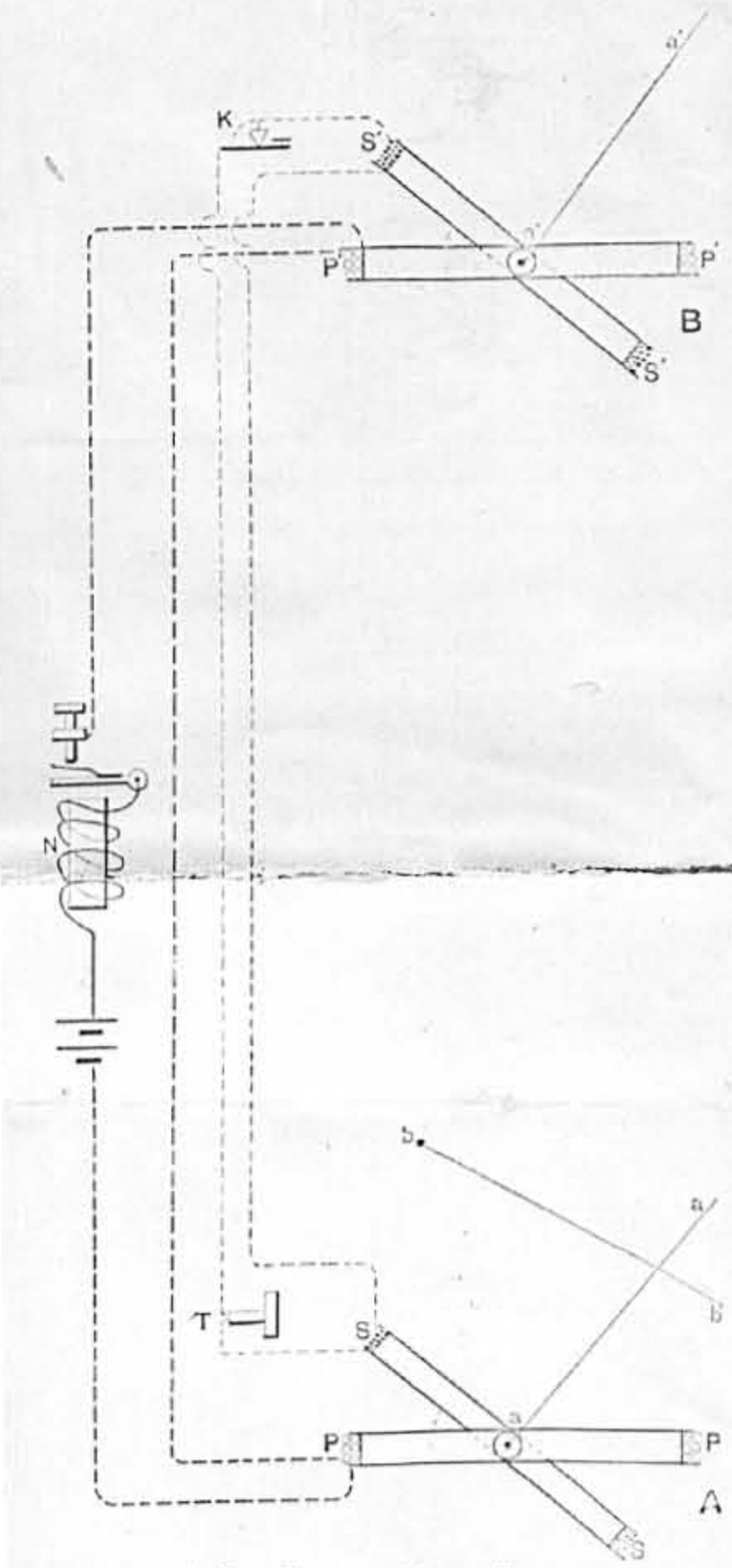
A New Form of Range Finder for Use with Modern Seacoast Guns.

BY LIEUT. GEORGE L. ANDERSON.

The modern seacoast gun is an expensive piece of machinery to construct and operate. As employed in our harbor defences or on board the new naval ships, it serves to fire, as a rule, not more than 300 pounds. The wear and tear on the gun and its carriage, the original expense of the projectile, charge and minor items make, in these days, the cost of delivering a single projectile by any powerful and self-respecting nation about $450. Economy alone suggests, therefore, that the piece shall be carefully aimed, and that means must be found to ascertain quickly and accurately the distance to the object—fixed or moving—aimed at.

A still more important consideration is effectiveness of fire. Future operations are destined to be short and decisive owing to the improvements in material, so that exact knowledge of the enemy's position at the outset and during the fight will be more strongly demanded than heretofore.

Artillerists have accordingly sought to devise some method of ascertaining readily, and so far as practicable automatically, the bearing and distance of any desired object—fixed or moving—from the gun, or of locating its position in some simple manner upon a chart of the harbor or other field. Such a method, if simple, would also prove serviceable to them in operating submarine mines. The result has been a great variety of range or position finders, to be found now for the most part in the museums or the scrap heap.



A New Form of Range Finder.

An effective method, early employed on land, consisted in placing at the extremities of a suitable base line two azimuth instruments, by means of which the angles to any given object were measured. The readings were then signalled to the persons at the gun, who plotted the courses on a map of the harbor and thus located the object. A scale of the map gave the required distance, and, when the signaling was performed by telegraph, the whole operation occupied less than one minute's time. The plan when carefully conducted was found in every day practice to locate any position with sufficient accuracy. Yet the precision depends upon the skill and coolness of each of a half dozen persons, and it is not thought the method would find much use in time of war.

To render as far as possible the foregoing method automatic, the Siemens Brothers brought out several years ago their "distanzmesser" in which two light horizontal arms 20 inches long swept over the map on the plane table—each one keeping constantly parallel to the axis of the telescope with which it was connected electrically. Either arm was moved by the usual step by step contrivance driven by currents induced by a magnet, whose motion turned the telescope. If the telescopes at the ends of the base lines were continually directed upon a moving vessel in the harbor, the two arms of the plane table turned with them and by their intersection indicated the vessel's position on the map in a continuous manner. Only two observers were required, and the system was sufficiently automatic. But the apparatus, finely executed like all the Siemens' work, was costly, complicated and easily disarranged. The failure of either arm to remain parallel to the axis of the telescope was not easily discoverable.

Other range finders on the Siemens principle using the make and break direct current or the induced have been tried, but they have proved too complicated, expensive and uncertain in action.

The Watkins range finder adopted in the British service is essentially a depression instrument requiring a vertical base line not always obtainable, a correction for the height of the tide and a clear view of the water line on the vessel, which would frequently be hidden in smoke.

The Austrians use the camera obscura, which requires only a single observer, and which is so simple as to suggest its employment in this country as a check upon whatever better method may be adopted to locate objects in our harbors.

Of all the various devices thus far suggested, the range apparatus of Lieut. A. B. Fiske, U. S. Navy, is most original and interesting. It is constructed and operated upon the plan of the Wheatstone bridge. There is no complicated mechanism to adjust, and it is fairly accurate within a large range of distances: it can be manufactured cheaply, it will withstand the rough usage of service, it requires a short base line and seems to be admirably suited to service on board ship. Several Fiske range finders have already been purchased for the government service.

The resistance of the arms of the bridge is small, and and yet we have not heard that there is a liability to error or uncertainty in the readings of the instrument, due to slight changes in the connections between the arms or to unequal heating or slight injury to the bridge wire. The inventor has, doubtlessly, considered the advisability of using larger resistances in the arms by replacing the slide turn of the bridge by a great number of small resistances joined in series and allowing the slider to move over the usual brass contact pieces.

A new form of range finder, which is here proposed, involves the principle of the Hughes induction balance as modified in the teleinductor. Balance is obtained by a motion of rotation instead of translation. It has no delicate mechanism, and it dispenses with the troublesome galvanometer. It is, moreover, simple, inexpensive, and may be brought to as high a degree of accuracy as may be desired. A full description of the instrument is not given, but the principle of its construction will be readily understood by all interested in the subject from the accompanying diagram:

PP and *SS* are primary and secondary coils, respectively of circular or other form, located at station *A*, one extremity of the base line. One coil has a smaller diameter, so that it may revolve inside the other about a vertical axis, lying in the planes of both. *SS* may, therefore, occupy any position from 0 degrees to 90 degrees to *PP*. *aa* is a light pointer attached to *SS*, perpendicular to its plane, and moves with it over the face of the map, which for simplicity of description we shall suppose in this case to be located at station *A*. At station *B*, the other end of the base line, *P'P'* and *S'S'* are respectively primary and secondary coils similarly constructed to those at *A*, or so made as to have the same coefficient of induction. *AA'*, perpendicular to the plane of *S'S'*, is the axis of a telescope, whose motion in azimuth carries, in the case here shown, coil *S'S'* with it.

The two primaries *PP* and *P'P'*, whose planes are kept parallel to each other, a battery and a buzzer are joined in simple circuit, as shown. The two secondaries *SS* and *S'S'*, a telephone at *A*, and a closed key, *K'*, are connected in simple circuit in such manner that the current induced in the secondary at *A* is opposite to that induced in *S'S'* at *B*. It is evident that whenever coil *SS* is moved by hand to occupy a position parallel to *S'S'*, the buzzer being set in operation, all noise in the telephone will cease and the observer at *A* will know that the pointer *aa* is parallel to the vertical plane through the telescope axis *a'a'*.

bb is a pointer like *aa* sweeping over the surface of the map and keeping parallel with the motion in azimuth of the axis of the telescope *a'b'* *A*, with which it is connected mechanically. The point on the map where *aa* and *bb* cross will then represent on the map the object in the harbor to which the telescopes at the ends of the base line are directed, if we may suppose the surface to be a plane area.

The secondary at *A*, as here described, should be made to revolve from 0 degrees to 90 degrees in the same direction, as at *B*. Both secondaries may, however, revolve from 0 degree to 90 degrees in the other direction if the observer at *B*, by means of key *K*, so signals to *A*. The best positions are from 45 degrees on one side to 45 degrees on the other, and these may be used if 90 degrees give sufficient range, as would be the case in most instances.

The battery power may be all that the contact points of the buzzer will admit, and therefore considerable. Two telephones, having the lightness and distinctness of instruments manufactured abroad, should be employed. These are connected with each other by a metal strap which holds them tightly to the ears of the observer at *A*.

Two observers only are actually necessary. Three or four observers and essentially a duplicate of the plant above described will be required if the map is desired at any point other than the extremity of a base line.

To simplify the description four wires are here shown connecting *A* and *B*. In practice it will be found preferable to ground one of the circuits so that three wires serve equally well. Or if both circuits are grounded two wires only will be required.

The object of this article is to show how readily the induction balance lends itself to locate the position of a distant object at sea rather than to give a complete description of the instrument.

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Electric Lighting in the Church of Notre Dame.

In taking in a view of the city of Montreal from the beautiful mountain at its back or from the river at its feet one of the most prominent buildings and one which seems to first catch the eye is the Church of Notre Dame, with its two high and imposing towers. No visitor in that quaint old town has come away satisfied without having ascended one of these towers, and viewing the great bell which they are told is the largest swinging bell on the Continent.

The church shown in Fig. 1, which is the most elaborately decorated of any church in Canada, is wired for 400 incandescent lights, and these lights have all been arranged to the very best advantage. One hundred and fifty are placed around the alcove that contains the altar, and being hidden from view shed all their light directly on the altar with its dozens of golden pinnacles, each surmounted by a tiny incandescent lamp, and altogether making the most gorgeous spectacle that can well be conceived. The plant that furnishes the light is placed in a convenient place just beneath the altar, and consists of one 300-light and one 100-light Royal Electric Company's (of Montreal) machines driven by one 60-h. p. Waterbury engine, there being another duplicate engine in reserve. Two Babcock & Wilcox boilers are installed in the basement at a convenient distance from the dynamo room. As seen in Fig. 2 the dynamos are belted from a countershaft placed on a trestle or bridge. This was found necessary to avoid the vibrations that would have naturally occurred with a hanging shaft—a shaft being necessary on account of the precaution against accident in having two engines each ready for use in case of any trouble with the other. The plant will no doubt be examined by the visitors to the coming convention with considerable interest.

ELECTRIC LIGH

The Rockford (Ill.) West End Railway.

The West End Railway Company, at Rockford, Ill., is operating the Short system on two lines of 2¼ miles each, which were opened to the public on June 3. Three motor cars and three Stephenson trail cars are only used at present, the motor cars carrying two 15-h. p. high speed Short motors, but the additional motor cars will be equipped with the Short gearless motor. The road contains several curves and two grades of 4 per cent. and 6 per cent. respectively. Sawed 6" × 6" white oak ties, laid 2 feet apart, support 48-pound girder rails in the business portion of the city, and 35-pound T rails near the outskirts. The pole line presents a handsome appearance far above the average and would be a credit to any street in the larger cities. Both lines run to the baseball grounds, and on July 4 there were 178 passengers carried at one time on a motor and trailer without the slightest difficulty being experienced. The installation was supervised by Mr. W. J. Davison, of the Short Electric Company. The company has an 80-h. p. Short generator and an Ideal engine of 150-h. p. that are being operated in the station of the Forest City Electric Light and Power Company until the question of a new power house is decided. The completion of this line has materially added to the value of suburban property, and it is reported that contracts for 14 new buildings have been let, and that several new factories will be built now that the western section of the city has such excellent rapid transit facilities. The officers of the company are Mr. J. S. Ticknor, president, and Mr. F. A. Ticknor, secretary and treasurer. These gentlemen are energetically pushing the work of the company.