sheet with no intermediate process. This can be done in a fraction of the time required to prepare tracings from photostats ; the cost of photostatic reproduction is eliminated, and the errors due to photostat distortion and repeated tracing are avoided. The principal advantage, however, is in the saving in time both to the hydrographer and compiler, in that the work is done as required in the field, and no time is lost on plotting or compilation while waiting for sheets to be returned to the field.

The projector was designed primarily for the transfer of shoreline but it was soon found to have other uses of only slightly less importance. All detail inked on the aluminium mounted control sheets can be quickly and accurately checked against the compilations by the method outlined above. Another important use is in the comparison of junctions between compilations of different scale. This process heretofore required tedious use of the proportional dividers which process at best was often inadequate where junction detail was intricate. Comparison with charted detail can be made in the same manner by projecting the compiled shoreline onto large scale charts of the section. This is very useful in checking structures along waterfront areas.

In several instances it was found that the paper of the hydrographic sheet had distorted. This distortion was generally greater in the direction of the long axis of the sheet thus "warping" the projection. This could be compensated for by "warping" the projected image of the compilation which is done by tilting the lens slightly or by shifting the lens in a horizontal plane or by both, thus making it unnecessary to adjust the sheet frequently while tracing an area.

Along the South Atlantic Coast the field topographer frequently finds areas in which it is exceptionally difficult or even impossible to carry planetable surveys for hydrographic control. This may be due to lack of precise control, unstable marsh land areas where set-ups are difficult or restricted ground visibility. Several such areas were found in Georgia, the most extensive being the Altamaha River above Darien. This river winds for a distance of 21 miles through a dense cypress swamp where planetable control is impossible, so Lieutenant C. A. EGNER, who was in charge of the hydrographic party, tried the following experiment.

The building party took aerial photographs of the area with them to the field, and spotted the hydrographic signals on these prints as they were built. The signal points were then carefully transferred to the mounted office prints and plotted on the compilation with colored ink by holding the surrounding radial points. This method assured a more accurate signal location than could be secured by spotting the signals on the compiled shoreline. The signals and shoreline were then projected directly on the boat and smooth sheets, and the colored hydrographic signals removed from the compilation. The field prints on which the signals were spotted were retained by the hydrographic party and forwarded with the hydrographic sheets in lieu of topographic control sheets. This system proved to be satisfactory and was used several times on the Georgia project and is being used at this time by Lieutenant J. A. BOND in the Pungo River area in North Carolina.

DEEP SEA ELECTRIC BOMBS.

by

J. M. SMOOK, HYDROGRAPHIC AND GEODETIC ENGINEER,
U. S. COAST AND GEODETIC SURVEY.

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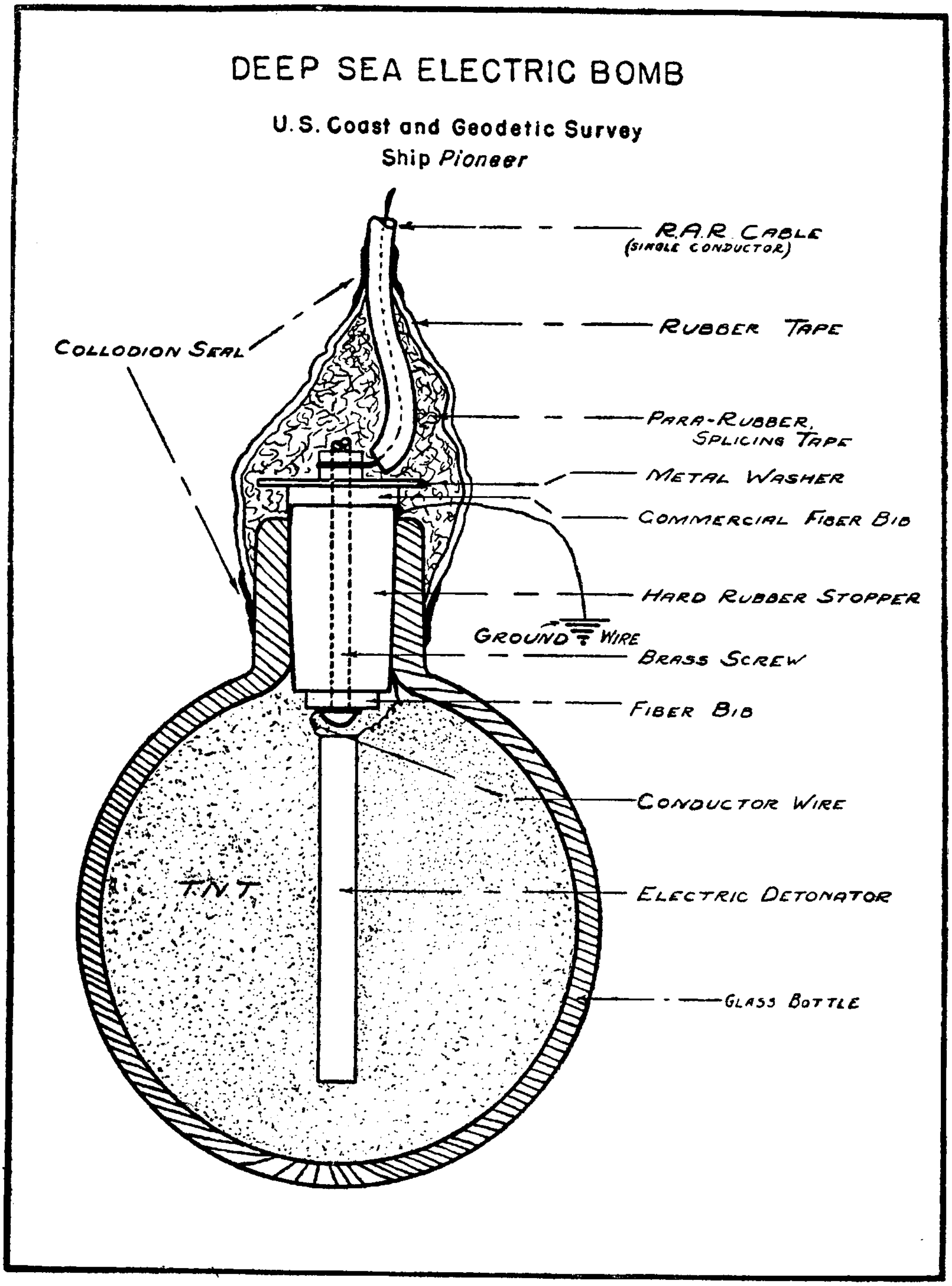
In order to carry out the experiments between the ships *Pioneer* and *Guide* to determine the velocity and ray paths of sound waves in deep sea water, it was necessary to perfect a bomb that would withstand the enormous pressure encountered at a depth of 1000 fathoms, as the original intention was to fire bombs at varying depths, with 1000 fathoms as the maximum. There was no available literature on the subject, and inquiries of the powder manufacturers showed that so far as they knew, the field was a new one. They were very much interested, however, to see how the standard detonators would work at such depths, for at 1000 fathoms the pressure is approximately 2700 pounds per square inch.


DEEP SEA ELECTRIC BOMB
U.S. Coast and Geodetic Survey
Ship Pioneer
R.A.R. CABLE
(SINGLE CONDUCTOR)
RUBBER TAPE
COLLODION SEAL
PARA-RUBBER, SPLICING TAPE
METAL WASHER
COMMERCIAL FIBER BIB
HARD RUBBER STOPPER
GROUND WIRE
BRASS SCREW
FIBER BIB
CONDUCTOR WIRE
T.N.T.
ELECTRIC DETONATOR
GLASS BOTTLE

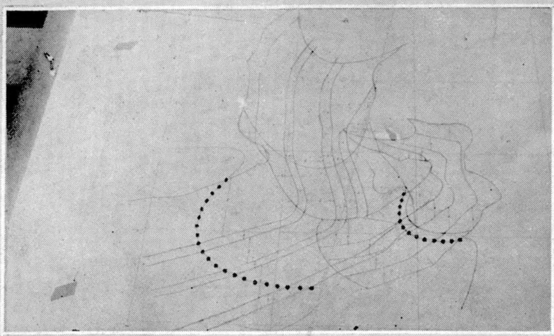
The first consideration was to get a container that would withstand the pressure, and still be economical. A glass bottle was finally decided on, after having given considerable thought to having a special bomb made up according to specifications of our cast iron bombs. The bottle was spherical in shape and the walls were about 1/4 inch thick. (See figure). The bottle was then tested for its strength. This was done by stopping it up with a rubber stopper and lowering it to the desired depth. Practically all of the first attempts were failures, as the pressure forced the stopper into the neck of the bottle ,and the latter came up full of water. Best results were obtained by using a washer over the top of the stopper, so that the pressure would be distributed to the neck of the bottle instead of directly on the rubber. That difficulty overcome, the next step was to make the bottle watertight to protect the T.N.T. and the detonator. This was done by drilling a hole through the stopper to take a N° 8×32 screw. A fiber washer was used at each end of the rubber. By tightening up on the nut, the rubber stopper expanded enough to completely fill the neck of the bottle.

The bottle was completely filled with T.N.T., and then a stick, slightly smaller in diameter than the detonator was forced into it, to make room for the cap. Before inserting the detonator, the conductor wire was secured to the screw, between the inside and the head of the screw and the ground wire was led along the stopper, in a slit made with a knife. The stopper was then placed in the bottle, fitting the detonator into the hole for same and slightly tamping the T.N.T. so that it was well packed around the cap. The nut was then tightened up as much as possible with a socket wrench. This left the ground wire free, outside of the bottle. (The sea water was used as the return). The bomb was now ready to be secured to the conductor cable. The usual single conductor rubber covered airplane wire (used for R.A.R. work) was used for this purpose. Two or three strands of the wire were secured to the screw just outside of the tightening nut, and another nut was then put on to hold it. Some para rubber splicing tape was wrapped around the neck of the bottle and up to a point above where the conductor cable joined the bomb. The para rubber was then covered with rubber tape. (As an added precaution, a coat of collodion was applied to the rubber tape, but this probably was not necessary).

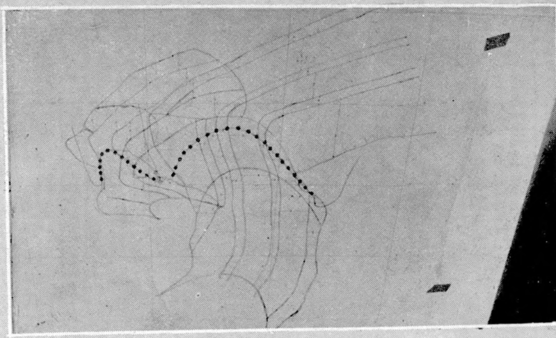
In order to make the bomb sink fast and to keep the wire straight up and down, scrap railroad iron weighing about 60 pounds was used. It was secured by a piece of 6 thread line about four feet above the bomb and extended about one foot below same. (The ground wire was made fast to this weight). The 6 thread line was made fast around the neck of the bomb by a piece of rope yarn, so that when the explosion occurred the line would part and the weight would be detached.

The following precautions were taken to prevent a premature explosion of the bomb. The hook-up was so arranged that the firing switch was in the radio shack, for by throwing the switch an initial was sent out to the chronograph. The bomb would not explode, however, unless a lamp was firmly screwed into its socket and another switch was closed. The latter two were located on deck, near the dynamiter, and on prearranged signals from the radio shack the lamp was screwed in place and the switch closed. The lighting of the lamp indicated that the circuit was completed in the radio shack.

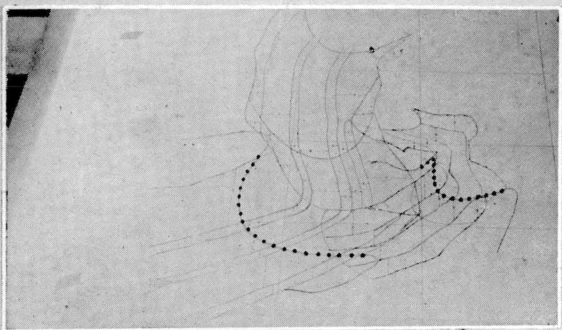
The bombs, when prepared as above mentioned, worked very satisfactorily and there were no failures up to a depth of 700 fathoms which was the deepest depth tried. One bomb failed to explode due to a leaking conductor cable and another failed when a bottle with a broken neck was sent down, causing the powder to get wet. Several empty bottles, fitted up with the stoppers, were sent down to 1000 fathoms and they came back perfectly dry, indicating that they would have made successful bombs at that depth. This brings up the possibility of using such bombs in our work. It was noted at a given position that a 4 ounce bomb fired electrically at a depth of thirty fathoms gave a full kick at a shore station, whereas a pint bomb thrown over the side at the same place, while the ship was underway, was barely heard. If the results of the experiments conducted between the ships *Pioneer* and *Guide*, show that a sound wave will get through to a shore station better when at a considerable depth below the surface than at the surface, we can be prepared to fire the bombs at such depths. Also when engaged on R.A.R. work, whenever the ship stops for a vertical cast, an electrically detonated bomb could be fired to obtain the position of the ship, and where a long distance from the station, a larger bomb could be used by lowering it deeper in the water.



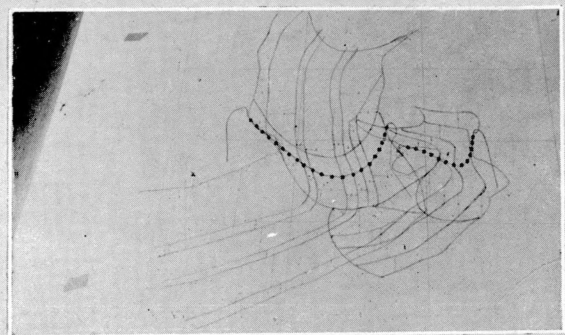
Position 13 E day Position 7 B day



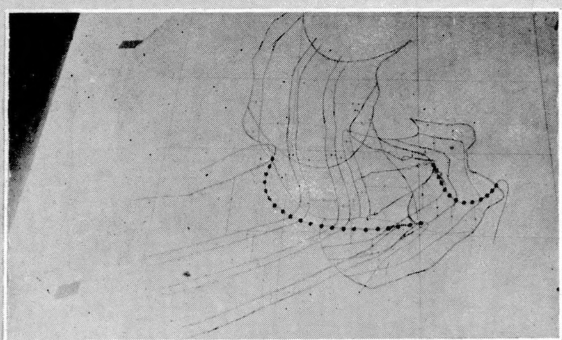
Position 24 E day Position 20 B day



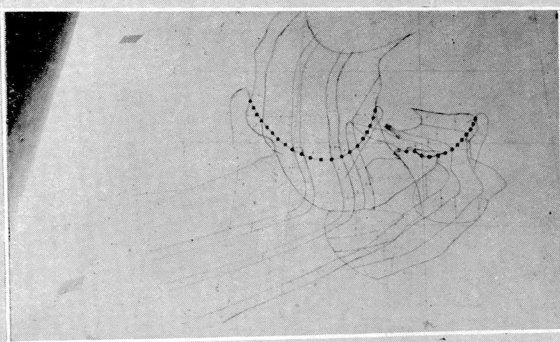
Position 16 E day Position 13 B day



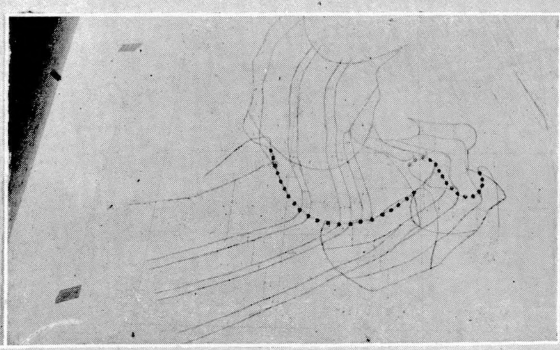
Position 26 E day Position 22 B day



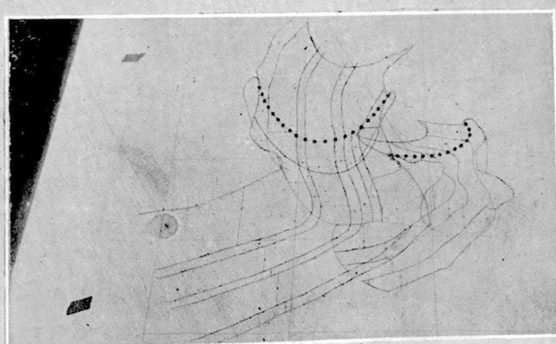
Position 20 E day Position 16 B day



Position 28 E day Position 25 B day



Position 22 E day Position 18 B day



Position 31 E day Position 27.5 B day

WIRE DRAG BUOY SPACER IN OPERATION