DUPLEX DIRECTIONAL FOG SIGNAL.

In reply to a request for information from the Bureau, Messrs. CHANCE Brothers & Co., Ltd., world renowned Lighthouse Engineers and Constructors of Smethwick, Birmingham, sent the following description which gives a general idea of the apparatus, and of uses to which it may be put—the chief of which is to guide vessels into port during a fog.

Practical experiments have been carried out with this apparatus at Newhaven, and the latest trials took place in 1927.

This device will practically obviate the dangers and difficulties of a vessel trying to find a harbour during dense fog, for by this system a vessel literally "hears" her way in. The inventor of the new system, which is known as the "Fellows' Duplex Directional Fog Signal", is Mr. H. M. FELLOWS of Great Yarmouth.

The demonstration was carried out with miniature diaphones, or foghorns, but even so the blasts were distinctly heard at a distance of a mile ; the diaphones that would be used in a proper installation would be heard many miles at sea.

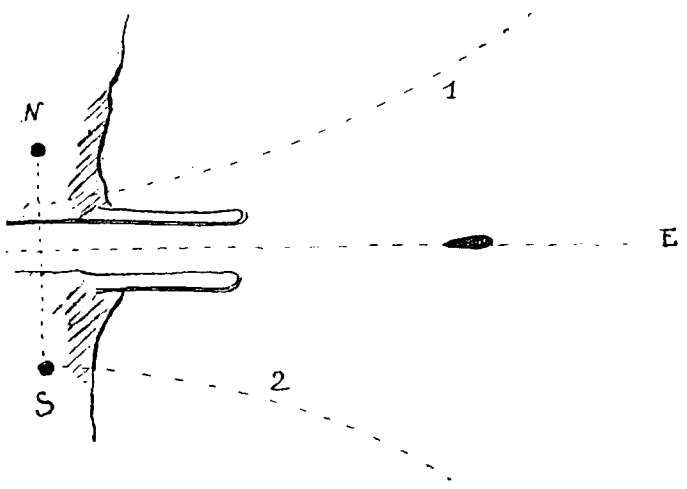

fig. 1

E — Ships on this line hear both diaphones N and S together.
1 — » » » » » N diaphone one second before S diaphone.
2 — » » » » » S diaphone two seconds before N diaphone.

The principle underlying the "FELLOWS" Duplex System is the fact that if two sounds are emitted at the same instant from points, say 1,100 feet apart, an observer situated at an equal distance from the two sounds will hear them both simultaneously within 1/2 second of their sounding. If, however, he is at a distance of 660 feet from one sound and 440 feet from the other, he will hear the nearer signal in 2/5 second after sounding, and the further one in 3/5 second, in other words he will hear the one 1/5 second before the other. If the sounds are different, he can tell which point is nearer to him and on which side of the dividing line he is.

If then, such sources of sound be placed at equal distances on each side of a harbour entrance, and be made to sound at the same instant, the two will meet "in one" precisely in the centre of the harbour's mouth and this "line of consonance" will stretch out to sea as far as the sounds can be heard.

It is important that the blasts themselves should be short and distinct, as any hesitation in the note sounded is a disadvantage. The CHANCE'S diaphone system of signals lends itself peculiarly well to this method, as the sound is quite distinct from that of any other form of sound signal, very short penetrating blasts can be given, and can be very exactly timed.

It is convenient to arrange for one signal to give a single blast, and the other to give two short blasts with a short interval between them. The centre of the channel would then be indicated when the longer blast was heard between the hearing of the two short blasts, thus forming, as a whole, one comparatively long blast.

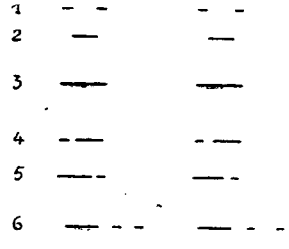

Fig. 2

1 Starboard Diaphone Signal.
2 Port Diaphone Signal.
3 Combined Signal heard midway between Diaphones.
4 Combined Signal heard at a position to starboard of midway position } when within 30 ft. of
5 Combined Signal heard at a position to port of midway position } centre of channel.
6 Combined Signal heard at a position when 100 ft. from centre.

If even a few feet out of the centre a ship would hear ——— — or — ——— according to which side she was on. When further away from the centre she would hear — — ——— *i. e.*, the two short blasts just before the long, the interval between the two blasts and the single one of course increasing the further from the centre she went, see illustrations (Figs. 1 & 2).

The sounds are made by diaphones actuated by compressed air at about 30lbs per sq. inch pressure. The two notes are quite distinct in tone and

consist of short, sharp barks which are heard at about ten seconds intervals, both being transmitted at the same instant. The diaphones producing the signals are operated by a very simple and robust electrical wireless control from a station representing a Harbour Master's Office about half a mile away.

In practice such diaphones or sirens would be planted about 500 feet—or any greater distance—on each side of a harbour entrance and would be a guide to a fog-bound vessel coming in either from sea or coastwise. In the latter case her Pilot would first of all pick up the sounds and hear them at about a second of time apart. When he came abreast of the first sound the interval between the two would gradually begin to get less, just as "leading lights" begin to close up when the Channel is found. At last a point would be reached when the two sounds were "in one" and knowing the bearing of this line the Pilot can turn and steer the ship, correcting her position if need be by the sounds. If they open out at all he will steer towards the one he hears last; if he hears the deep low note first and the high one second, he will go to starboard, or vice versa, until the sounds are in one again and the vessel is consequently on the centre line.

In cases where the entry to a harbour has to be taken along a curved course and not along a straight line, the one signal is timed slightly in advance of the other. This makes the line of synchronism a curve, and by regulating the timing any hyperbolic curve can be laid down. In this way a very near approximation to any curved channel can be given.

By this very simple modification the stations can be set up in such a way that any curved course within the limits of a hyperbola—and that means practically any natural approach—can be charted as easily as a straight line. By the addition of a third consonant sound any point on the line may be located, and so either a straight line may be defined, or a curved one or a point on either a curved or straight line or a whole area may be protected.

Where a long channel with S bends has to be "sound charted" with DUPLEX signals, it is necessary to put a pair of signals at each curve. Each pair is then synchronised with the adjoining pair in such a way as to indicate to the vessel which pair of signals she has to attend to. Usually she can only hear one pair at a time.

In cases where sharp turns have to be made from a straight or curved course, the spot at which to turn may be indicated by a third sound signal or by a bell buoy placed by the side of the channel.

It will often happen that it is necessary to instal one or both signal stations in situations where no electric power is available or where the cost of electric mains would be prohibitive, or where one of the signal stations is across an estuary or river from the control station. To meet these contingencies, Messrs. CHANCE Bros. & Co. have worked out various types of plant. Compressor sets driven by automatic petrol engines specially designed for running unattended can be installed, started and stopped by light relay circuits controlled by push button at the harbour master's office, or, if there is no means of running even relay circuits, can be controlled by wireless so designed that atmospherics or other circuits operating cannot interfere.

In all cases the synchronising of the two signals is done by a master timing device in the harbour master's control office, which is set in action by means of a single push button or switch and which automatically makes the two signals sound simultaneously for a straight course, or with a predetermined interval between them in the case of a curved course. The apparatus for timing the signals functions by means of electro-magnets, which are adjusted during erection to give and maintain exact synchronisation.

During the trials made at Newhaven, the W. diaphone was below the cliff at the base of the long breakwater, the E. diaphone was on the beach at the now deserted flying station. The two diaphones were connected by a telephone wire, and were blown every 15 seconds at precisely the same instant. The difference between them was that while the W. diaphone blew a blast about half a second in length, the E. diaphone blew two very short blasts at half a second interval.

The signals to both stations are despatched by electric contacts made by one long pendulum, and a gramophone table tells the pendulum when to send out the signals, *i. e.* every 15 seconds or as required.

The whole purpose of Mr. FELLOWS' invention is that a steamship in a fog does not have to try to locate the sound signal, which it is impossible to do accurately, but receives according to her position a definite instruction which way to steer, and she has her compass to enable her to comply with the instruction.

The Trinity House Elder Brethren have tested the system and consider it "eminently suitable for such a harbour as Newhaven".

In connection with the new fog-horn apparatus, so far as it affects Newhaven Harbour, a couplet that will be readily understood by navigators has been composed and reads as follows : — "Dot first and best - veer West ; dot last and least — veer East ; when all are one, Nor'rard you run".