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Eyes and Ears for the Sub-Sea Fighters

By Thomas W. Benson

CAPTAIN KRONIG gazed with rapturous eyes at the highly polished mechanism fastened to the steel walls of his undersea craft. It had taken over a year of patient, scientific endeavor to evolve that apparatus and across his face there flitted for an instant the memory of the epochal day when he had gained permission to install it on his beloved ship.

"Eyes and ears," he whispered—"electrical eyes and ears for my pet; no longer must we crawl along in the dark towards a hidden death."

His reveries were interrupted by the chief engineer who entered the control room of the U-104 with an order in his hand.

Captain Kronig glanced at the paper and sighed a thankful "At last." He then turned abruptly to his engineer, inquiring curtly if everything was ship-shape.

A reply in the affirmative started the machinery of discipline into action and a half hour later the slim, cigar-shaped hull was gliding smoothly towards the open sea.

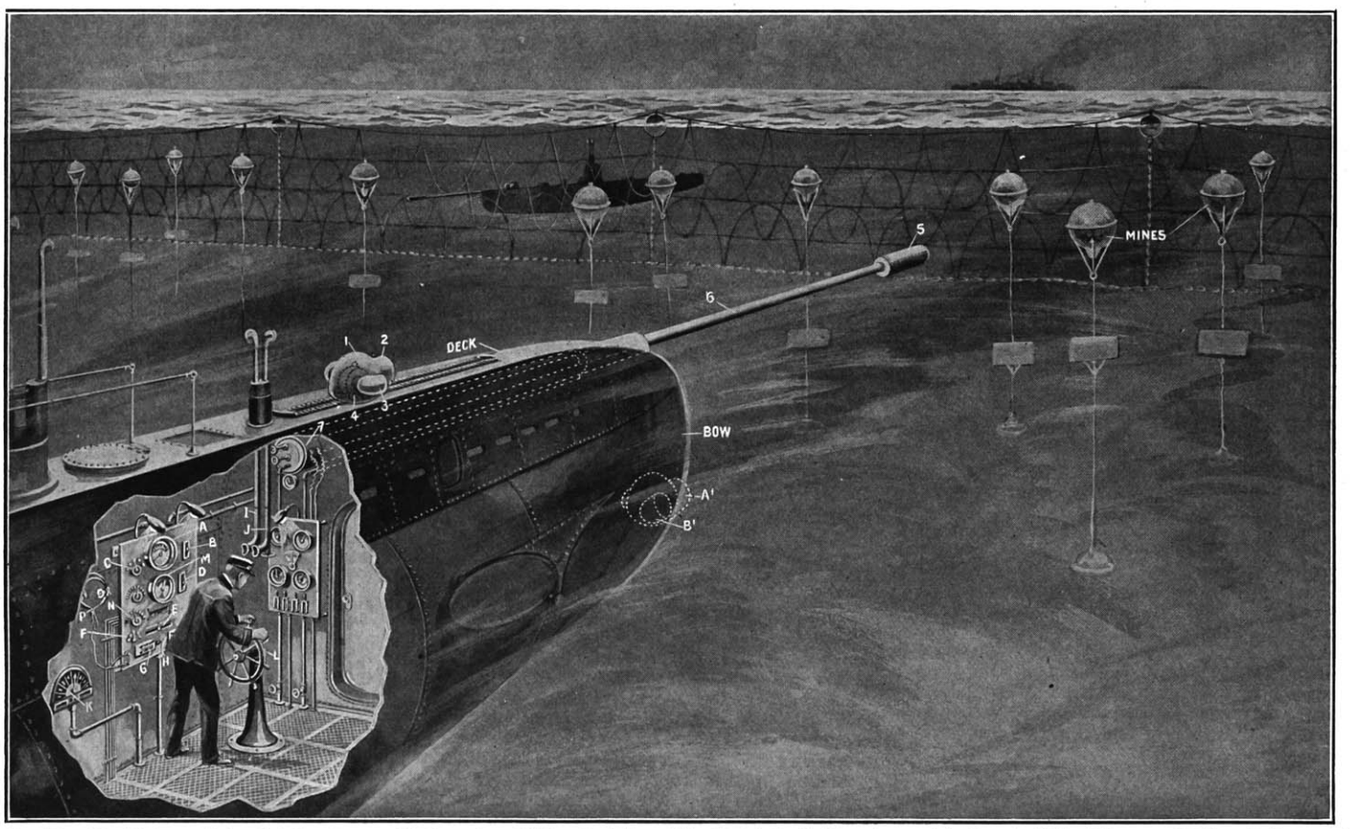
The U-104 was the youngest model submarine built for the German Navy and incorporated the latest and most wonderful *brain-kinder* of some of the Vaterland's cleverest and ablest engineers. It was, among other things, equipt with the new *electrical eyes and ears* that enabled the commander to feel his way safely among mines and nets. When it had been built matters not; suffice it to say it was an important arm of the powerful undersea navy of the Central Powers.

Later we find the U-104 off the west coast of Europe traveling northward with hatches open and the sea quite serene, except for a black smudge on the eastern horizon that indicated a tramp merchantman. But the game was bigger; the orders had read to report at Kiel and report they would, despite any ruler of the waves.

Captain Kronig was taking his position with the sextant and just as he had lined up the reflections on his screen he noticed a spot on the horizon that grew larger each second.

"Batten down the hatches!" he fumed, as he dashed to the conning tower while he threw his signal handle to the warning position and spun the wheel of his periscope. Three short minutes later and the tiny electric globes are glowing in the darkened steel chamber and the waves are splashing against the port-holes of the conning tower.

The *spot* had now grown until it revealed the shape of a fast patrol scout, bearing down on them at the rate of 45 miles an hour and as Captain Kronig got it lined up with the periscope a puff of white smoke appeared over its bow and



A New Electrical Scheme Intended for Use on "Submarines" Whereby These Wonderful Craft May Accurately Locate Nets, Mines and Other Submerged Metallic Obstructions. It Utilizes the Reflection of Sound Waves and the Hughes' Induction Balance in an Original Manner which Has the Ring of Plausibility.

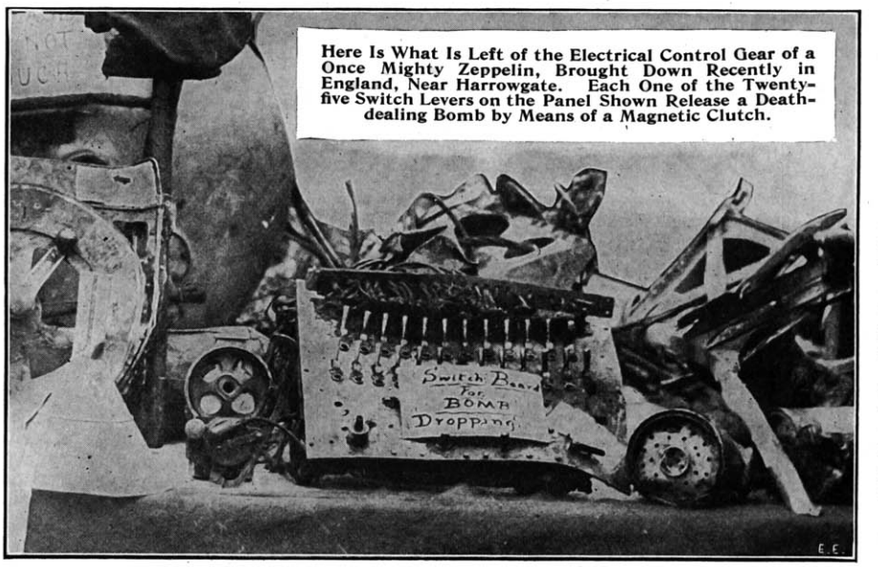
SWITCHBOARD FOUND IN ZEPPELIN WRECK IN ENGLAND.

In a recent Zeppelin raid on England, the defending anti-aircraft gunners were lucky enough to "bag" one of these huge fighting demons of the air. As is generally known, electricity plays an important part in the maneuvering and general operation of all Zeppelin war-craft.

In the accompanying illustrations the switchboard used for bomb dropping is plainly visible, together with one of the magnetos used to furnish current for the ignition of the gasoline and air charges in the gasoline engines which propel the Zeppelin. Several other important parts of the control gear will be noted in the illustration, including the steering wheel and a signal lever projecting from its center post, this apparatus being visible at the extreme left of the picture. The magneto is directly at the left of the switchboard.

Some idea of the terrific concussion taking place when one of these fighting monsters of the sky is brought to earth may be gleaned from the picture.

While the Teutons are extremely busy at this time in their everyday pursuit of military affairs they have taken sufficient time in which to develop a specially accurate means for waging aerial warfare from their giant fortresses of the air. The switchboard shown contains twenty-five levers, each one of which will dispatch a large bomb earthward, with its several hundred pounds of high explosive. The bombs are dropt from various points along the basket suspended beneath the Zeppelin gas bags, and by means of accurate sighting instruments the officers in charge of the bomb dropping can dispatch the missiles very close to the mark in most instances; or at least where there is not too much fog or intervening mist, which, of course, makes it very difficult to sight the various points on the earth or sea with accuracy.



Here Is What Is Left of the Electrical Control Gear of a Once Mighty Zeppelin, Brought Down Recently in England, Near Harrowgate. Each One of the Twenty-five Switch Levers on the Panel Shown Release a Death-dealing Bomb by Means of a Magnetic Clutch.

The bombs are supported in a light cradle-like structure and when one of the switches on the control board here shown is closed, a quick-acting magnetic clutch releases the aerial projectile and it speeds earthward with rapidly increasing velocity—in fact, if it is dropt from a height of several hundred feet, it will have attained such a momentum and high velocity that if it should strike a building it will not only explode, but will, in many instances demolish the structure and pass clean thru it from attic to cellar. Some of these bombs have penetrated so deeply into the earth that they have never been found.

The Zeppelin and other aircraft of an allied nature as is now in use, has added a new phase to the warfare as waged by man. With these machines the great wars of the past, such as our own Civil War and the Spanish-American War, would have had a much different aspect.

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a shell skimmed dangerously near. Another and yet another followed in quick succession just as the undersea craft obeyed the diving rudders and slipped beneath the waves.

Down, down, until the *submerged depth dial* before the navigator indicated 45 feet. Consulting the chart and the gyroscopic compass index the course was laid through the English Channel—through that veritable sea of nets and mines; but a glance at the marvelous, nay, almost supernatural, mechanism on the wall seemed to convey a feeling of safety to all of this heroic crew who braved any danger for the Kaiser and their Vaterland. Deutschland *under* the Allies!—that was their battle-cry.

They were rapidly nearing the forbidden ground, or rather scout, when Captain Kronig turned to his ever-faithful switchboard and rapidly manipulated several switches. He clapped on a pair of head 'phones and seizing a tiny projecting lever turned it down for a moment, then released it, watching intently the while a large dial just before him. The pointer sped around quickly and came to rest finally at zero.

"Gut!" he muttered, pulling another lever and the peculiar hiss of escaping comprest air was heard above the whine of the dynamo and the faint click-clock of a reciprocating pump. The snap of a switch sent home, the adjustment of another handle and Captain Kronig settled down to the precise maneuvering necessary to get through to Kiel.

With an alert eye on compass and depth gage, and a steady hand on the wheel, he would occasionally reach over and throw a switch or adjust a graduated handle. It was becoming monotonous, in fact wearisome, this crawling along at half-speed, this eternal handling of switches. So, eventually he relaxed a little as his thoughts wandered to a little cottage in the quaint valley of Genderen.

And with a suppress "Ach! Mein Gott!" his hand flashed to the switchboard and as the wheel spun violently under his mighty thrust, the hand of the indicator lever was thrown to full reverse, mingled with the sibilant hiss of air. A shock, as the mighty machine endeavored to check itself, the groans of powerful motors as they took up the load, only served to tense the men the more as they stood at their posts, ready to obey any order their doughty chief might give.

Kronig snapped that little lever on the switchboard again and again, watching intently the fast revolving finger on the dial. Then, slowly turning a knob, he glanced at a second dial, and his lips moved, framing an unspoken *hate!*

He had detected an enemy battleship and by maneuvering carefully by means of the switchboard dials, he had finally succeeded in passing it. A thousand yards beyond, according to his *log*, he signaled for a stop and ordering a rise to the surface, he stood motionless with his eye glued to the eagle-eyed periscope.

At first all was black, but slowly, gradually, the light began to appear and there, in the trough of a wave, he detected a huge green hulk. At last he made out the vast hulking form of an armored enemy cruiser and at the same moment they caught sight of his periscope.

"Ready!" was signaled his stern tube; *Full Speed* glowed the engine room indicator, and as the first shot rang out from the cruiser the U-104 dove. "Fire!" was flashed to the man behind the stern tube and like an automaton he pulled the lever that shot the tiny engine of death towards the big craft. Just as the diving rudders flattened out at 40 feet, a heavy shock was felt and the air of tenseness that had settled over the crew disappeared in an unanimous smile. *Another Britisher sunk by a daring submarine,* the papers would print the next morning. Meanwhile, the marauder crept north at half-speed.

Detecting and avoiding mines and nets was a continual experience. Being in the heart of the enemy's stronghold, it was necessary at times to creep beneath a huge ship of the first line; exchanging shots with a scout from the forward turret was an everyday occurrence.

Thus they journeyed northward and east, reaching at last the scientifically mined entrance to Kiel, the long-ought haven of rest, where they safely wormed their way along the narrow, tortuous channel to security.

As they glided into their stall alongside the rest of the submarine fleet, a mighty cheer went up for the daring men. Captain Kronig, standing in the conning tower, heard it, and smiled confidently to his lieutenant, who glanced thankfully at the marvelous switchboard below that had made such things possible.

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"What scientific device made all this

(*Continued on page 609*)

DATE OF ISSUE.—*For the information of our readers, we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same despatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

EYES AND EARS OF THE DEEP SEA FIGHTERS.

(*Continued from page 550*)

possible?" you ask. Merely a possible adaption of common electrical devices already in use, to the special requirements of sub-sea navigation in mined and net-infested waters.

The apparatus might comprise a device for locating large metallic masses, such as battleships, a sudden rise in the bottom of the ocean or a sub-sea peak and to indicate when they are nearing shore. Second, an apparatus for determining when the submersible happened to approach small masses of metals.

Let us consider them in the above order. Referring to Figure we have the bow of a submarine. Mounted on the deck or under the water-line as desired, there is a huge siren or horn 2 or A^1, and two microphones, 3 or B^1; only one microphone being shown in either case, the other being on the opposite side. When placed on deck it may be swiveled and turned by means of the motor, 4.

It is well known that sound waves will be more or less reflected by any large body they strike; this phenomena is illustrated by the well-known echo. Also let us remember that sound travels at a certain definite speed through water.* Now, it is evident that if we send out a sound wave which is reflected and then measure the time and multiply by the velocity of sound we shall have the distance to the reflecting object.

Refer again to the figure. At A is seen a large dial with a pointer that travels over a scale graduated in feet. At B is shown a projecting handle By pulling down, then releasing B, it flies up. On the return it operates the siren 2 for a moment, and at the same instant releases the needle on dial A. As soon as the siren stops the microphones are switched automatically into the circuit by the action of B.

As soon as A is released, it starts to move over the scale at a certain rate of speed. When the sound wave reaches the microphones on their return, the current in them is varied, actuating the Audion amplifier, which energizes a magnet and stops the needle on A for a moment. It will be evident that with the scale of A, properly calibrated in feet, it is possible to read the distance to the object directly from it, since the distance around the scale it travels is dependent directly on the length of time consumed between the emission of the signal and its momentary halt upon the reception of the reflected sound signal by the microphones. The needle is stopped by the magnet controlled by the Audion long enough to obtain a reading before it continues on to the zero mark. The needle is driven by clockwork so arranged as to be kept wound up to the same tension by lever B, acting on the spring every time it is depressed.

The rheostat C regulates the strength of the transmitted signal; F controls the direction of the deck *eye*, the position of the latter being indicated by the dial M, thus the direction of the obstruction can be readily determined. If desired, the 'phones can be switched into the checking magnet circuit to assist in determining the distance to the object on scale A, thus giving a double check, both by noting the momentary checking of the pointer's movement and the sound in the 'phones.

The location of large objects being thus easily obtained it is a simple matter to avoid them, but in the case of nets and mines the reflection of sound waves is not great enough to show their presence.

We therefore take recourse to the oft-described and remarkably sensitive Hughes induction balance. Referring to sketch, we see the differentially wound coils, 5, fitting into a chamber. These coils are mounted on a rod 6, which connects with a disc that fits tightly into the cylinder 7. By allowing comprest air to enter behind the piston the rod is forced out and the coils are advanced some 30 feet in front of the craft proper; admitting comprest air in front of the piston, drives it back to the normal position.

These coils are connected to a similar pair located behind the main observation switchboard. The latter are wound in the same direction as in the usual balance as described in a previous issue of THE ELECTRICAL EXPERIMENTER. The coupling between the coils can be varied by means of the sliding handle E. Lever D controls the comprest air actuating the piston of the rod carrying the coils, 5; switch H allows the 'phones to be connected into the circuit with one pair of coils, switch G throwing current into the other set, the strength of which is varied by rheostat N.

The principle is self-evident. While in a mine field the coils S are extended and a balance obtained with lever E. When approaching a mine or net, which are large metal bodies, the precise magnetic balance is disturbed and a sound will be heard in the 'phones. Operating D draws the coils back into the chamber, placing the rudder hard over and full speed reverse prevents an actual collision.

The switchboard is placed conveniently near the wheel L, speed controller K, periscopes I and J and the bank of indicating devices necessary for the operation and control of a modern submarine such as here considered.

A commander equipped with this apparatus is, in accordance with my plans, therefore in a position to maneuver quite safely among the enemy mines and nets.

The objection might be raised that the siren would warn the enemy of the presence of the craft, or in case the method of detecting submarines previously described in this journal was in use, the submarine could easily be located by the enemy. In answer to the first objection, consider that the mere knowledge of the presence of a submarine does not constitute capture, especially so, when it can move safely through a netted district without being caught in it.

Secondly, the microphones on shore are tuned to pick up the high note of the motors and in case they succeed in locating it there still remains the difficult undertaking of capture.

That such a device would be valuable is not so very doubtful the author believes; at least it would seem to require a practical test to prove it a failure.

*The velocity of sound through water is approximately 4,000 feet per second. Hence, if the distance be 100 feet to a reflecting object, the time taken by the sound in traveling from the ship to the object, and from object to ship will be approximately one-twentieth of a second. This effect has been utilized in taking "soundings" or measurements of the depth of the sea in a very accurate manner as cited by Mr. R. F. Blake (Prof. R. A. Fessenden's work) in a paper presented before the American Institute of Electrical Engineers, at Philadelphia, Pa., October 12, 1914. The distance to hidden icebergs, even 2½ miles away, was measured in this way, also, and the results were very satisfactory. It should be mentioned that a special switching device or commutator must be used in such sound reflection measurements, which operates so as to enegize first the sound producer, and then to close the circuit to the microphone or receiving resonators in time to intercept the "echo." For an interesting account of the present type sound wave submarine signaling apparatus, carried by all first-class ocean-going steamships and warvessels the reader is refered to THE ELECTRICAL EXPERIMENTER for February, 1916. From these reports we find also that the deeper the submergence the better the results, for the surface water is not quite as good a conductor of sound. Also the velocity of sound will vary slightly with change in temperature and corresponding variations in density.