

Wend

No. D1



STUDIES FROM THE
SCHOOL OF CIVIL ENGINEERING

**THE DISCRIMINATION OF
RADIO TIME SIGNALS IN AUSTRALIA**

G. G. BENNETT

UNICIV REPORT No. D1. JUNE, 1963

UNIVERSITY OF NEW SOUTH WALES, KENSINGTON, N.S.W., AUSTRALIA

THE DISCRIMINATION OF RADIO TIME SIGNALS IN AUSTRALIA.

G. G. Bennett*

Summary: The Problem of discriminating between time signals received on Short Wave frequencies 10 and 15 megacycles per second is discussed. A technique is developed for ensuring that only signals from W. W. V. (H) are recorded.

* Senior Lecturer,
Department of Surveying, School of Civil Engineering,
The University of New South Wales,
Broadway.

It has become apparent over the last few years that on the standard Short Wave frequencies of 10 and 15 megacycles per second (the usual frequencies employed for receiving time signals in field astronomical determinations and field frequency comparisons) that stations other than W. W. V. and W. W. W. (H) are transmitting and impressing time signals. The result has been that observers have doubts as to which station their impersonal time recording equipment is responding to and therefore what post observational corrections need to be applied to their results. Aural monitoring of these frequencies in Sydney shows that the following stations are transmitting:-

<u>Station</u>	<u>Location</u>	
W. W. V.	Washington	U. S. A.
W. W. V. (H)	Hawaii	U. S. A.
J. J. Y.	Tokyo	Japan
B. P. V.	Peking	China.

These facts are consistent with a paper entitled "Standard Frequency Transmissions" by J. McA. Steele in the "Wireless World" of April 1962. Moreover it is apparent from that paper that stations other than the above mentioned may also be present on the two frequencies selected, but it may be assumed that because of their geographical locations the signals from these other stations are sufficiently attenuated as to cause little concern. In passing, mention should also be made of the valuable daily and hourly modulation schedules of the Standard Frequency Transmission provided in the above mentioned paper.

The problem of discriminating between these signals has been approached in two ways:-

METHOD 1.

Discrimination by means of restricting time signal comparisons to periods when some stations are not modulating or breaking their carrier wave.

This method is particularly useful when considering the transmission from B. P. V. , and provided no comparisons are attempted between 0-3, 15-18, 30-33 and 45-48 minutes in the hour no spurious responses from this station will be made. However, this station does transmit a 1,000 c/s tone at other times during the hour (see page 164 of the reference) which may reduce considerably the time available for time signal comparison and it is suggested that a Band Pass Filter be attached to the receiving apparatus to reject this tone. Such a filter has been constructed for the receiver in use in the Surveying Department of the School of Civil Engineering and a circuit and diagram of the filter characteristics is shown (Fig. 1). This filter was designed to allow minimum loss of the frequency 1200 c/s - the frequency of the W. W. V. (H) pulses, and to give maximum rejection of 1,000 c/s - the frequency present on most of the B. P. V. and J. J. Y. transmissions and the pulse frequency of W. W. V.

If such a band pass filter is to be employed it is as well to determine its delay characteristics. This can be done simultaneously with the determination of the delay of the relay in the signal detecting apparatus.

It can be noted that a detector and relay unit have been constructed for the Department's receiver. The unit has features which are considered to be superior to those of the usual high speed mechanical relays in current use. The unit is fully transistorised and is therefore compact and draws little current, also the operation time (delay) of the magnetic reed relay is extremely small (2.0 milliseconds) and is not as subject to variation as other mechanical relays. A circuit diagram of this unit is shown (Fig. 2).

It is apparent that by using the above techniques, the signals from B. P. V. can be discounted and the use of a filter can assist in removing unwanted tones and reducing noise level.

METHOD 2.

Discrimination by means of directional receiving apparatus.

The stations W. W. V. and W. W. V. (H) are geographically situated, as far as Australia is concerned, such that the signals from W. W. V. (H) are received before those from W. W. V. For Sydney the delay in transmission for W. W. V. is 57 milliseconds and W. W. V. (H) 30 milliseconds, and as these signals are emitted simultaneously there is some 27 milliseconds between times of reception. Thus no problem in discrimination arises.

A point of interest concerning the reception of W. W. V. may be noted. In the western parts of Australia W. W. V. is in an antipodal situation and there may be some error in the assumption of the route taken by the wave. Graphs are given (Figs. 3 and 4) to assist in calculating the transmission delay of W. W. V. and W. W. V. (H). These graphs are based on an apparent velocity of propagation of 274,000 km/sec.

These aspects reduce the situation to that of differentiating between J. J. Y. and W. W. V. (H). The major difficulty here lies in the fact that the transmission from W. W. V. (H) is amplitude modulated whilst that from J. J. Y. is in the form of a carrier break. Both of these stations are participating in international co-ordination and their emission times are simultaneous to within 1 millisecond. Geographically, the Stations are situated such that the delay in transmission from both stations is identical at Sydney - 30 milliseconds and at Perth the difference is 11 milliseconds. However, because the carrier from J. J. Y. is broken 20 milliseconds before the beginning of each second there may be false response from this break, which will always occur before the W. W. V. (H) signal actuates the

detector relay. Unfortunately the signals from both of these stations are quite strong in most parts of Australia. An attempt was made to try to decrease the strength of the signal for J. J. Y. by means of a directional aerial. At Sydney the angle between the directions to these stations is approximately 40° . A half wave (15 megacycles per second) dipole aerial with centre feed has been constructed and erected at Ultimo, Sydney. The aerial unfortunately is fixed and cannot be rotated but its direction is directly in line with J. J. Y. and should give minimum signal strength from J. J. Y. Comparisons of signal strength by aural means using both direction dipole and a short wire aerial have not shown any appreciable difference. It is also problematical from the practical viewpoint whether a portable dipole could or would be used by field parties, especially in remote areas where access and transportation is difficult and station siting limited.

Method (2) has disclosed that a directional aerial accomplishes little and the discrimination between J. J. Y. and W. W. V. (H) is not resolved.

A solution to this problem by means of method (1) is possible in the periods 0-3, 15-18, 45-48 minutes; however, it has been found that the signal from B. P. V. completely masks the other stations and differentiation is not possible.

A workable solution to the problem was found in the difference between the modulation schedules of the stations for each minute. The 59th pulse of every minute for W. W. V. (H) is omitted but is not absent for J. J. Y. The signals were therefore monitored using the band pass filter (principally to remove the 1,000c/s tone) and it was found that there was no relay response on the 59th second of each minute. Furthermore the J. J. Y. carrier is broken 200 milliseconds before the final second of each minute and here again no relay response was found. It was inferred

therefore, that the J. J. Y. carrier break does not operate the relay at all and that outside the time intervals stated in method (1), W. W. V. (H) is the only signal received.

Acknowledgements

The writer is indebted to the following for their assistance in this investigation.

Professor R. M. Huey, School of Electrical Engineering, University of New South Wales, for the design and construction of the audio filter.

Mr. W. O'Shaughnessy, Telephone and Electrical Industries, Meadowbank, for the design and construction of the signal detector and relay.

Mr. J. N. Boots, Mt. Stromlo Observatory, for the verification of the J. J. Y. transmission schedule from 'International Telecommunications Union' (I. T. U.) publications.

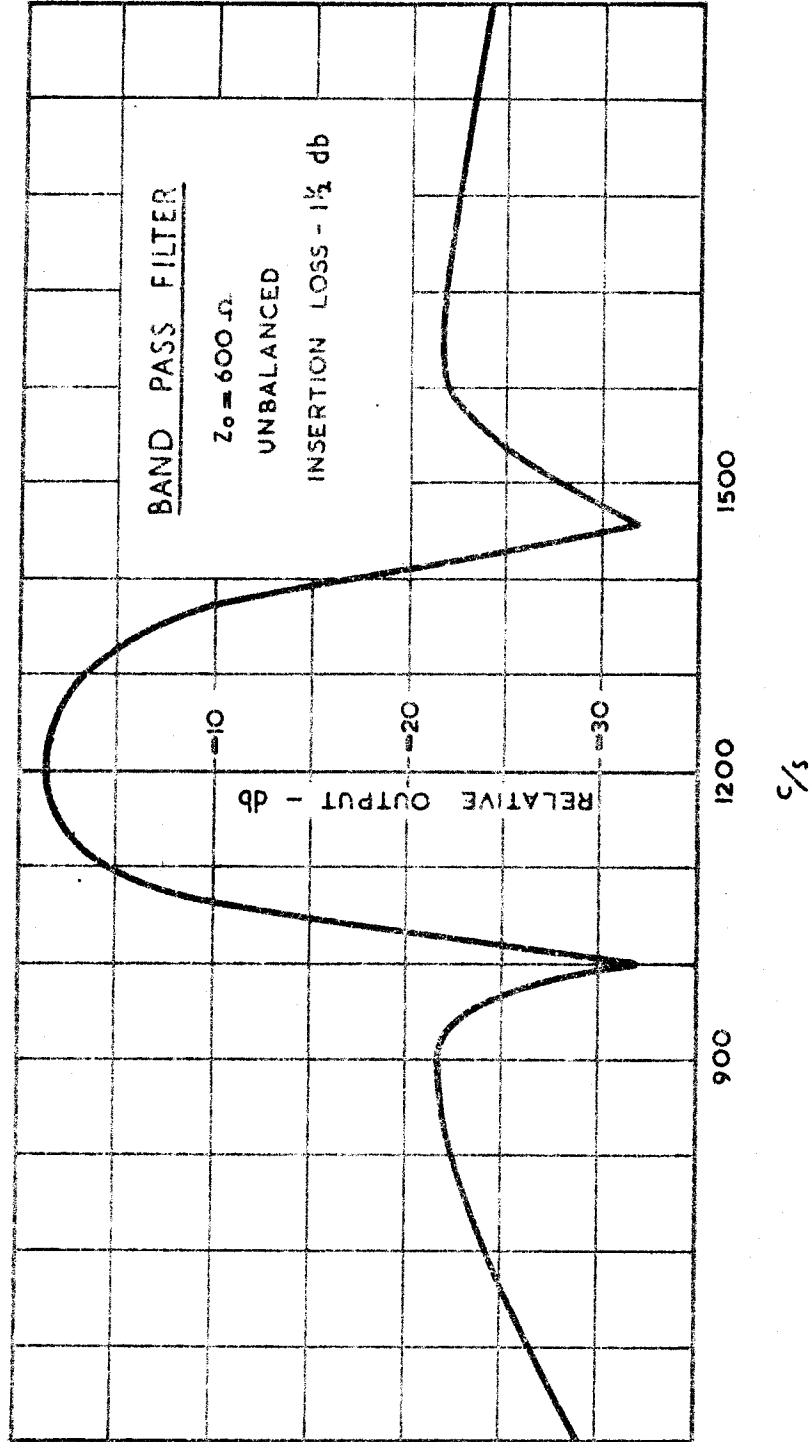
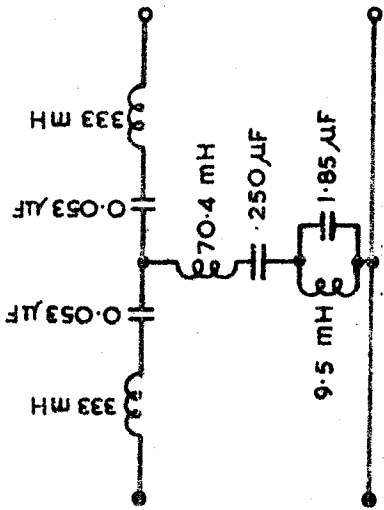
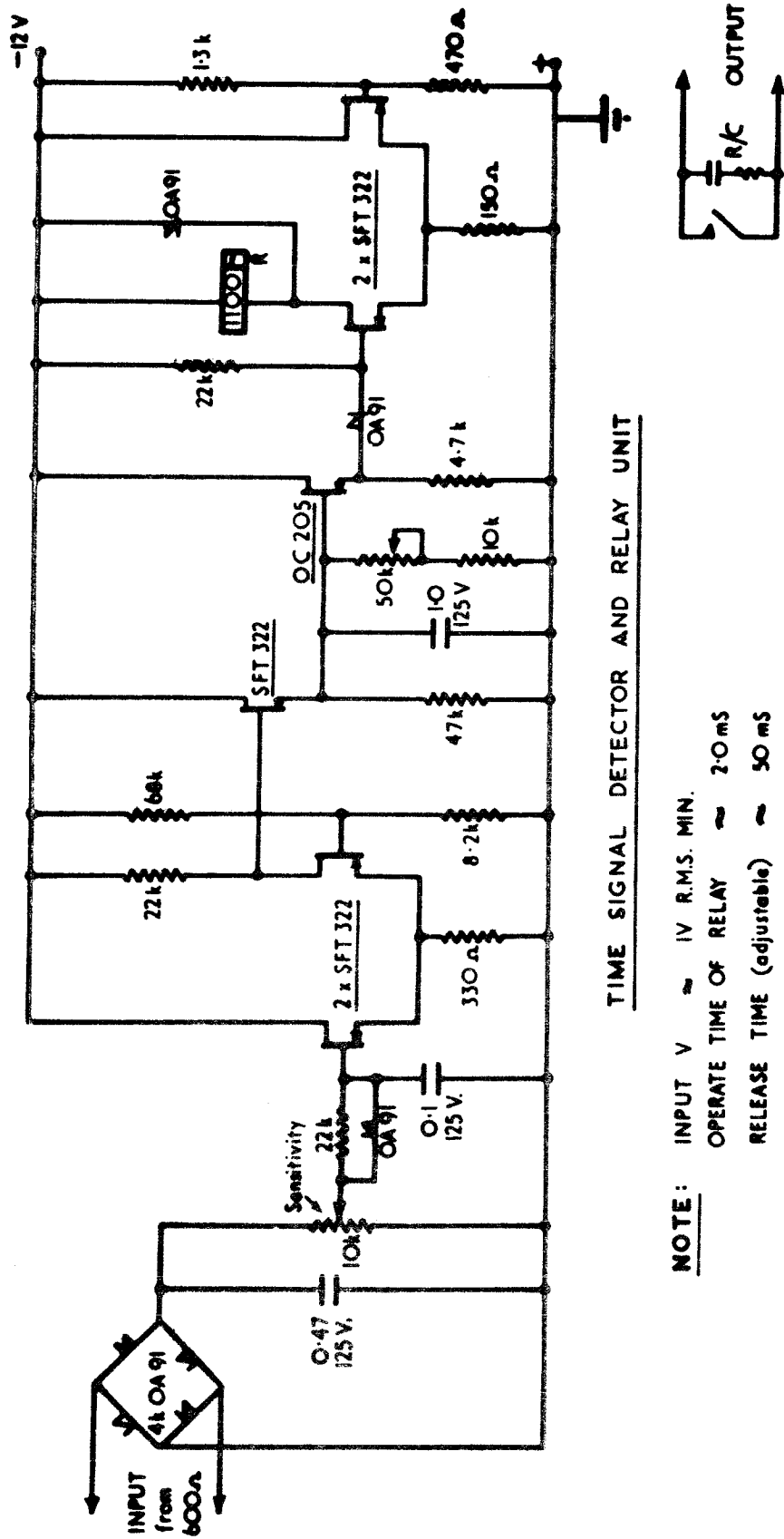


FIG. 1.



TIME SIGNAL DETECTOR AND RELAY UNIT

NOTE: INPUT V \approx 1V R.M.S. MIN.
 OPERATE TIME OF RELAY \approx 20ms
 RELEASE TIME (adjustable) \approx 50ms

FIG. 2.

TRANSMISSION
DELAY
WWV
IN MILLISECONDS

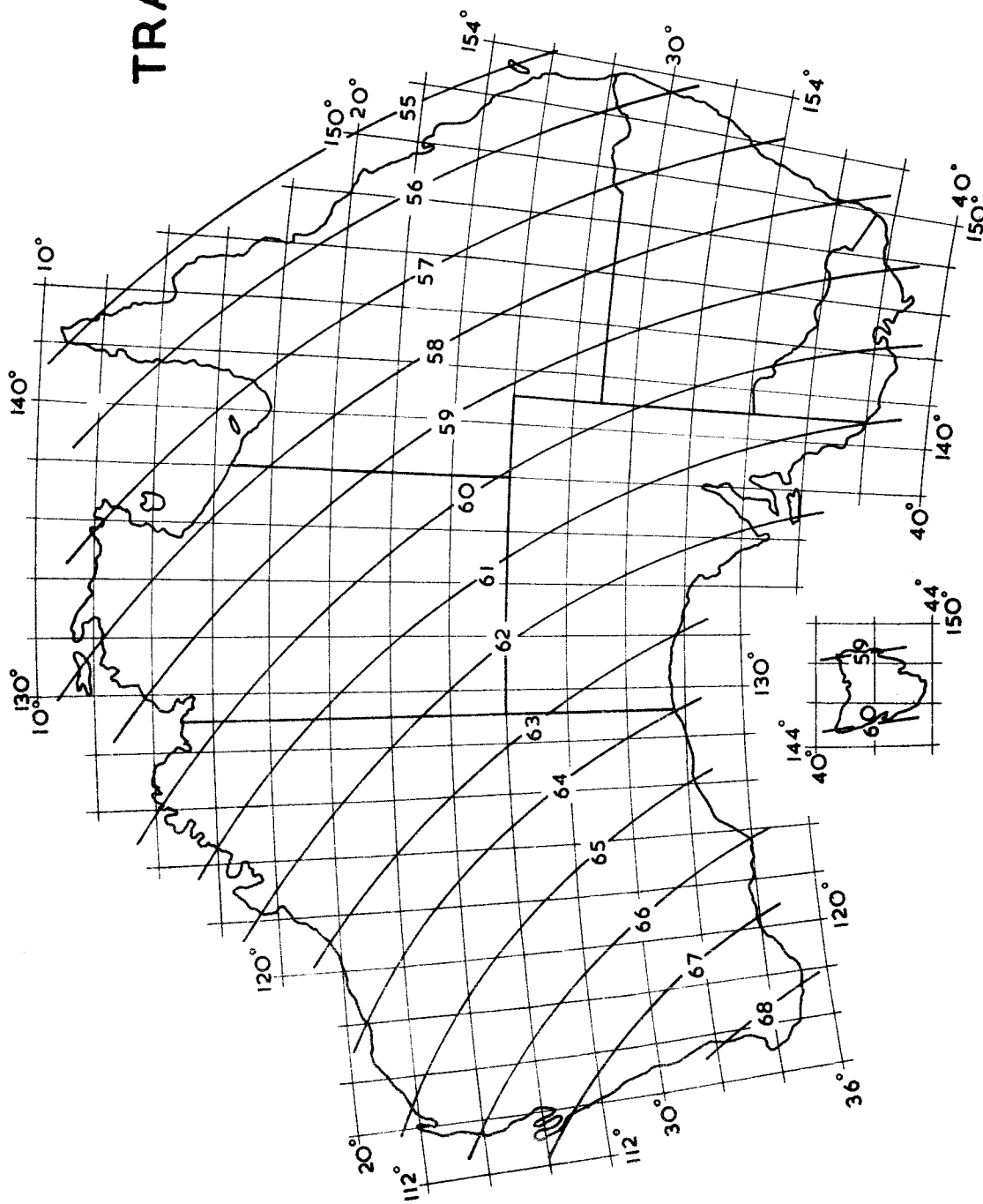


FIG. 3.

TRANSMISSION
DELAY
WWV(H)
IN MILLISECONDS

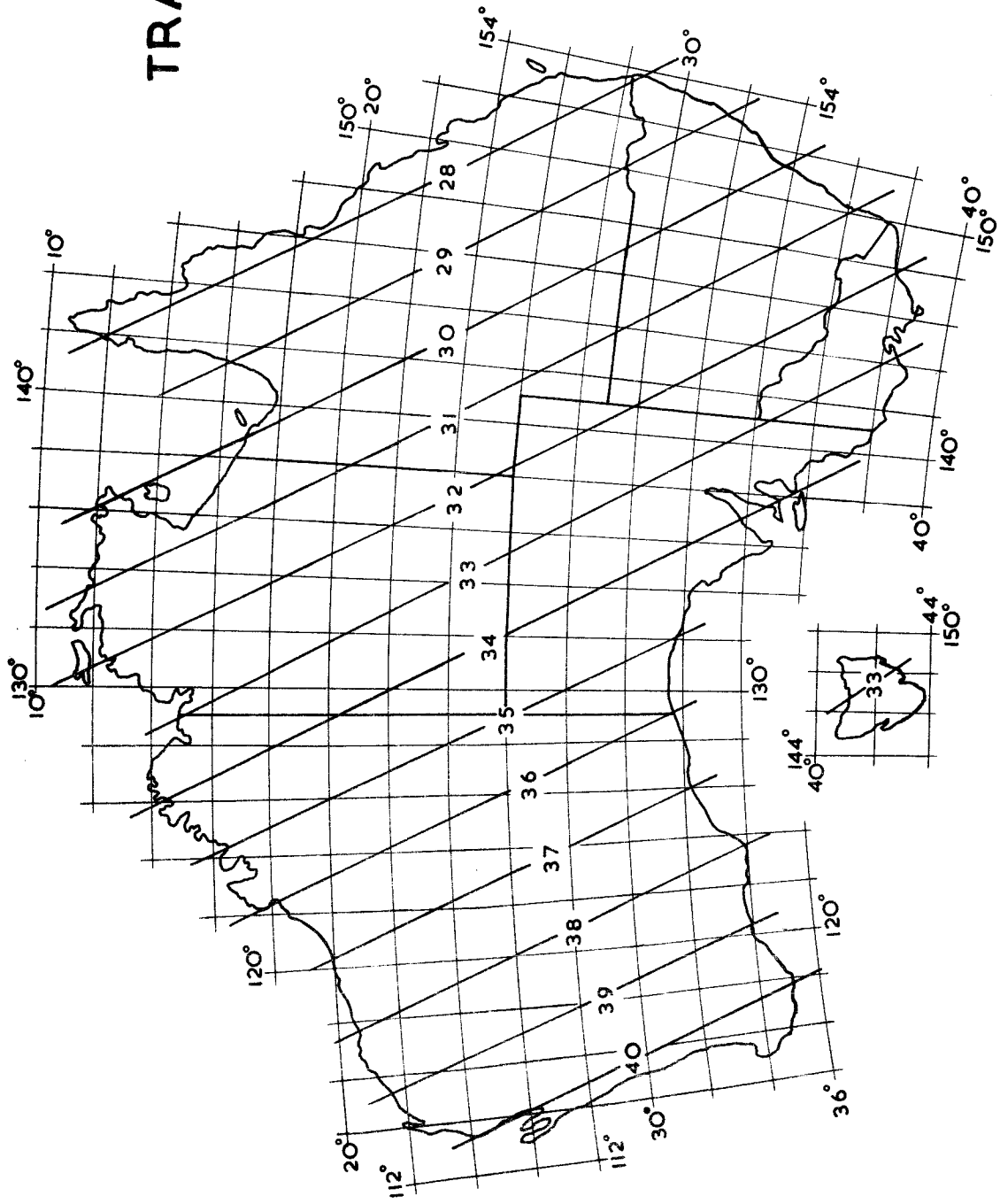


FIG. 4.