

RESEARCH ON TELESOUNDERS

(WIRELESS REMOTE CONTROL ECHO SOUNDING)

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Note on the authors. — Dr. HASHIMOTO is a specialist on echo sounders and fish-finder research. He is now the chief of the Instrument Section of the Fishing Boat Laboratory, Fisheries Agency of the Japanese Government. After graduating from Tohoku University in 1929, he was engaged in underwater acoustic apparatus research and manufacture at the Nippon Electric Company, Tokyo. He took up his present post at the Fishing Boat Laboratory in 1950, and is engaged in basic echo-sounding research and in its applications in the fishing industry. He obtained the degree of Doctor of Technology in 1956 by presenting a thesis on ultrasonic propagation in the sea. He has also published many papers on his studies.

Dr. MANIWA is engaged in research on underwater acoustics, such as basic echo-sounding research and its applications in the fishing industry, under the direction of Dr. HASHIMOTO at the Fishing Boat Laboratory. After graduating from Tokyo University in 1945 he was engaged in the above mentioned research. He obtained the degree of Doctor of Technology in 1962 by presenting a thesis on studies for the development of echo sounders, and of vertical and horizontal fish-finders using ultrasonic millimetric waves.

Mr. KATO is engaged in research and development of underwater acoustic apparatus at the Furuno Electric Company, Kobe. He graduated from Kobe Technical College in 1941.

ABSTRACT

In this paper the authors give the results of their research on the Telesounder device for sending echo images of the sea bottom and fish shoals to a distant place via radio waves. Accurate sounding may be expected by means of the Telesounder and by accurate determination of the surveying boat's position from the shore.

INTRODUCTION

If it were possible to record the profile of sea bottom at the land base by sending echo signals via radio waves from a surveying boat, inshore work would be made easier, since it is easy to determine the position of the boat with accuracy from on the shore. In the case of fisheries, it is possible with the same device to know at the land base the quantity of fish that

entered the set net, and it is also possible to direct net casting from the fishing base by looking at echo traces, and thus to increase fishing efficiency. The following device was conceived to demonstrate this possibility. A description of this device is now given.

When the oscillating equipment of the recorder is operating, it sends out a control signal to the distant ultrasonic oscillator on a surveying boat, in a buoy or on a fish-finding boat, which all emit ultrasonic waves. These ultrasonic waves, when striking sea bottom or fish shoals, are reflected to the receiving transducer and the carrier radio waves are modulated and sent to the location where the recorder is placed where they are received by the receiver which will operate recordings. This type of system is named Telesounder.

During the fundamental experiment off the Kurihama coast of Yokosuka City in October 1962 it was possible to obtain echo images of the sea bottom and fish shoals from a distance of about 2 000 m. A trial production model of the Telesounder, with a transducer connected to a transmitter-receiver set installed in a buoy, was tested at Izu Ajiro in March 1963. The experiment demonstrated that the records of the Telesounder were almost identical to those obtained by an ordinary echo sounder used at the same time, and that it was possible to transmit echo images to a location about 4 km away. Fish shoals in a set net were also recorded.

THE TRIAL PRODUCTION TELESOUNDER

The construction of the trial production Telesounder is shown in fig. 1. The circuit is completely transistorised and is thus compact. The station having the recorder is named the base station, while that having the ultrasonic transmitter-receiver is named the buoy station.

The 42 Mc band radio waves, which are frequency-modulated by pulses to control the buoy station, are emitted from the transmitter (T1). The receiver (R1), which is placed in a distant location, receives signals from the transmitter and it motivates the ultrasonic oscillator (Tu), and the transducer (T) in turn emits a 50 kc ultrasonic pulse. The echoes returned from the sea bottom and fish shoals are received by the transducer, and amplified and detected by the ultrasonic receiver (Ru). The 42 Mc band radio waves which are frequency-modulated by these echo signals are transmitted to the base station's receiver (R2) from the transmitter (T2). The radio waves are then detected, and echo signals to be recorded are picked out.

The FM method is chosen for its higher reliability and because it has better S/N than the AM method. The ultrasonic transmitter and receiver and the FM transmitter are not set to work before the FM receiver receives pulse signals from the base station. The buoy station consumes only a small amount of electric power, since only the radio receiver is constantly working when there is no pulse signal from the base station.

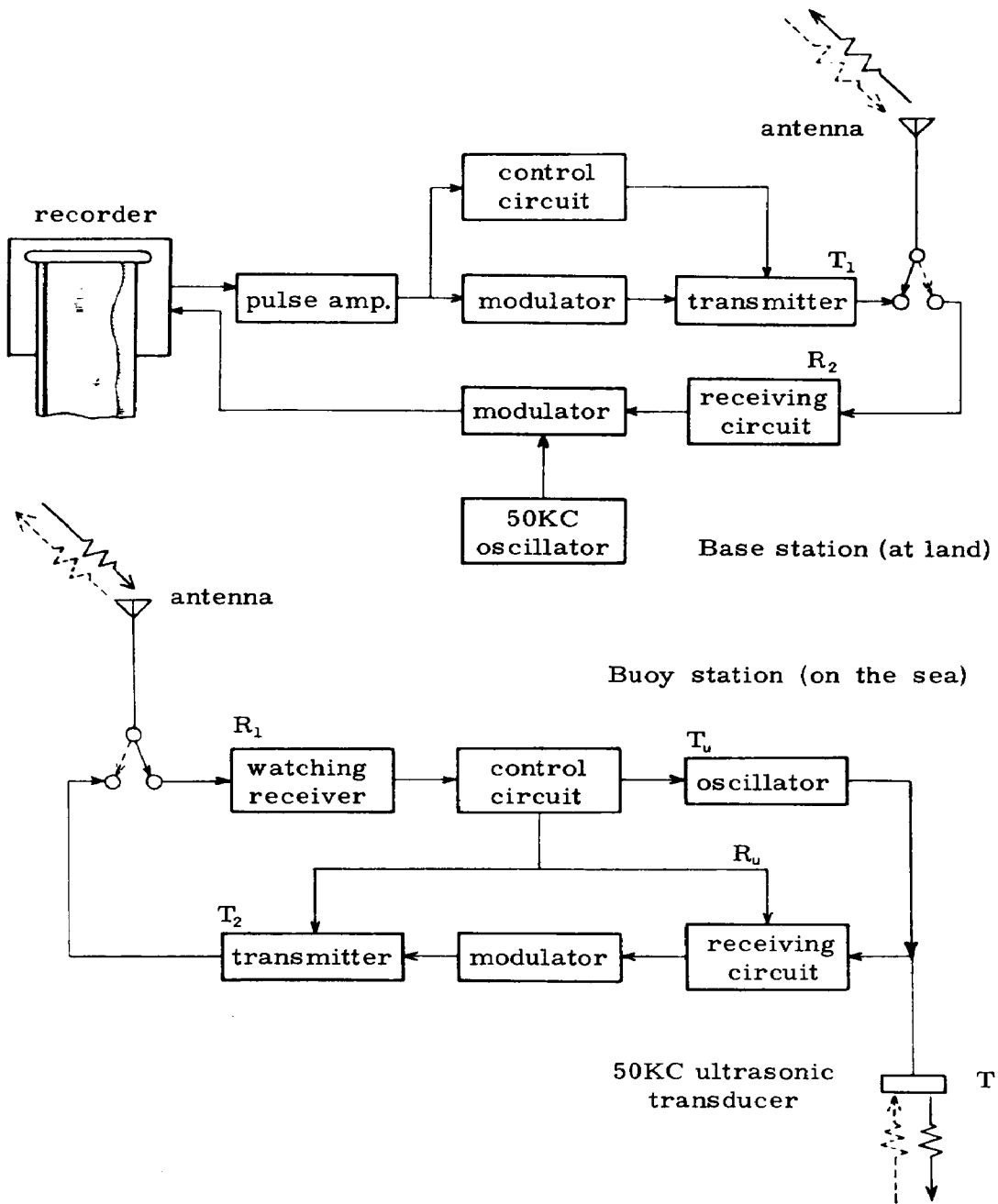
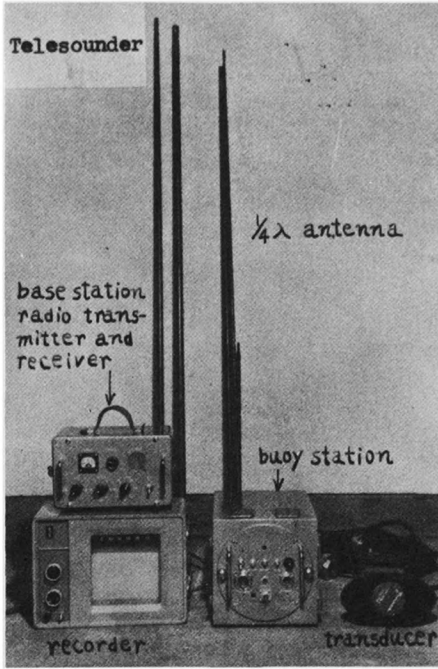
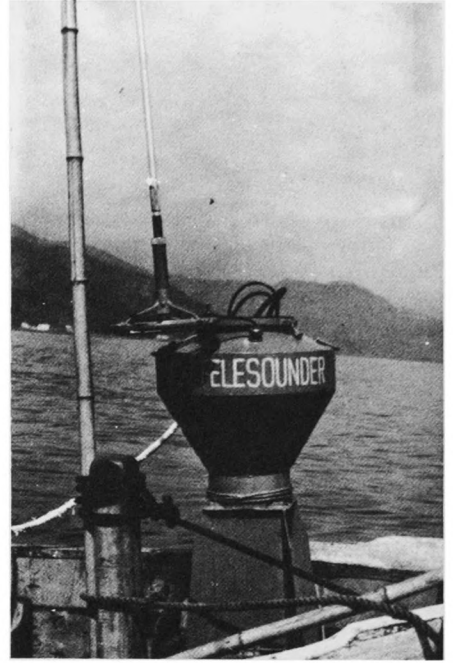


FIG. 1. — Block diagram of Telesounder.

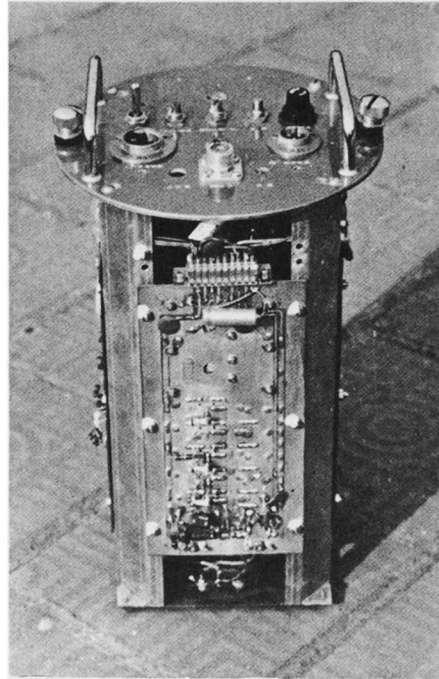
The transmitting power of radio waves is 100 mW and that of ultrasonic waves is 15 W. Fig. 2(a) shows the complete set of Telesounder equipment. The buoy station as shown in this figure is used on a boat. The buoy, in which the electronic instrument is installed, as shown in fig. 2(b), is used at a set net, fig. 2(c) shows the electronic instrument unit of a buoy station.



a



b



c

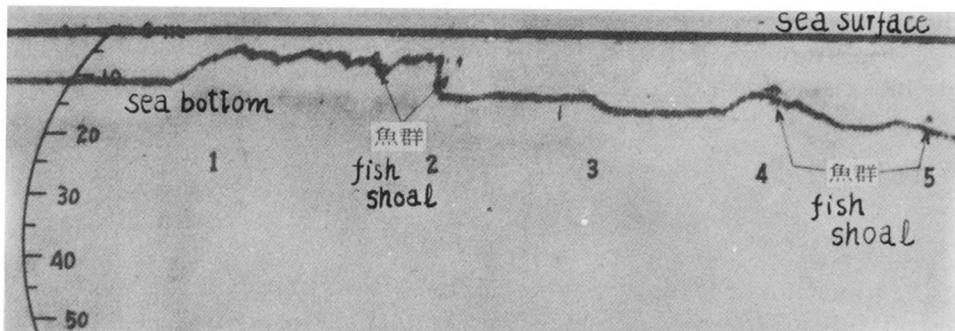
FIG. 2. — Telesounder

- (a) Complete set of Telesounder equipment
 (b) Buoy in which the electronic instrument is installed
 (c) Electronic instrument unit of buoy station

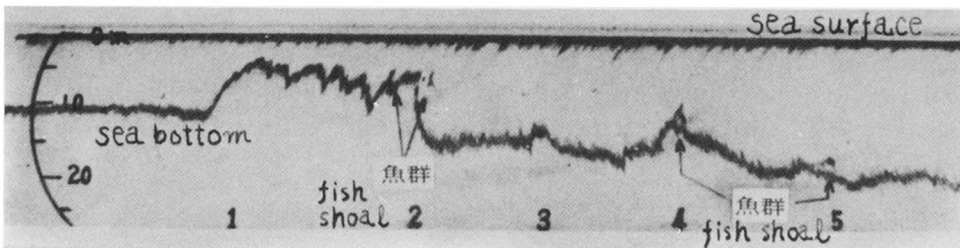
EXPERIMENT

The fundamental experiment was carried out in October 1962 off the Kurihama coast of Yokosuka City by using two boats and the equipment at our disposal, i.e. a 2.6 Mc radio transmitter and receiver, and a 200 kc ultrasonic wave echo sounder. Their construction is almost the same as shown in fig. 1. During the experiment a 400 kc echo sounder was used at the same time, and its result was recorded to compare with that obtained by using the Telesounder. These results are shown in fig. 3(a) and fig. 3(b). Fig. 3(a) is the result obtained at a distance of 2 000 m by using Telesounder, and fig. 3(b) is that obtained by using a 400 kc echo sounder. Numbers 1-5 are the relative positions of the Telesounder and the echo sounder. Because these records were obtained with different powers, frequencies, etc., there is no point in here discussing these relativities, but we are concerned with the results, for both the sea bottom and the fish shoals are clearly shown.

By using the results mentioned above, experiments were made at Izu Ajiro in March 1963 on the trial production model Telesounder as described above.



(a) Echo traces by Telesounder



(b) Echo traces by 400 kc echo sounder

FIG. 3. — Echo traces recorded by Telesounder and 400 kc echo sounder at the same time.

Two boats were used for the experiment. The base station for the Telesounder and the ordinary 50 kc echo sounder were installed on a boat, and the buoy station was installed on the other boat. These two boats ran on exactly the same course, operating both equipments at the same time. Fig. 4(a) is the record of the Telesounder and fig. 4(b) is that of the 50 kc

echo sounder. A, B and C in the figure are their relative positions. The spots on the figures are mutual interference by the 50 kc ultrasonic waves. It was clearly proved that the Telesounder could obtain the same kind of record by using an ordinary echo sounder. Also, it was possible to transmit echoes returned from the sea bottom and from fish shoals to a distance of 4 000 m.

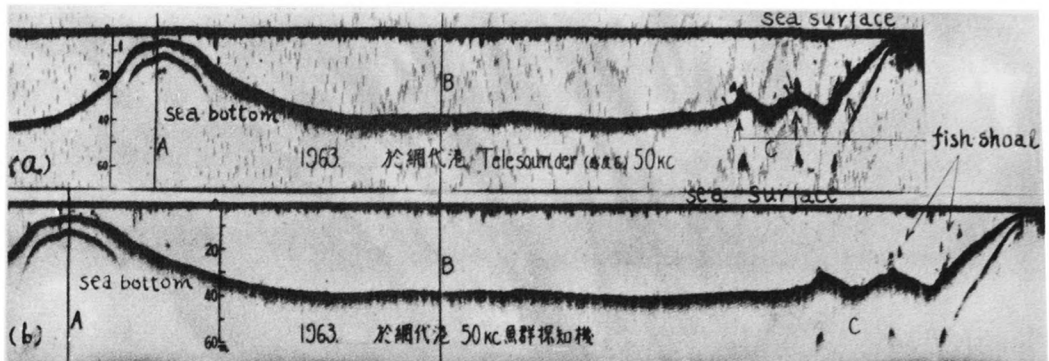


FIG. 4. — Echo traces recorded by Telesounder and by 50 kc echo sounder

(a) Echo traces by Telesounder

(b) Echo traces by 50 kc echo sounder

In the second stage of the experiment the recorder was placed on the land, and the buoy station was placed at the set net at a distance 3 500 m away. Fig. 5 shows fish shoals passing under the transducer of the buoy station.

CONCLUSION

A transistorised frequency-modulated type Telesounder was used to transmit ultrasonic echoes which were returned from the sea bottom and from fish shoals via radio waves to a location 4 000 m away, and the result was comparable to that of an ordinary echo sounder. Since the profile of the sea bottom can be recorded by the Telesounder at the land base, and the position of the surveying boat can be determined with accuracy from the land, inshore sounding work would be made easier. There could be many kinds of applications for the Telesounder, not only for sounding but also for fisheries.

ACKNOWLEDGEMENT

We wish to extend our appreciation to Mr. K. MINOHARA, of the Furuno Electric Co., Ltd., who kindly cooperated with us.

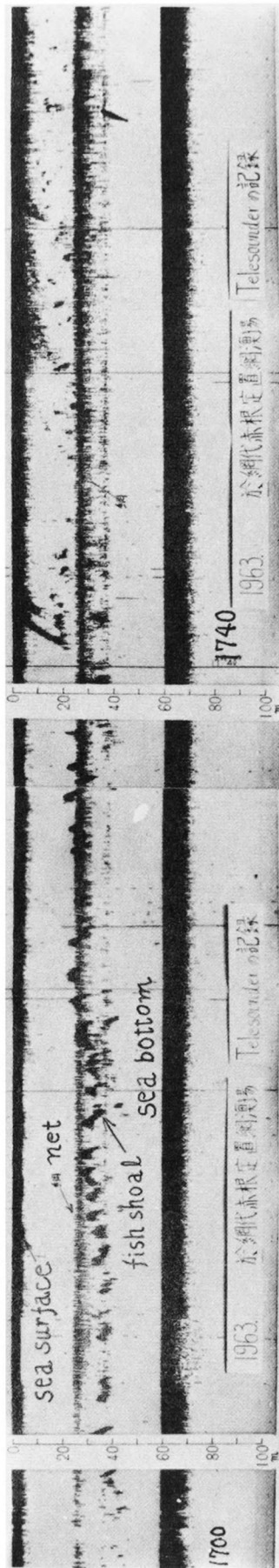


Fig. 5. — Echo traces of fish shoals entering the set net, transmitted by Telesounder.