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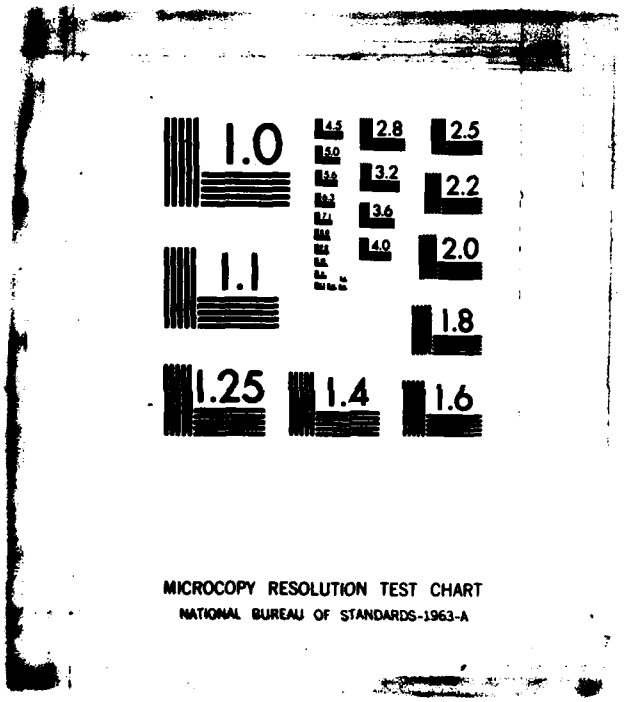
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TRANSLATION

TITLE: ANALYSIS OF THE SA-N-1 GOA
THE MOST COMMOM MISSILE ON SOVIET SHIPS

ANALISI DELL' SA-N-1 GOA
IL PIU' DIFFUSO MISSILE IMBARCATO DELLA MARINA SOVIETICA

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ANALYSIS OF THE SA-N-1 GOA

The Most Common Missile on Soviet Ships

[Spano, L. and Cioglia, S.; Rivista Marittima, April 1983, pp. 89-92; Italian]

The Soviet Navy has lagged a little behind the U.S. in AA missiles and their production vis-à-vis the enormous efforts made at the end of the 1950s to change the strategic-operational roles of a fleet no longer limited to coastal duties, but able to project power in an oceanic dimension. Not much is specifically known about the research and development that preceded making new AA systems operational, but presumably they [the Soviets] conducted numerous tests aboard modified auxiliaries, exactly as Western navies did and continue to do, and that they used one or more units of the SIBIR Class for the launches. /83*

Unlike the U.S. Navy, which developed specialized sea-going SAMs, the Soviet Union, to regain lost time and facilitate production with some evident economic and logistic advantages, prefers to employ land-based operational weapons or those being developed for use ashore. This would explain the GUIDELINE, whose large size and complexity created such problems that only a single SVERDLOV-Class cruiser, the DZERZHINSKIY, was outfitted with a single bulky system aft. As proof of the attendant difficulties and the resulting poor performance obtained, the old cruiser remained the only ship in the Soviet Navy armed with the weapon system.

Work on the SA-N-1 GOA proceeded much more quickly; it was a contemporary of a similar land-based medium-range system. Western observers were surprised when a KOTLIN-Class destroyer, the BRAVYY, made a June 1962 deployment to the Baltic displaying a highly modified twin-railed launcher complete with its own fire-control system aft. /84

The uproar over the novelty overshadowed the evidence of a new experimental version, which was only confirmed five years later, when missiles began appearing on several KOTLIN-Class ships with similar modifications and numerous secondary characteristics that differentiated them from the prototype. The sea trials of the first KYNDA followed in the same period, and it did not go unnoticed that she was the first Soviet ship designed and built around two different missile systems--an antiship system and the SA-N-1 air-defense system. Also laid down were the first KASHIN-Class units, designed primarily for an AA role, with a gas turbine propulsion system as their most notable characteristic.

On these destroyers the SA-N-1 became a fully operational system of undisputed capability. In 1967 the remaining KOTLIN-Class ships appeared, along with the first KRUPNYY-Class ships with their obsolete SS-N-1 antiship missile, replaced by the SA-N-1. This changed their underlying

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*Numbers in right margin indicate pagination in original text.

mission so much that they earned a new NATO designation: the KANIN Class. The last ships to get the GOA were four KRESTA I-Class cruisers that took over assignments from the KYNDAs, a more balanced combination emphasizing the AA role over the antiship role. On the slips, in fact, were the two MOSKVA-Class ships and many KRESTA II-Class vessels, which eventually achieved equivalence with Western systems by deploying missile systems and modern electronics. We may also mention that in 1970 the Polish Navy received the destroyer SPRAVEDLIVYY, a KOTLIN SAM-Class vessel rechristened WARSZAWA, and the Indian Navy took transfer of three recent KASHIN destroyers to their RAJPUT Class. This makes these two navies unique outside the Soviet Navy, to have the naval GOA system in service. It is likely that in coming years other navies linked to Moscow will get some ships armed with the same missile.

Arhitecturally, the GOA is a classic first-generation AA missile, with a two-stage body and many groups of fins. Its configuration vaguely recalls the GUIDELINE, especially the upper stage; they differ, naturally, in dimensions and propulsion systems, with the SA-N-1 first stage having a solid propellant like the second stage. The 1.98-m-long booster is made up of a 50-cm-diameter cylinder rounded on the upper end and slightly pinched at the tail. It is fitted with four 100 x 65-cm rectangular fins, folded lengthwise on the booster when the missile is stored or on the launch rail. When released on launch, they attain maximum span by a channel in immediate contact with the end of the arm of the ramp which triggers the unfolding. Because of the necessity for improved storage and great ramp compactness, this same solution was adopted by the British SEA DART AA /85
missile. The 4.7-m-long upper stage shows a notably advanced form with three sets of fins. The four fully-articulating small fins are slightly aft of the roughly 55-kg warhead. Aft of them, a package of electro-mechanical dynamic actuators receives signals from sensors contained in the shafts located at the extremity of the large cruciform fins midmissile; commands go to the small, mobile aerodynamic surfaces. The rocket motor takes up the aft part of the stage, which increases in diameter fore to aft, and which supports another two movable surfaces that are trapezoidal with small dimensions. The aerodynamics of the missile are strongly penalized by the number and size of the fins and, especially, by the presence of removable panels for periodic checks and longitudinal and transverse ribs for masking the control wires and for stiffening. On the whole, the /88
missile should have an optimum stability and maneuverability; but this is insufficient to guarantee defense of ships against high-speed, low-level attacks by modern aircraft from the Western bloc.

The SA-N-1 system usually relies on a radar system composed of a BIG NET long-range air-search radar, a HEAD NET A/C [Alpha or Charlie] medium-range radar, and naturally the PEEL GROUP missile-guidance radar. The PEEL GROUP is an integral part of the AA system, while there are several combinations of search radars. KYNDA-Class cruisers and some of the KASHINs carry HEAD NET A, for example, while KRESTA I-Class have the BIG NET and the HEAD NET C (the 3-D version of HEAD NET A), as do the rest of the KASHINs. A single package of the main search radar of the HEAD NET A or C version outfits the KOTLIN SAM and KANIN Classes. These differences, especially those which are intraclass, are owing to the age of the ship

(BIG NET and HEAD NET C appeared later), but also the role that the particular ship plays within the fleet.

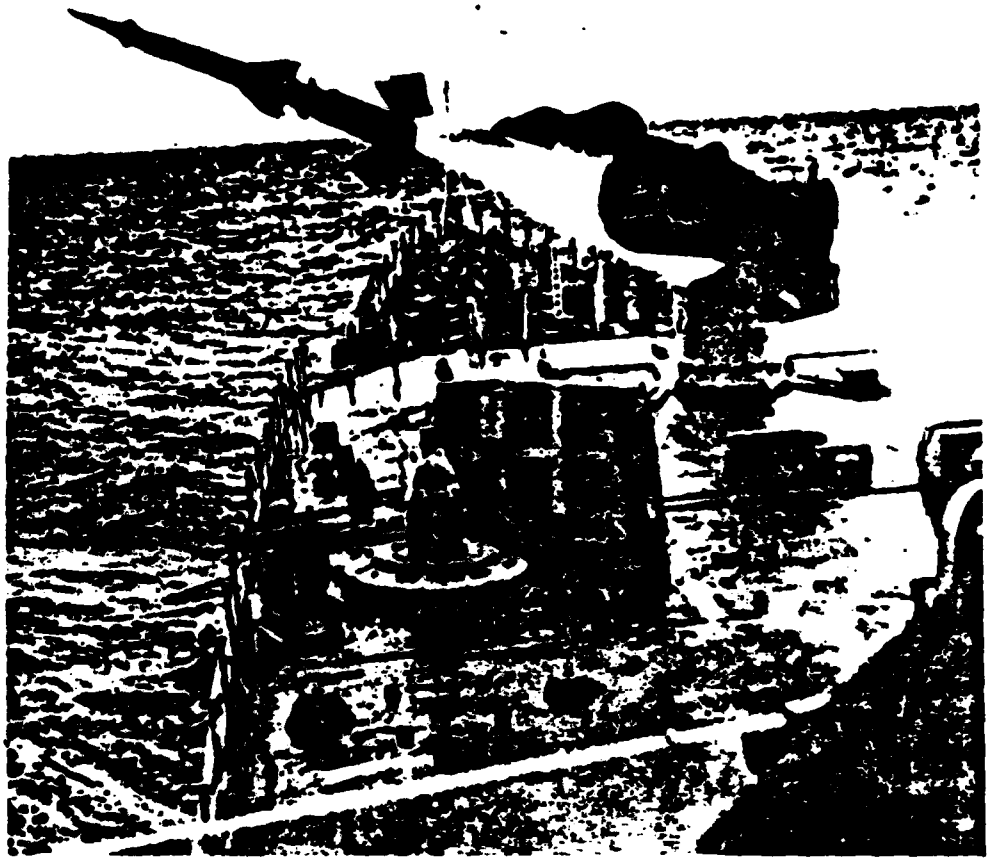
The BIG NET is a large, long-range search radar in D or E/F band with a radius of action of 200 nm and a useful range of some 100 nm. The HEAD NET A uses the same bands and has a range of 70 nm, which is reduced to a little more than 20 nm in naval use. The HEAD NET C has similar characteristics, with 3-D capability obtained by coupling two HEAD NET As, one /89 of which is inclined about 25-28° to the horizon. The weight of these antennas is very high, even higher than corresponding Western models that go back to the early 1950s. Locking on aerial targets, the radar tracks them to 30-40 nm for handoff to the PEEL GROUP, which is the real and appropriate control system. PEEL GROUP, according to some sources, operates in H/I band, while the others refer it to G/H. The apparatus is made up of a massive, truncated conical support capable of movement around its axes and of vertical movement, and four parabolic antennas of differing dimensions. Two of the antennas operate for elevation, two for azimuth. The vertical antennas have oscillating scan, while the horizontal (azimuth) antennas have a wider rotating sector. In practice, each antenna pair has a function to transmit information to the missile on its position relative to the target and what flight path corrections to make.

The launcher ramps illustrate a definite technological backwardness vis-à-vis comparable Western launchers, especially those in the U.S. Navy, but function notably well. All the electrical drives necessary for various movements are contained in the body of the launcher. The cylindrical base sits on a toothed pinion connected with an electric motor and included /90 in the upper body of the ramp for azimuthal movement of the two arms. Movements are accomplished by a chain drive that transmits them from a series of discs in a pressurized oil bath.

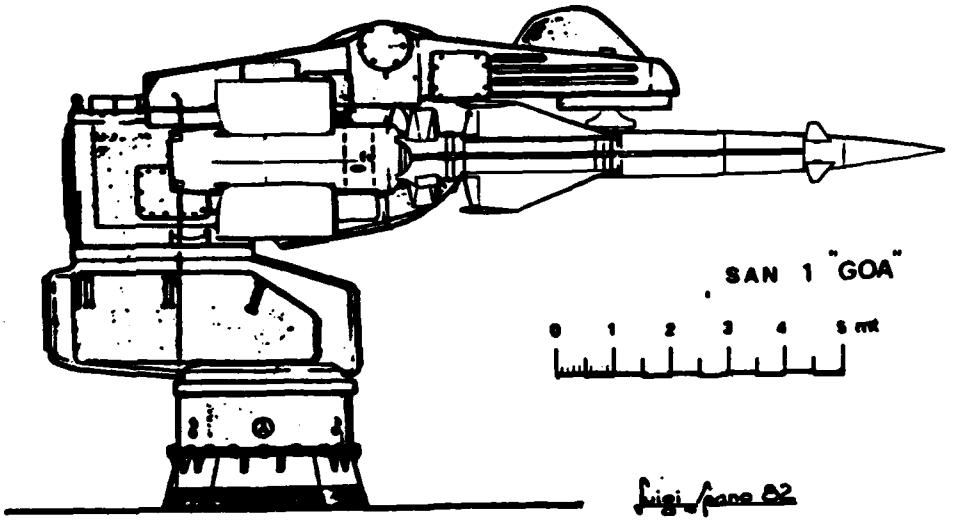
The two S-shaped arms function to keep the missiles parallel to the plane of rotation. Some sources describe a complex stabilization system for the ramp, but indications seem to be to the contrary. The top part of the launch rail shows a noticeable curvilinear keel-like structure made of narrow sections that removes easily and probably protects the chain used to pull up the missile to the ramp. In the absence of the GOA, the attachments are retracted and protected by special hatches. The launcher has lots of panels for maintenance access. All the motors are easily checked in place, as well as the various mechanical parts and drives, or removed in case of repair or replacement.

For more extensive maintenance there are several hooks and eyelets that allow all or part of the ramp to be easily hoisted and disconnected from the base. A system peculiarity, variously interpreted, is the varying arrangement of hatches for missile release along the longitudinal axis of the ships on which they are embarked. ON KYNDA, KASHIN, and KOTLIN SAM ships, these hatches are aligned with the ship's transverse axis and consequently the ramp must be in the same position for loading. On KRESTA I and KANIN-Class ships the hatches are alongside the ramp on the long- /91 itudinal. In our opinion this diversity is more a result of the housing for the missiles (22 missiles per magazine) that must be connected modularly.

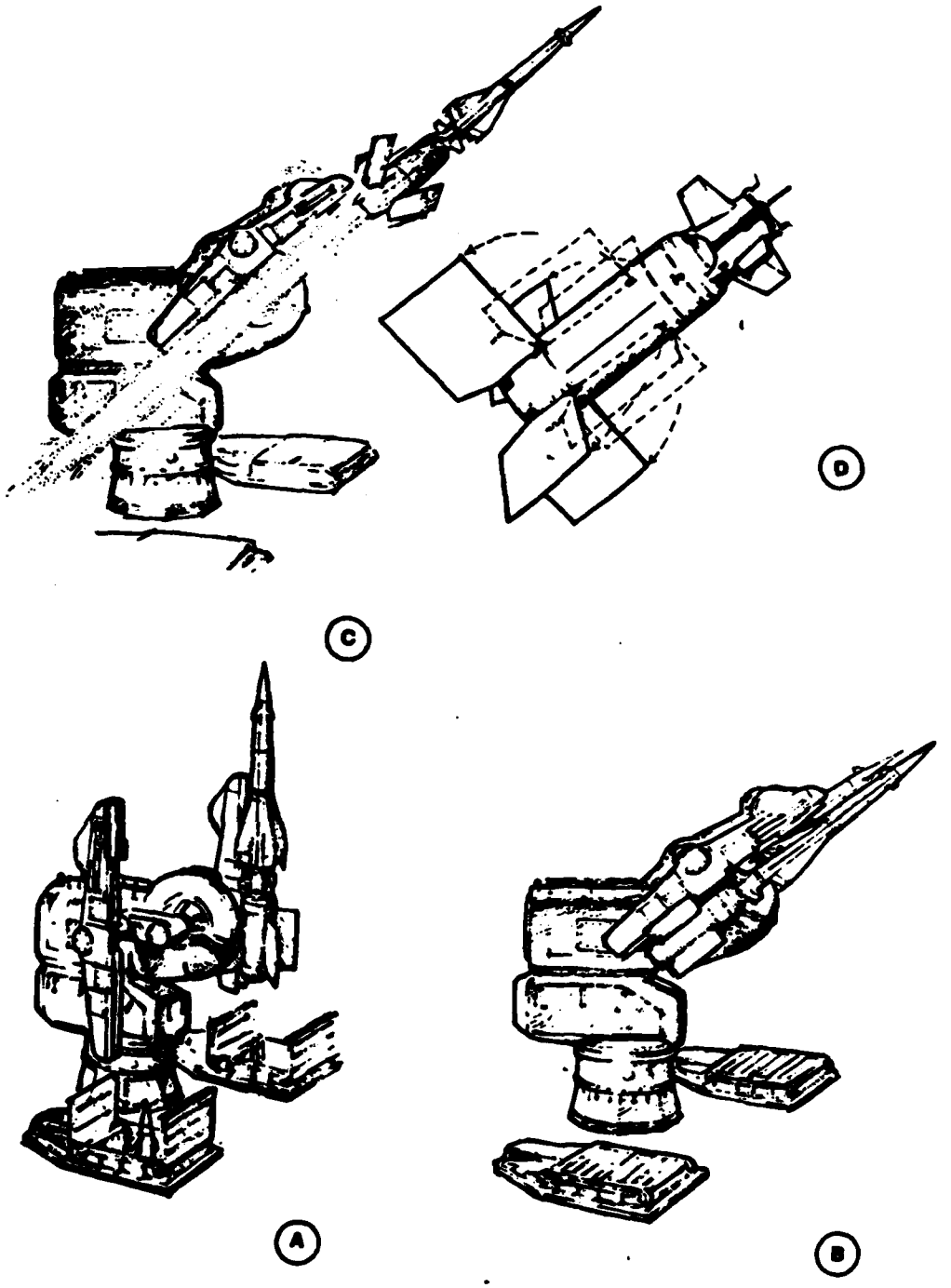
The SA-N-1 GOA will remain the standard, medium-range AA missile in the Soviet Navy for some time; new missiles being brought into service have different operational characteristics, and rather than being substitutes are installed alongside the older Soviet system. Production of the ramp and the PEEL GROUP has certainly stopped, while the missile continues to be produced, with small variations in warheads and electronic equipment, and is the same missile used by the Red Army and numerous other countries friendly to the Soviet Union or within her orbit. Since the GOA is the ultimate extrapolation of an idea , or rather of a family of now /92
largely obsolescent missiles, it will not be open to futher development, contrary to what occurred with the TARTAR-TERRIER-STANDARD family. This has jeopardized in no small way the capability of the Soviet fleet for medium-range air defense, since either the SA-N-3 or the SA-N-4 performs too differently to be able to cover the airspace assigned to the SA-N-1. Only now, with the new missiles found on KIROV, UDALOY, and SOVREMENNYY-Class ships, whose capabilities are only approximately estimated, the Soviet Navy is the probably preparing to replace the old GOA with a true state-of-the-art system on a single light launch ramp, with a vertical magazine, and with (finally) very sophisticated electronics and miniaturized components, that equals, if not surpasses, any comparable Western design. The modernity of the KASHIN Class and the importance still attributed to the four KRESTA-Is by the Soviet Union point to an upgrading in the near future of the weapons on these classes, or part of them, with new missiles and electronics. This will probably coincide with the transfer of older ships armed with SA-N-1 weapons to other countries. Only then will the GOA be given an honorable retirement.



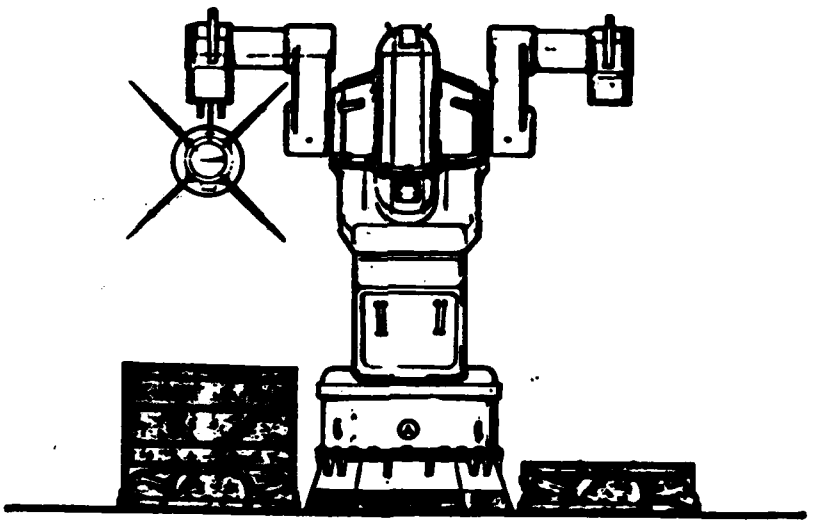
A rare picture of a missile launch from the forward launcher of a KRESTA I cruiser. The missile is frozen in the seconds following separation from the ramp while the wings are in the deployment phase.



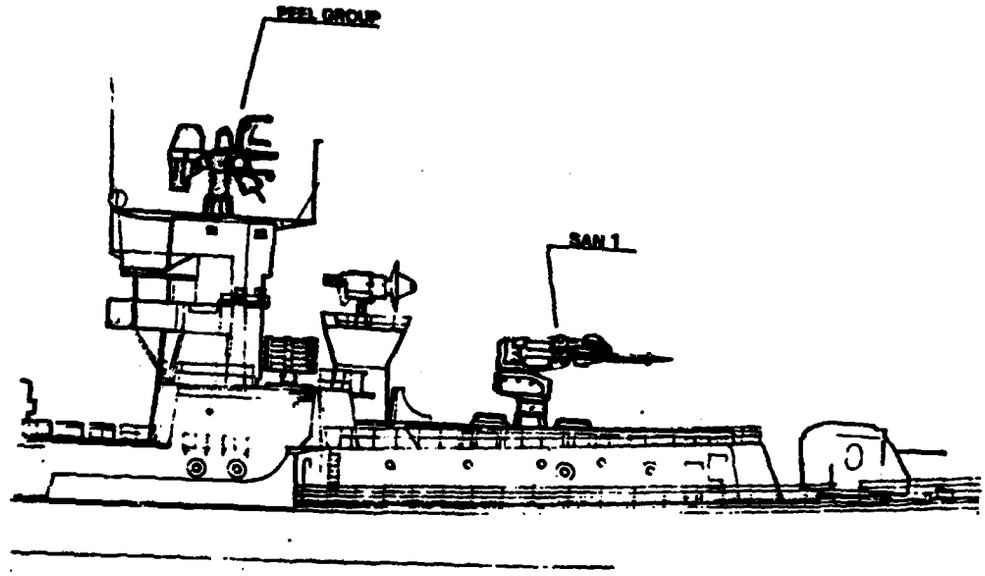
Side view of SA-N-1 GOA missile and launcher



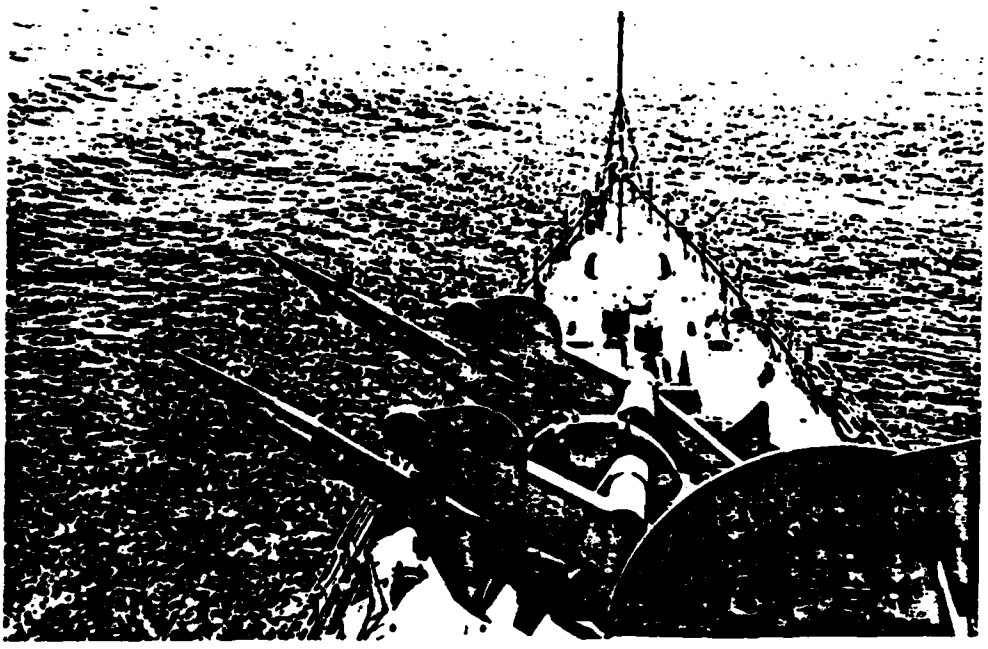
Load and launch sequence of the GOA missile: a) the missile hooked to the launch guide rails while the second missile emerges from the magazine; b) the ramp is raised; c) the missile being launched with the wings in the deployment phase; d) wings completely deployed.



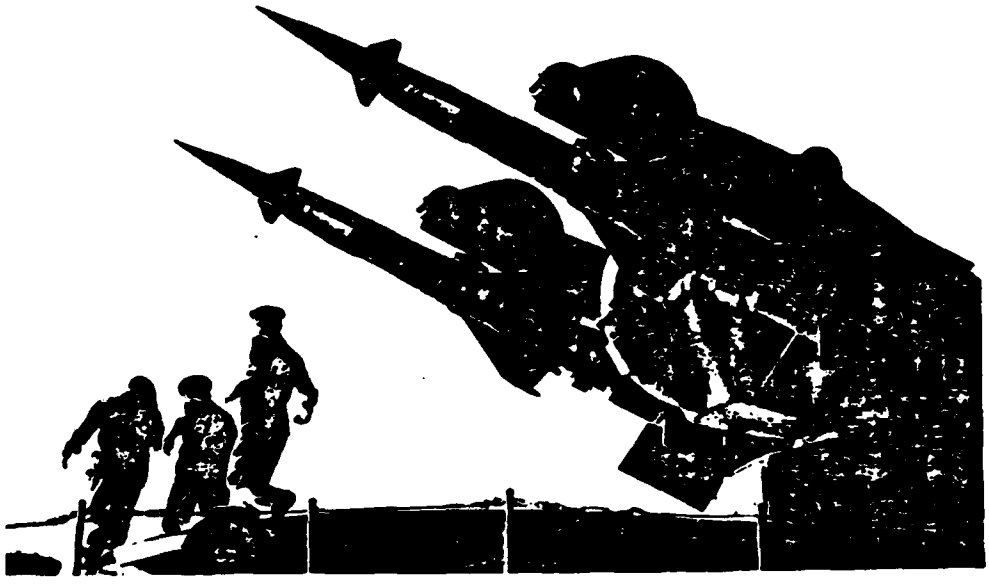
Front view of the launcher with a missile on the right ramp. The corresponding hatch is in the open position.



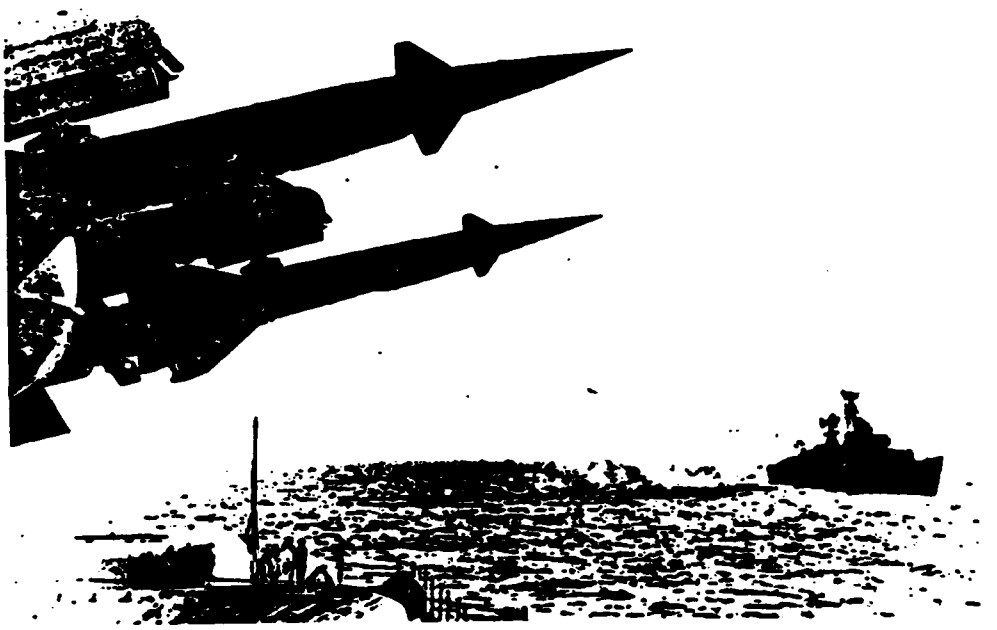
The SA-N-1 GOA weapon system on a KASHIN-Class destroyer



View from above of an SA-N-1 missile and launcher on a KASHIN-Class guided-missile destroyer. Both of the missiles' second stages are visible; the boosters are blocked from view by the antenna of the OWL SCREECH fire-control radar that can be noted in the foreground.



Excellent view of a complete missile and launcher system installed aft on a KASHIN-Class destroyer: notice the booster wings are still folded in a prelaunch position.



Front end of two SA-N-1 missiles on board a KASHIN-Class destroyer. To the right is a guided-missile destroyer of the KOTLIN SAM Class, also armed with the GOA missile system with a single launcher aft.

SHIPS ARMED WITH THE SA-N-1 GOA

USSR

19	KASHIN and KASHIN MOD	x 2 launchers
4	KYNDA	x 1
4	KRESTA 1	x 2
8	KOTLIN SAM 1 and 2	x 1
8	KANIN	x 1

Poland

1	KOTLIN SAM 1	x 1

India

3	KASHIN	x 2

Total

47 ships 73 launchers