RADAR TECHNIQUE FOR BEACONAGE PURPOSES

German Hydrographic Institute, Hamburg

The Federal Republic of Germany has been able since 1951 to resume practical tests involving the use of radar technique for beaconage purposes.

1. Work was initially limited to passive radar aids since live aids such as racons, ramarks or radar beacons had not yet been developed.

1.1. The first requirement regarding passive aids consisted in improvement of the effectiveness of buoys to be used as targets for shipborne radar.

Observations as to the range at which variously-shaped buoys could be detected were carried out by buoy-laying vessels carrying a Decca-159 set built in 1950 and Kelvin-Hughes instrument dating from the same year.

In buoying channels located in German waters, use was made for this purpose of conical, spar, and pillar buoys, the latter category including lighted buoys, bell and whistle buoys. Average dimensions above water-level are as follows:

(1) Conical buoys:	ϕ	0.70 - 1.50 m
	H	1.20 - 3.00 m
(2) Spar buoys:	ϕ	0.70 - 1.20 m
	H	3.00 - 6.00 m
(3) Lighted buoys:	ϕ	2.20 - 2.50 m
	H	3.10 - 3.60 m

ϕ Diameter at water-line

H Elevation above water-line

The following average ranges were observed with the shipborne radar:

	Detection range in miles
1. Conical buoys:	0.7 - 1.0
2. Spar buoys:	0.75 - 1.0
3. Lighted buoys:	1.5 - 2.0

Special results were recorded at the mouths of rivers where the buoys were tilted by the strong tidal current. Thus, in the case of conical buoys observed against the current, the detection range reaches 2 miles, whereas in the case of those observed in the direction of the current, it decreases to 0.5 mile. The difference with regard to spar buoys was less.

This information, obtained on the scope of the shipborne radar set, was carefully measured by means of a special device enabling the strength of the returning echo to be compared with that of another echo by measuring the height of the peaks above the time base.

1.3. It would be helpful if the various services responsible for beaconage could reach an agreement as to the method of measurement, in order that a basis of comparison between the ever-increasing numbers of radar beacons may be available.

2. Following these tests, it appeared advisable to increase the echo-strength of the buoys in certain important locations, or to devise some way of eliminating the effect on such strength of the tilt in the buoys produced by the current.

2.1. In 1952 experiments were carried out with radar reflectors based on the three-sided mirror principle, by using them as topmarks on all types of buoys (Fig. 1). These produced the expected result on the radar scope, but experiments were subjected to difficult practical conditions : in zones swept by currents, the reflectors lasted only for brief periods, and were often torn away by ships or tugs. In the end they were replaced by ordinary topmarks.

2.2. During this same year, buoys to be used as reflectors were even built, with appropriate regard to their characteristic shapes (conical or spar). But the buoys, in addition to supplying greater echo-strength, had to be sturdy enough for beaconing requirements, and were thus required to withstand mechanical stress. The various types shown in Figures 2, 3 and 4 were accordingly built.

These buoys have behaved well, and there are at present 31 of this type.

Their average detection range by an ordinary shipborne set varies between 2 and 2.5 miles, i.e. about twice the range of a standard buoy.

Efforts to increase the echo-strength of lighted buoys have so far met with little success, as their shape already supplies a better echo than a standard buoy. Tests are planned in several places, however, of models developed in the United States by the Coast Guard.

3. In addition to sea trials of floating sea-marks, tests have been carried out on shore with special radar targets.

It is a well-known fact that low-lying coasts, harbour entrances or indented coast lines, supply a very different picture on the radar screen than the one familiar to the mariner from his chart, owing to the effect of shadows or the low elevation of the coast. In order to mitigate this defect, which makes orientation difficult, targets in the shape of « fences » were set up along the *line* of demarcation. These initial experimental fences were 1.20 m high, and were made of wood or wire-netting. There was no substantial difference in the reflecting qualities of either type of material for radar purposes.

To reduce expenses the fences were borrowed from the road-building authorities, who use them as snow-fences. (Figs. 5-7).

Results were so encouraging that experiments are being continued.

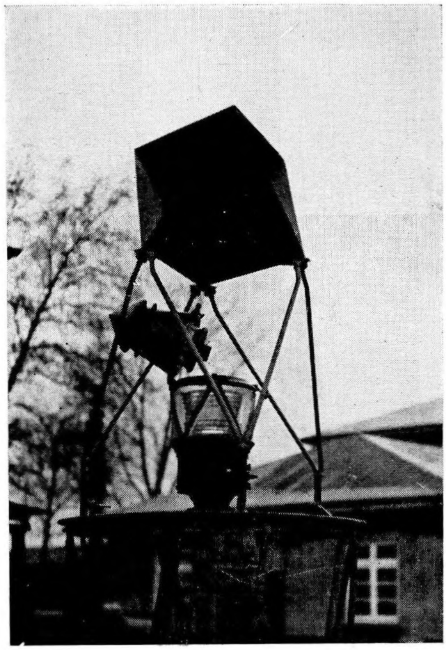

Fig. 1.

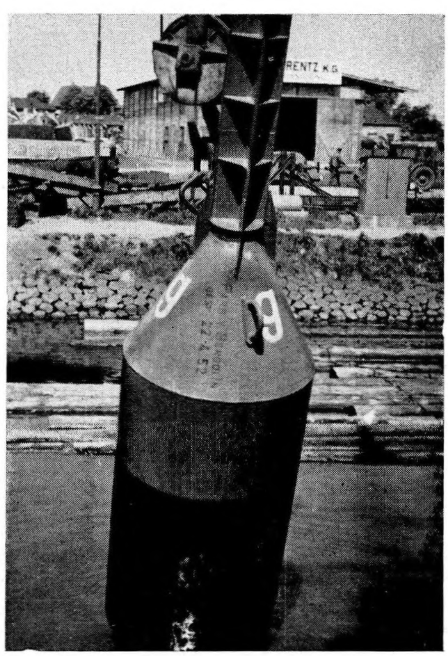

Fig. 2.

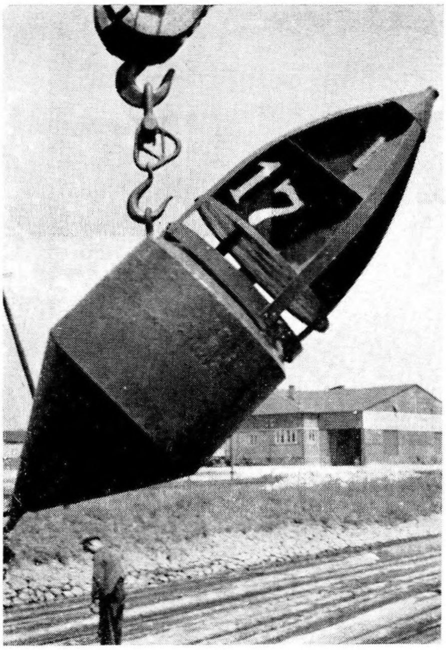

Fig. 3.

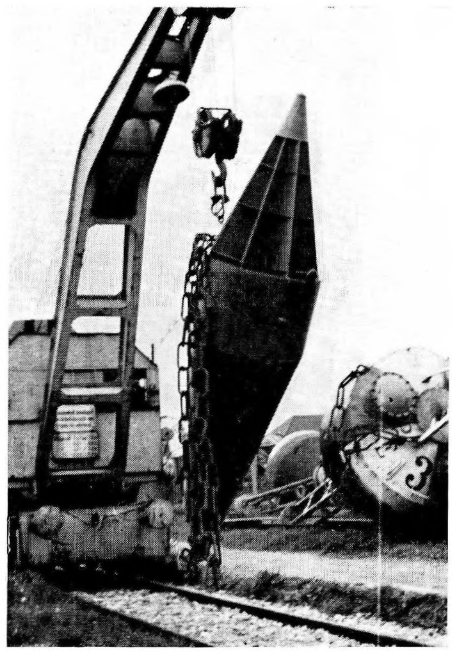

Fig 4.

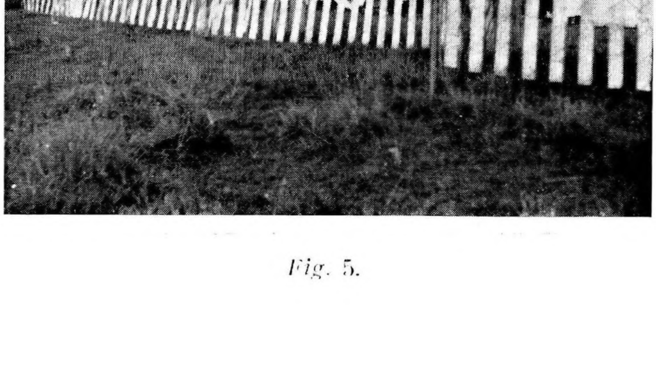

Fig. 5.

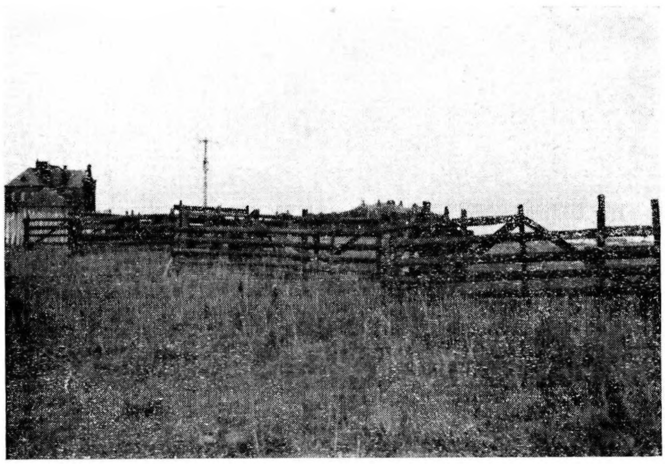

Fig. 6.

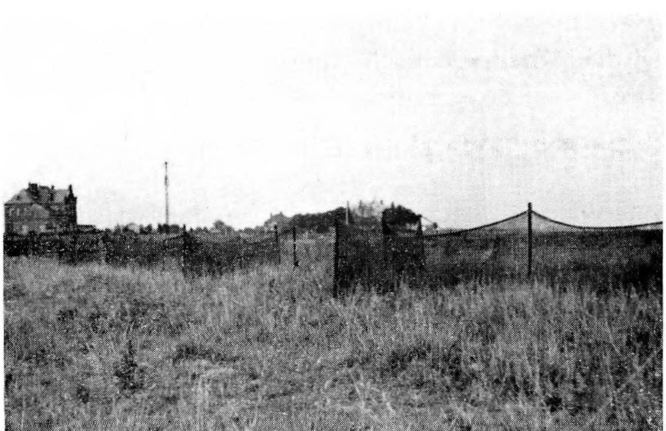

Fig. 7.