THE NEW S. A. L. LOG.

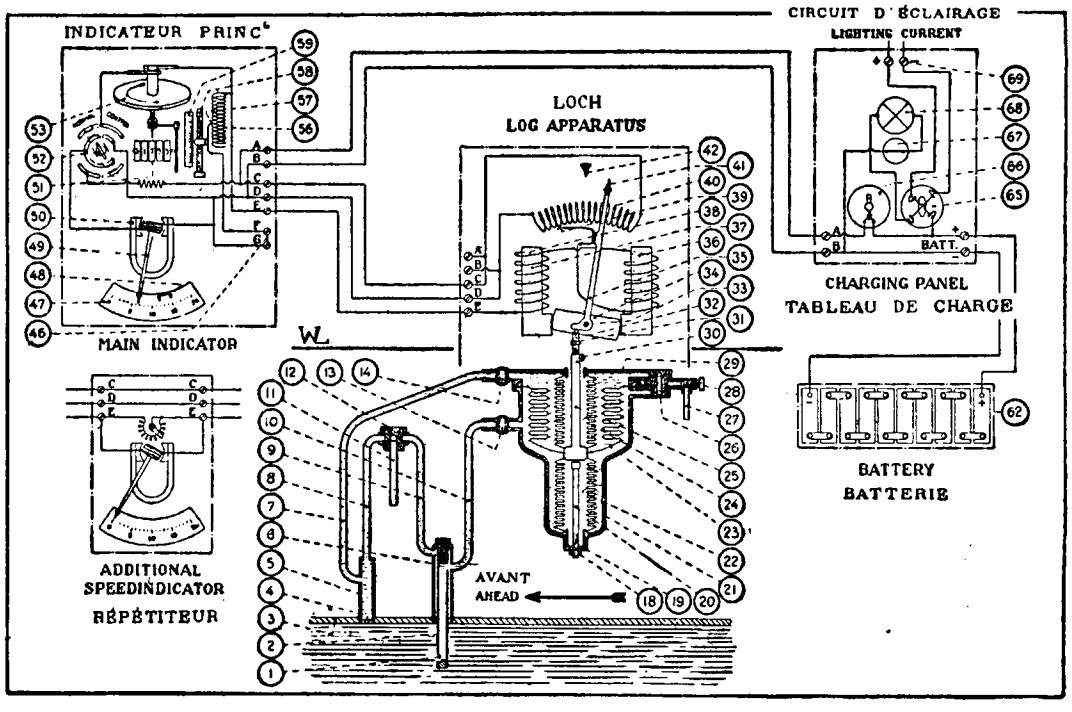
(Extract from the "*De Zee*" The Helder, December 1929, page 795.)

This hydraulic log with electro-magnetic transmission has for some time been installed in various steamers of both heavy and light tonnage. The extreme accuracy attained with this instrument by these ships encouraged us to describe its working.

It is principally during fog and when the ship is running at a reduced speed that its advantages become apparent. The navigator has a further technical improvement for the determination of the ship's position owing to constant indication of the speed and of the number of miles run on the bridge itself.

Principle of the Log. — The action of this appliance is based on PITOT'S law which states that the dynamic pressure produced by a liquid is proportional to the square of its velocity. The S. A. L. Log is, therefore, in the true sense a pressure log.

The speed of the water relative to a ship under way (or rather the speed of the ship in relation to the water) can be measured if an instrument specially adapted to this purpose is available. The S. A. L. Log is precisely an instrument of this kind.



Owing to the friction of the water against the skin, the pressure must be measured at a certain distance from the ship's hull. For this purpose (see figure) a PITOT tube from 19 to 25 millimetres (3/4 to 1 inch) in diameter is used, which projects about 30 centimetres (1 foot) from the hull plating near the keel (3). The lower extremity of this tube is closed, and an opening (1) — PITOT orifice — is drilled on the fore side of the tube.

The PITOT tube is contained within sleeve fitted inside a sluice valve (6) and thus can easily be pushed out or pulled in as required.

When the ship is under way a certain pressure, dependent on the speed, is produced in the PITOT tube, which with the hydrostatic water pressure, is conveyed by a pipe (10) to the pressure transmitter (21) which is divided into two compartments by the membrane (23).

The static aperture (4) transmits the static pressure only as it is nearly flush with the hull. This pressure is conveyed to the pressure transmitter through the valve (5) by the pipe (7). This valve (5) is placed either before or abaft the PITOT tube and at a certain distance from it. The static valve is fitted with a grid.

In the pressure transmitter the water from the static pipe brings pressure on the lower face of the membrane (3) whilst the water from the PITOT tube brings the hydrostatic pressure, plus the pressure due to speed, on the upper side. Thus the hydrostatic pressure is balanced out and the action of the membrane becomes independent of the upward water pressure against the hull. The pressure due to speed only can produce movements in the membrane; with the object of ensuring transmission of the instrument to the armature (34) unaffected by friction, two bellows are introduced, one (24) on the upper and the other (22) on the lower side of the membrane (23).

Reduction cocks. — Each of the two reduction cocks, PITOT'S (13) and the static one (14), is fitted with two passages, one of large and the other of small diameter. The former is only used when the apparatus is being filled. When the log is in normal use, the narrow conduit is used in order to suppress any oscillations of the pointer which might occur owing to slight variations of the pressure due to speed.

Pet cocks. — Sea water always contains a certain amount of air and this is likely to collect in the valves (5) and (2). This air should be removed by opening the cock (12). Cocks (26) and (28) must also be opened from time to time to allow any air which may have accumulated in the pressure transmitter to escape.

Pressure transmission. — The rod (25) transmits the speed pressure from the membrane to the armature (34). This armature is fitted with a steel knife-edge (32) which forms part of it. This knife-edge lies in a notch at the top end of the rod (25) and contact is ensured by a spring.

By means of the screw (30) at the top of the rod, the pointer can be set at zero. This adjustment must never be made except when the tip (41) of the pointer does not coincide with the reference mark (42), the ship being stopped and the leads (7) (8) and (10) and the pressure transmitter being full of water, but freed of all air.

The actual Log. — The actual log has two principal components, *i. e.*

The *Armature* (34) suspended between two electro-magnets (36) and (37).

The *Pointer* (35) attached to the armature. The pointer has a contact-piece (39) which presses against a resistance (40). The outer right-hand extremity of the spiral of this resistance is connected to the positive pole of a feed battery.

Charging Board. — Connected to the Charging Board, shown diagrammatically on the right of figure, are

The ship's lighting mains.

The log battery.

The main indicator.

The Board has a carbon filament lamp (68) a cut-out (67) and switches for the lighting and battery currents respectively. The lamp (68) is intended for reducing the tension of the lighting current to the tension necessary to charge the battery.

The Battery. — This is a battery (62) of ferro-nickel accumulators, giving a tension of from 12 to 18 volts, capacity 10 ampere-hours. This battery consists of 10 elements and contains a very large amount of electrolyte. Owing to this last peculiarity it may be kept charged up continuously without it being necessary to refill it too often with distilled water.

The main indicator. — The main indicator has a distance meter (53), a speed meter (47) a resistance (56, 57, 58 and 59) to regulate the PITOT constant and a control switch (52).

The distance meter is an ampere-hour meter of special make, the disc of which makes 300 revolutions per sea mile.

The speed meter is a milliammeter fitted with a scale for exact gauging of the tension of the battery.

There are two positions for the control switch "normal" and "control". When it stands at

"normal" the speed and distance meters are connected in series, this being essential for simultaneous recording of the speed and number of miles run. When the switch is at "control" the two measuring appliances are coupled in parallel so that the speed meter operates as a voltmeter and indicates the tension of the battery.

The adjustment of the PITOT constant is carried out with a resistance (56) and a contact (57) which can be shifted by turning a screw (58). The position is given by scale (59). The resistance is in parallel with the speed and distance meters; thus any increase of resistance tends to increase the value of the speed and distance meter readings and vice versa. The log once adjusted on board the ship should accurately and continuously record the actual speed and number of miles run.

Electric installation. — The cable which connects the battery with the charging Board has two conductors; the poles + and − of the battery are joined respectively to the same poles of the Board.

The cable from the Board to the main indicator has two conductors: the one between the actual log and the main indicator has three conductors.

The main indicator, the charging Board and the battery should one and all be able to be disconnected in case of necessity. Should unforeseen circumstances prevent the Battery and Charging Board from being disconnected from the actual log, care must be taken that the connections *A* and *B* of Charging Board are connected to *A* and *B* of the actual log and *not* to *A* and *B* of the main indicator.

Working of the Log. — At the zero position, the contact (39) is not connected to the resistance (40). If current is cut off by means of the switch (66) there is a flow of electricity from *A* of the Charging Board towards *C* of the main indicator and from thence to *C* of the log: then it passes through the resistance to *D* and eventually reaches *D* of the main Indicator and, from there, returns to *B* of the Charging Board. It is clear that in these circumstances the main indicator receives no current.

Under the influence of the way on the ship, the speed pressure pushes the membrane (23) upwards. This movement is transmitted to the contact (39) by means of the rod (25), the knife-edge (32), the armature (34), and the pointer (35). The result is that the current is switched on and can run from *C* of the log along the outside right hand part of the resistance (40) towards the poles of the magnets (36) and (37), after having passed through the contact (39). The current then passes from *E* of the log to *E* of the main indicator and from this point towards the Charging Board and the Battery.

The magnetic field created between the two poles (36) and (37) exerts a force on the armature in a contrary direction to that produced by the speed pressure. This pressure acts upon the armature and moves the contact (39). In sliding the contact allows a more or less intense current to act on the magnets, and thus varies the magnetic field in proportion.

When the contact (39) has reached a certain position the moment of the couple induced by the speed pressure will be balanced by the magnetic moment. Magnetic force is proportional to the square of the current and the speed pressure is proportional to the square of the speed. The strength of the courant (number of amperes) running between the poles of the magnet is therefore proportional to the speed of the ship.

The ratio chosen is 5 milliamperes per knot of speed, *i. e.* 9 miles = 45 milliamperes; during a period of 24 hours the distance meter (ampere-hour meter) will register $9 \times 24 = 216$ sea miles ($24 \times 0.0045 = 1{,}08$ *A. H.*).

During the first trip of the liner *Bremen* on board of which this log was used whilst crossing from New-York to Southampton the following results were obtained:

	Distance indicated by the log.	*Distance actually covered.*	*Errors Percent.*
July 27-28	635	629	— 0.96
" 28-29	643	641	— 0.31
" 29-30	657	651	— 0.92
" 30-31	675	667	— 1.18

It must be pointed out that the entire manipulation of the log can be done on the bridge and that the engineers need only be called upon for the purpose of moving the PITOT tube in or out.