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FOREIGN TECHNOLOGY DIVISION

THE LATEST NAVAL NAVITATION EQUIPMENT OF THE SOVIET UNION

by

I. Kalinskiy

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UNEDITED ROUGH DRAFT TRANSLATION

THE LATEST NAVAL NAVIGATION EQUIPMENT OF THE SOVIET UNION

By: I. Kalinskiy

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ABSTRACT: Various aspects of three Soviet radio beacons presently in use in Soviet waters are discussed. The first of these is the VRM-5 sectored radio beacon with a range of up to 1000 nautical miles and a direction-finding accuracy of 0.2-0.5°. Two figures in the article give the computed and experimentally determined corrections for the VRM-5 radio beacons located at Terpeniya and Shumshu on the eastern coast of the Soviet Union. It was established that systematic errors in VRM-5 sectors are time stable and keep their sign and magnitude at all distances from the beacon. During the period 1958-1960, a new operating procedure was introduced for use with omnidirectional radio beacons. In this procedure, which significantly reduces mutual interference between beacons and makes direction finding much easier, six beacons are placed together, with each beacon operating for one minute on the same frequency; thus, over an interval of six minutes, each beacon operates only once. Between 1958 and 1960, many radio beacons were replaced by the KRM-100, which has a field strength of 75 μv/m at a maximum range of 150 nautical miles. The transmitter has a medium-wave range and operates on crystal-controlled fixed frequencies or over an entire band. A tone generator modulates the carrier frequency by one of eleven fixed audio frequencies from 354 to 1052 mc. The Soviet MRM-61, a low-power automatic tubeless radio beacon which requires no servicing over a 4-5 month period, was recently introduced. Depending upon the antenna used, the operating range of this beacon is between 25 and 35 miles. Parametric integrity is maintained at air temperatures of -20 to +40°, humidity to 98 ± 2%, and at wind velocities up to a force of 12. Frequency stability is 0.03% and the output is 1.5w. In high-traffic and hard-to-reach areas, two transmitters are used in the MRM-61. The primary and secondary transmitters are controlled by a "Dubler-1A" switching unit which cuts in the secondary transmitter should the primary fail. An additional signal is transmitted in the beacon code, indicating primary transmitter failure. The author also briefly discusses power sources for

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radio beacons with emphasis on solar batteries. In conclusion, he states that Soviet specialists have found new methods of combatting interference. The basis of these methods lies principally in improving beacon operation and in the distribution of frequencies between stations. Orig. art. has: 3 figures. English Translation: 6 pages.

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THE LATEST NAVAL NAVIGATION EQUIPMENT OF THE SOVIET UNION

I. Kalinskiy, Captain of Engineers, 2nd Class

The navigational equipment utilized on the seas washing the shores of the Soviet Union is being improved each year.

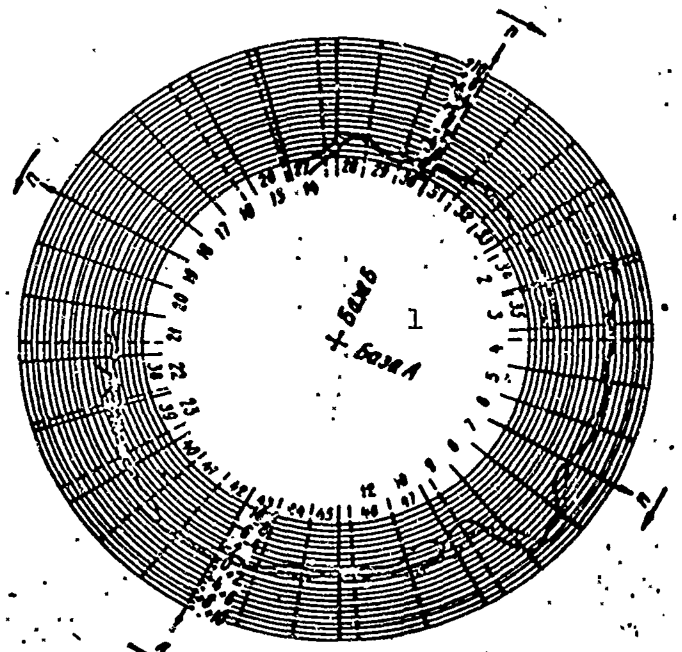
During the past 5 years more than 35 new radio beacons have been put into operation, as well as 30 electrically operated light beacons, 150 navigational blinker signals, 18 sound-warning installations and more than 50 beacons for various purposes.

All of these beacons and structures are built, as a rule, according to standard plans out of contemporary materials. Industrial reinforced-concrete prefabricated units have been used extensively in the construction work.

Included among the navigational-equipment facilities in the Far East are new powerful VRM-5 sector radio beacons.

The advantages of the sector radio beacons include their great effective range (up to 1000 miles), elevated direction-finding accuracy (0.2-0.5°) and the possibility of radio-beacon signal reception by means of conventional radio direction-finders or message receivers.

Extensive scientific-theoretical and experimental work has been carried out in recent years to facilitate the study of the features involved in the utilization of these radio beacons and to increase the accuracy of determining position with their aid. Calculations of the errors arising as a result of the conditions of radio-wave propagation are accomplished on the basis of a generalized method of radio-wave



2 — Расчетные поправки
3 — Экспериментальные поправки базы А
4 — Экспериментальные поправки базы Б

Fig. 1. 1) Base; 2) calculated correction factors; 3) experimental correction factors of base A; 4) experimental correction factors of base B.

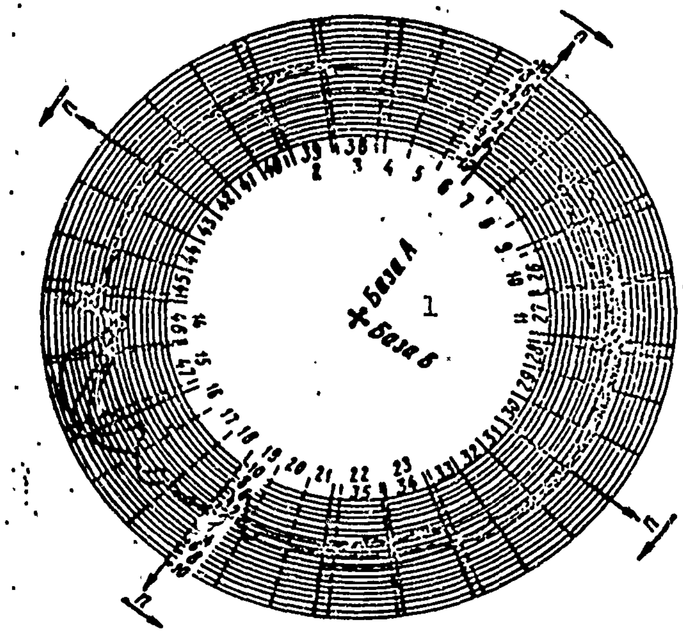


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Fig. 2. 1) Base; 2) calculated correction factors; 3) experimental correction factors of base A; 4) experimental correction factors of base B.

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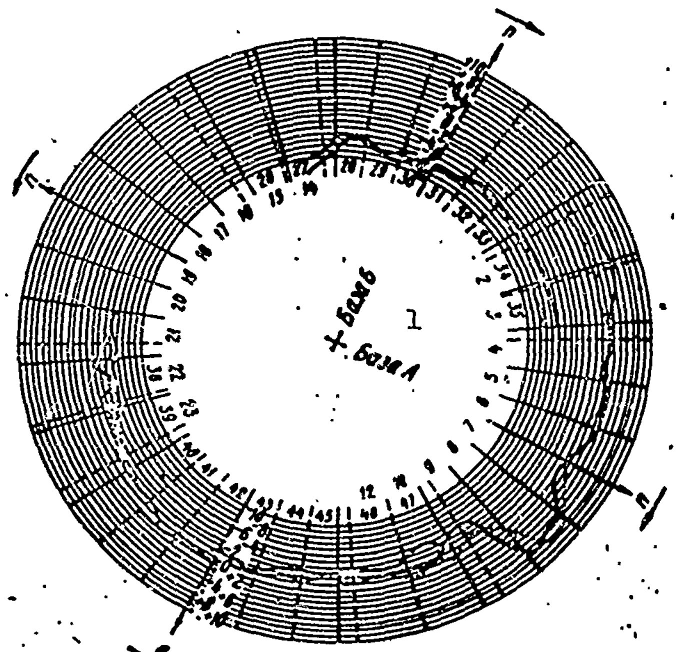

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Fig. 1. 1) Base; 2) calculated correction factors; 3) experimental correction factors of base A; 4) experimental correction factors of base B.

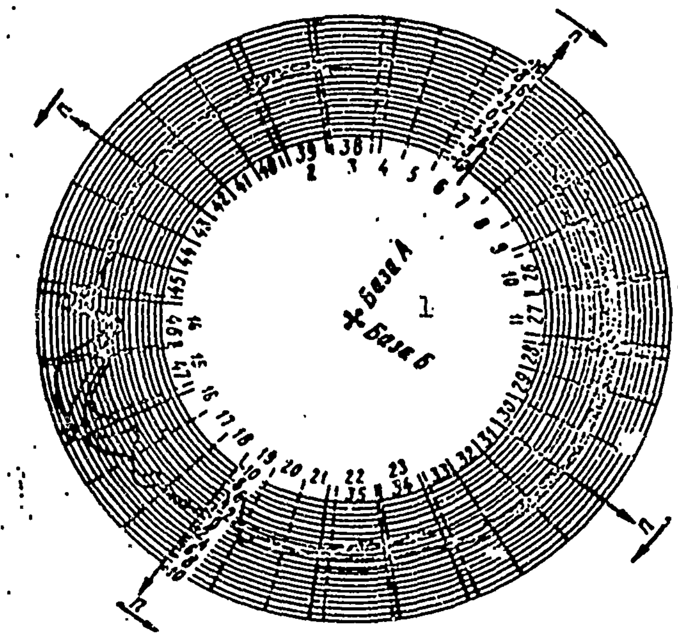

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Fig. 2. 1) Base; 2) calculated correction factors; 3) experimental correction factors of base A; 4) experimental correction factors of base B.

amplitude and phase calculation for waves being propagated above the electrically nonhomogeneous surface of the earth. These calculations are in good agreement with experimental data.

Figures 1 and 2 show the results of earlier calculated correction factors and indicate the correction factors determined experimentally for the VRM-5 Terpeniya (Fig. 1) and Shumshu (Fig. 2) radio beacons. The correction factors calculated in advance clearly reflect the quantitative relationship governing the variations in the experimentally determined correction factors for the indicated radio beacons.

As a result of the consideration of the correction factors shown in Figs. 2 and 3, the systematic errors are eliminated and the accuracy of direction determination is increased by factors of three and four. It has been established that the systematic errors in the operating sectors of the VRM-5, measured during the course of naval navigation studies, are stable with respect to time and virtually retain their sign and magnitude at all distances from the beacon.

In 1958-1960 a new regime was introduced for the operation of conventional circular-scan naval radio beacons which made it possible considerably to reduce the level of mutual interference between these radio beacons and to ensure greater convenience in direction finding for the masters of vessels.

The outstanding feature of this new regime was the consolidation of six radio beacons into a single group, each operating successively for 1 min on a single frequency. Thus, within the course of a six-minute cycle, each radio beacon is in operation once. This cycle is retained under all meteorological conditions.

Simultaneously, the old equipment in the majority of the radio beacons was replaced by a new type KRM-100 in whose design the latest achievements in the field of radioelectronics have been taken into consideration.

The effective range of the KRM-100 is equal to 150 miles for a field strength of 75 μv/m at the limit of the effective range. The transmitter of this unit has a middle-wave range and can function both on fixed frequencies, quartz-stabilized, as well as over a variable range. The audio-frequency oscillator provides for modulation of the radio-beacon carrier frequency for one of the eleven fixed audio frequencies from 354 to 1052 hz.

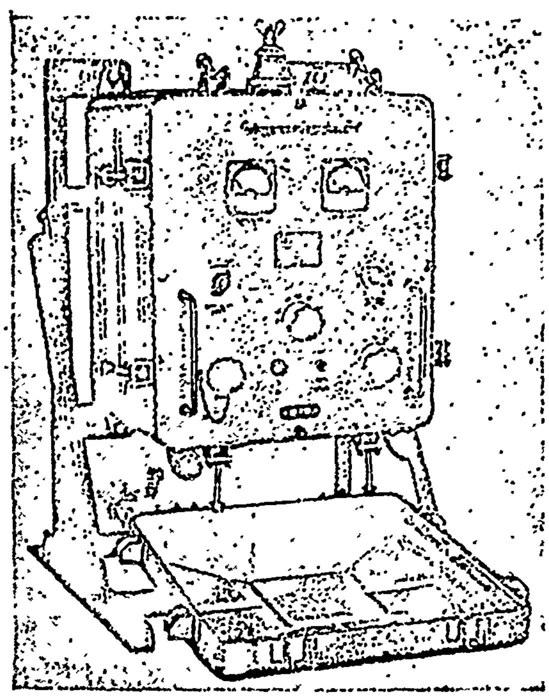

Fig. 3

In radio-beacon operation the oscillation audio-modulated call signals and the dash for direction finding can be transmitted with intermittent or continuous emission of high-frequency oscillations. The latter form of operation facilitates direction finding by means of an automatic radio direction finder, since it ensures stability for the readings of an indicator at the instant of call-signal transmission.

Transistorized instruments utilized to achieve significant increases in equipment operational reliability with simultaneous reduction in dimension have come into extensive use as beacon equipment.

A new low-power automatic tubeless radio beacon of the MRM-61 type (Fig. 3) has come into extensive use in recent times and the circuit of this unit has been designed for the exclusive utilization of transistorized instruments. The equipment exhibits great operational independence and requires no servicing whatever for periods of up to 4-5 months. The operating range of a radio beacon, depending on the type of antenna utilized, varies within limits from 25 to 35 miles. The preservation of all engineering parameters of the equipment is guaranteed at air temperatures ranging from -20 to +40°, for humidity up to 98 ± 2% and for a wind velocity of up to 12 points.

The transmitter, which weighs 30 kg, operates on the middle waves and on quartz-stabilized fixed frequencies. The frequency stability is 0.03%; the output power is around 1.5 w.

To increase the operational reliability of the unserviced MRM-61-type radio beacons placed at points of difficult access and in sections of intensive navigation, two transmitter installations are utilized – a main transmitter and a reserve transmitter – with the latter cut in automatically on breakdown of the main complex by means of a special "Dubler-1A" unit. The latter ensures transmission of an auxiliary signal in the code of the radio beacon, making possible the timely announcement of beacon failure.

The services of all nations concerned with the operation of naval radio beacons are presently confronted with a problem of extreme importance – the reduction of interference in radio-beacon direction-finding. Soviet specialists have established new norms of interference protection. These norms provide the basis for radio-beacon operation and the distribution of frequencies among stations.

Particular attention has recently been devoted to problems of establishing highly effective sources of power for completely automated and unserviced coastal and sea-going facilities of navigational equipment. To increase operational reliability and to improve the tactical-engineering characteristics of these facilities, they must be completely electrified. The problem of the electrification of unserviced navigation signals with low-power light sources fitted out with lamps ranging in power from 6 to 50 w is currently being resolved successfully. If we take into consideration the flashing sequence of a beacon, the daily energy requirements of these facilities do not exceed 0.25 kw/hr.

To supply power to the navigational light beacons that are set up in hard-to-reach areas, low-power wind-driven stations of the VES-2M type, with a storm-resistant windpower unit, are utilized in addition to galvanic batteries.

The introduction of solar batteries for power supply to hard-to-reach and infrequently visited navigational facilities is of particular interest. The conversion of solar energy into electrical power by means of silicon photocells is particularly attractive.

A domestic power installation with a solar battery for navigational signals provides particularly high reliability. It can operate in latitudes from 40 to 60° at any time of the year and requires no servicing for a period of twelve months.