCA" co-ordinates of all buoys along the routes have been noted, thereby enabling ships to find their way through Danish waters during the ice-period when the buoys are withdrawn, and also enabling the Buoyage Service to re-establish the buoys after the ice-period even if weather conditions are so bad that visual fixes cannot be obtained.

The buoys marking the mine-swept Channel to Esbjerg, the positions of which had not been previously accurately known, have now been controlled by means of the Danish DECCA Chain, and Danish Chart N° 94 — HORNS REV — has been issued showing the exact position of this Channel and the amended positions of the buoys marking it overprinted in red.

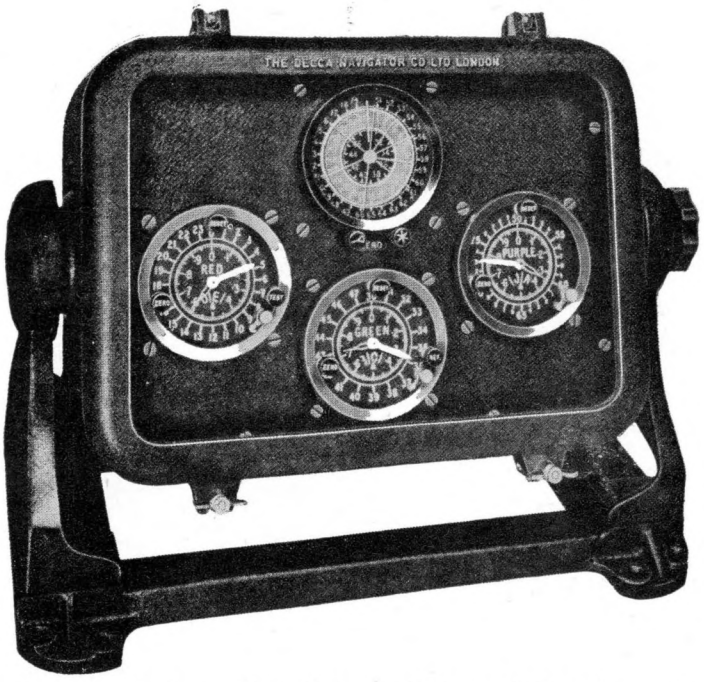


The Mark IV Marine Decometer Unit includes Red, Green and Purple Decometers. The viewing position can be adjusted to the angle required and the Unit is designed for vertical or horizontal mounting.

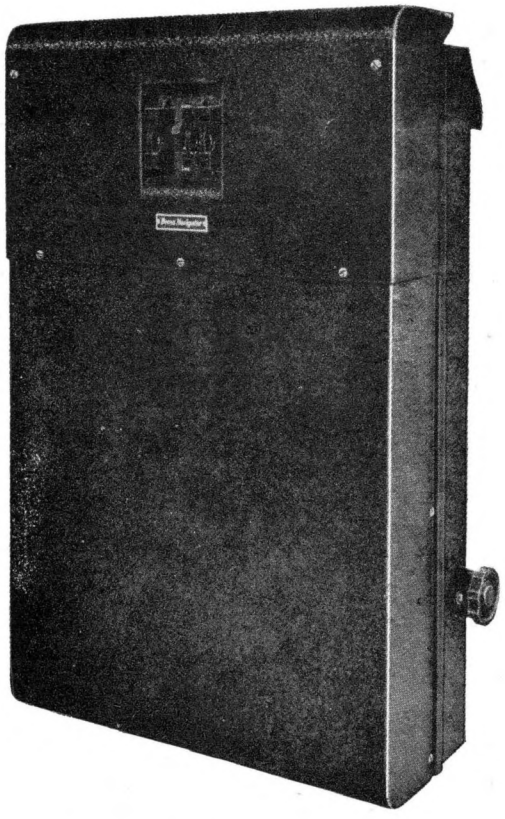


The Mark IV Marine Receiver Unit is remotely connected to the Decometers, and is installed in any convenient position.
Dimensions in inches : 20 × 19 1/2 × 19 1/2 (50 × 49 × 49 cms).
Weight 60 lbs. (27.2 kgs).

FIG. 3 — The DECCA Navigator, Mark IV.



The Decca Navigator Mark V Marine Indicator Unit includes the standard Red, Green and Purple Decometers, and the Lane Identification Meter



The Mark V Receiver Unit, designed for vertical bulkhead mounting, includes multi-chain working. The required Chain of Decca Navigator Stations is selected by simply turning the knob on the right hand side of the Unit.

FIG. 4 — The DECCA Navigator, Mark V.

DECCA MARINE RECEIVERS.

THE DECCA NAVIGATOR MARK IV UNIT (see Fig. 3) comprises a single Chain Receiver. There are two models now available, one for the English chain and the other for the Danish Chain. This Receiver does not include the feature of Lane Identification, and ships fitted with Mark IV Receivers must know their position accurately when initially setting up the meters and when re-setting them for any reason (for example after failure of the transmitter or receiver or when the ship enters the approved coverage area). The possibility of lane-slipping must also be borne in mind. This is more likely to occur towards the limits of coverage, but steps should be taken at all times to check that lanes have not slipped, *e. g.* by checking with the dead-reckoning plot at regular intervals.

Many vessels working within the approved coverage of one Chain of Stations do not however necessarily require Lane Identification and experience has shown that the Mark IV DECCA Navigator provides them with a most satisfactory service. For ocean-going vessels and ships engaged on the longer sea routes, the new Mark V Receiver described below is recommended.

THE DECCA NAVIGATOR MARK V INDICATOR UNIT (see : Fig. 4) is designed to enable ocean-going shipping and vessels engaged on the longer sea routes in North-West Europe to Scandinavia and the Southern Baltic to obtain the advantages of the DECCA Navigator System. This receiver includes the new features of multi-frequency working and Lane-Identification. All vessels equipped with this Receiver will have continuous and automatic position fixing information as soon as it is switched on when entering the area of operation of the DECCA Navigator System. Lane Identification requires no additional skill or operation from the Mariner : it is automatic and as simple as reading the Decometers of the Standard DECCA System. It is emphasised however that before using lane identification reference should be made to British Admiralty Notice to Mariners N° 101 of 1949, and to the Company's special instructions referred to therein. The Indicator Unit comprises the three Standard Decometers and an additional meter for Lane Identification. Signals sent out from the DECCA ground stations once every minute operate the Lane Identification meter and, in turn, it indicates the Red, the Green and the Purple Lane number of the position of the vessel at that time. Each indication remains set for five seconds. The minute by minute Lane Identification provides a valuable cross check of the Standard Decometers of the Mark V Receiver, thereby presenting the Mariner with two independent position fixing systems in one unit.

The Mark V Receiver includes also the feature of multi-chain operation and works from a number of different DECCA Chains. This again is completely automatic, requiring no skill from the user. The DECCA Chain required is selected by the knob on the side of the Receiver Unit illustrated here. Merely by turning this knob from N° 5 to N° 7 the Receiver ceases to receive the signals from the English Chain and works directly from the Danish Chain.

The Mark V Receiver incorporates a small converter unit, and works from all standard ship's voltages. The installation includes the use of a single aerial, normally a vertical wire from the ship's foremast.

The above article has been referred to the Decca Navigator Company before publication and the following is an extract from their reply : « We consider the article to be a very valuable summary of the main features of the English and Danish chains... In connection with the British Admiralty Notice to

Mariners N° 102 of 1949, warning that Mark IV Receivers used in that area might be subject to interference from the Danish Chain (this) was very properly issued by the Admiralty to draw attention to this danger. It is however purely theoretical, since it would imply that a ship was using a Mark IV Receiver, designed to work on the English Chain, when proceeding to either a northern German port or to Scandinavian waters. In practice, of course, any such ship would be carrying a Mark V Receiver ; this Receiver is designed to work under the extreme conditions applying when using the English Chain up to the limit of Danish coverage. The Mark IV Receivers could be equally well dealt with, but there is no operational requirement and therefore no attempt has been made to safeguard them. Expressed more simply, Mark IV Receivers are for use in the English coverage, and Mark V Receivers for ships going between the two coverages".

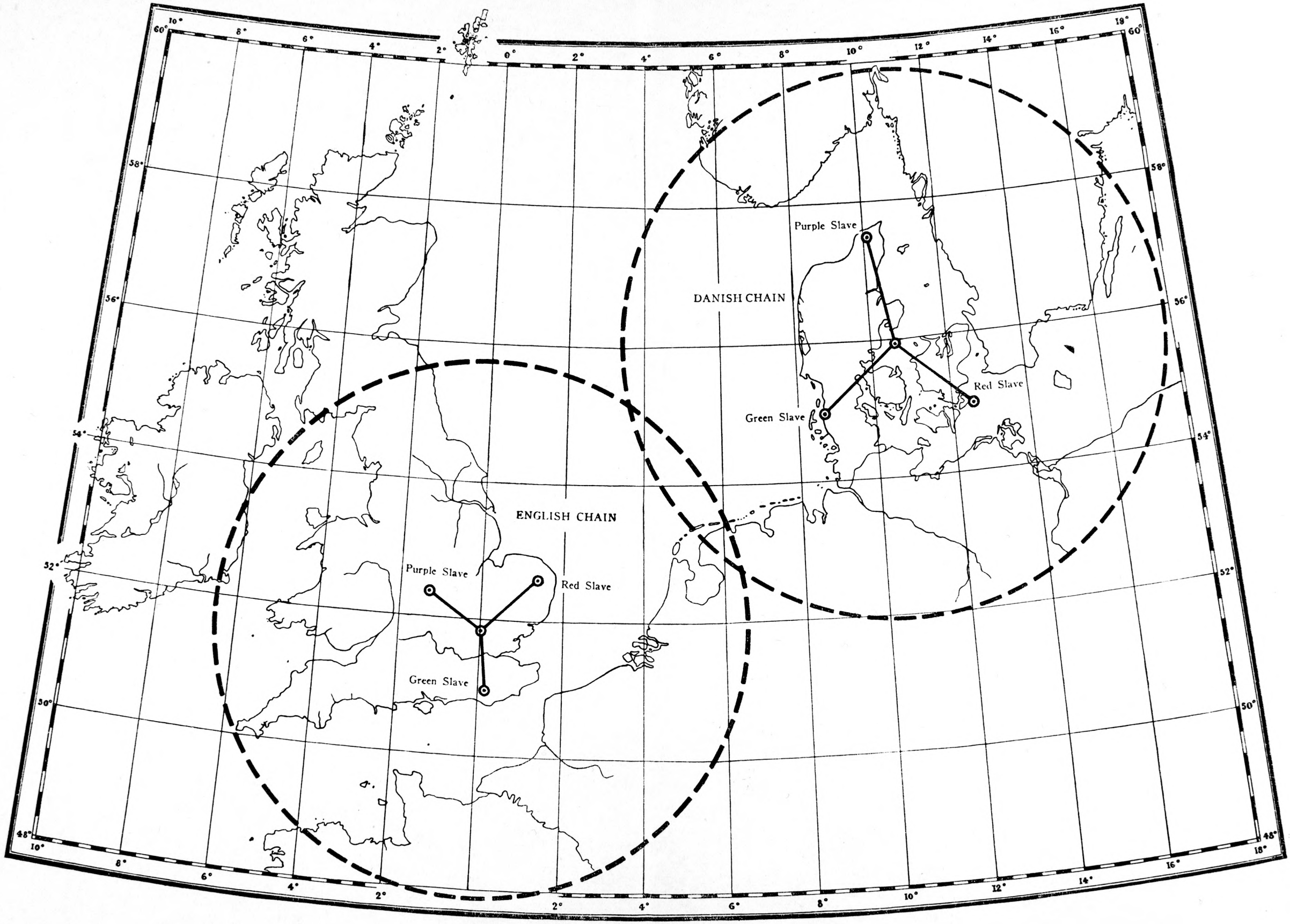


FIG. 1
Diagram showing present coverage of English and Danish DECCA Navigational Chains.

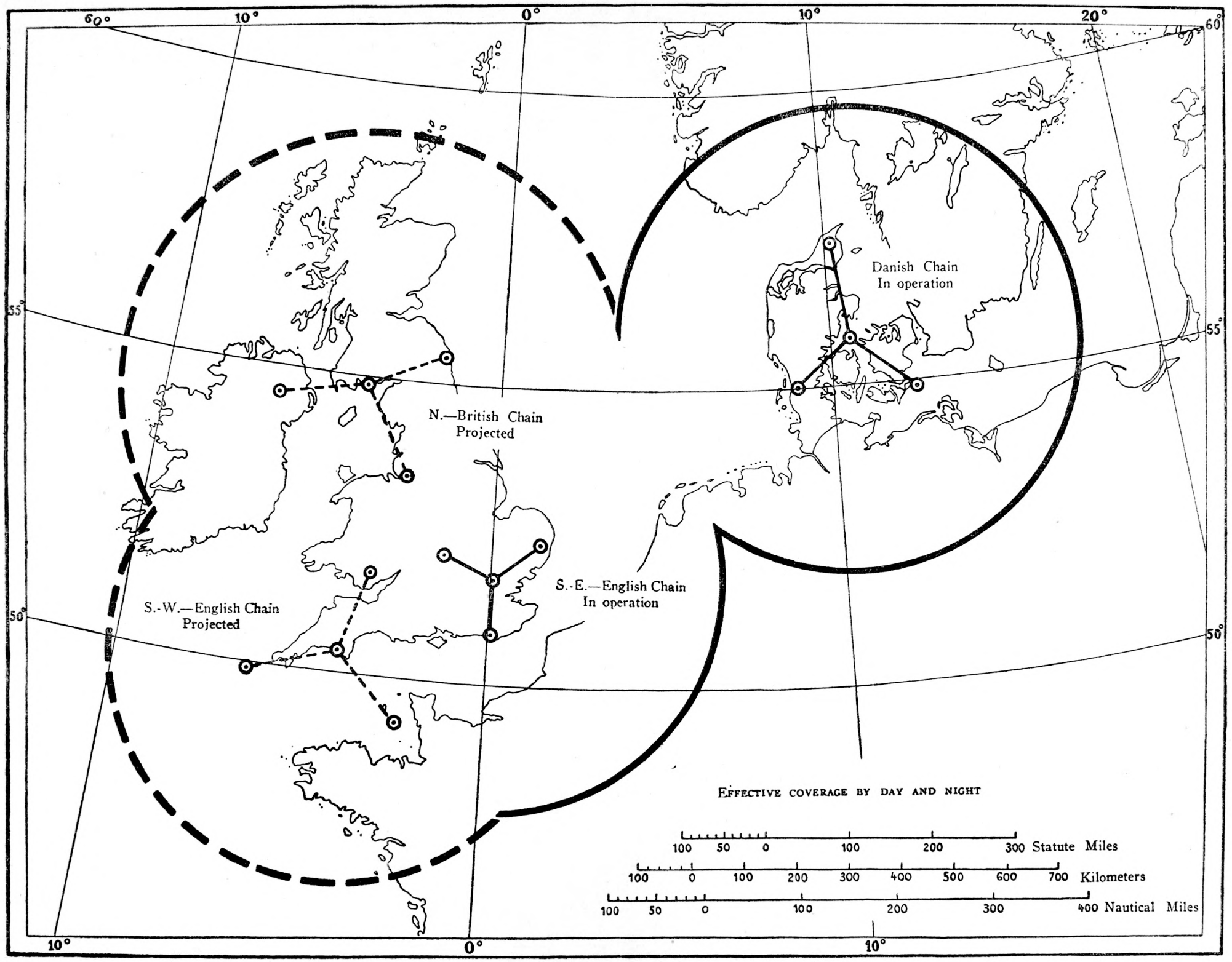


FIG. 2

Diagram showing projected coverage of British and Danish DECCA Navigational Chains.