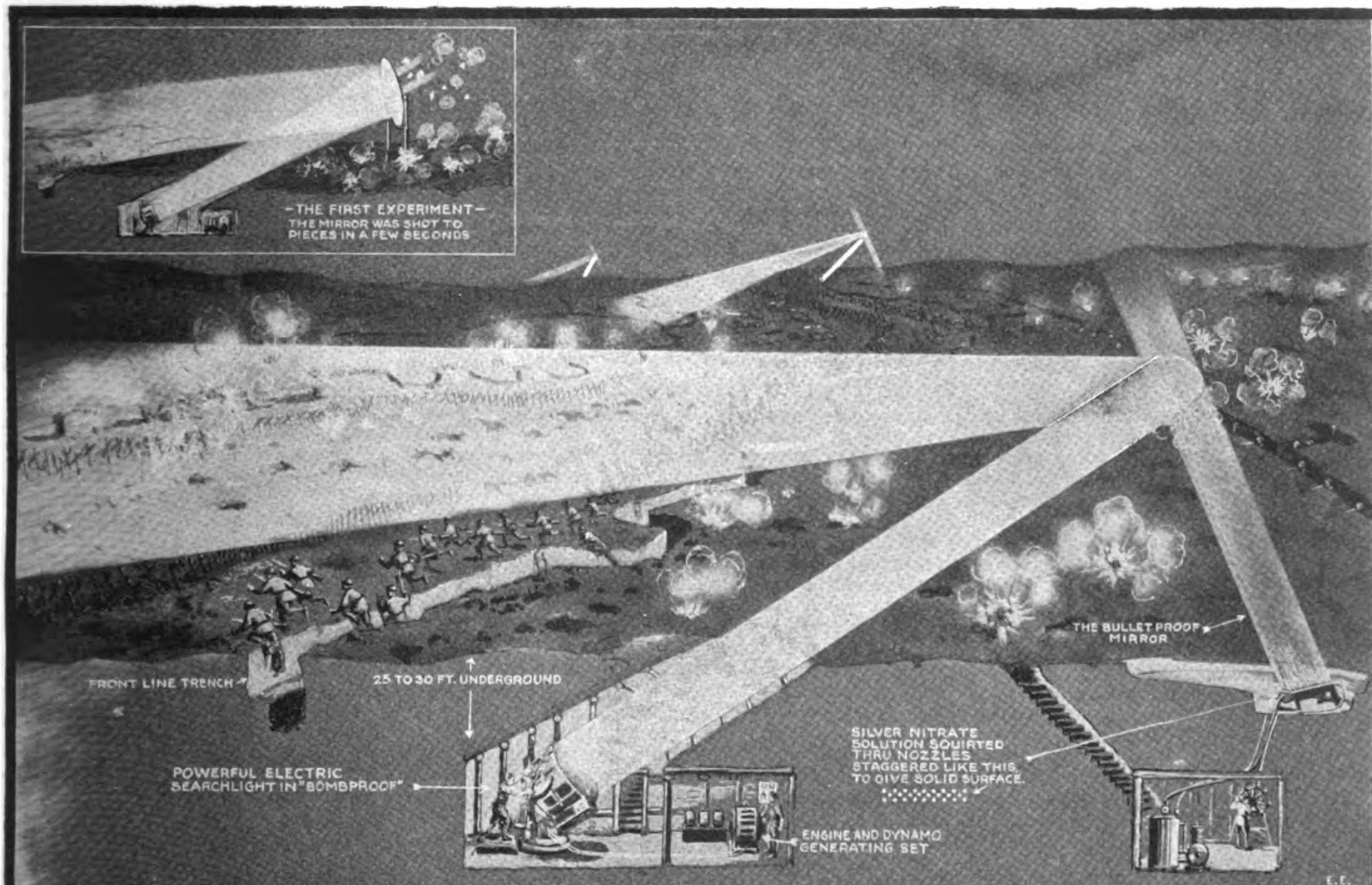
A Bullet-Proof Searchlight Reflector

By EDWIN F. LINDER, M.E.

MANY ingenious contrivances have been produced under the stress of the unusual circumstances which have always accompanied the wars waged by nations during the various periods of history. The recent great conflict was no exception to this natural tendency in stimulating the inventive traits of the scientific members of both the civil and military groups opposed to each other. It can therefore be safely assumed that the great magnitude of the last military campaign, in which so many millions of people were engaged, presented a much larger field for the development of suggestions for military use than any other previous war. Perhaps, at the close of actual combat, more than *one hundred thousand schemes* were under consideration by the officials of the allied governments and by engineers and other private professional enterprises engaged in the production of supplies and equipments for the armies in the field. Thousands of experiments were made along heretofore unknown lines of military action; a number of these efforts were crowned with success, yet the vast majority proved of little use when put to the terrific test of the battlefield. However, the benefits gained by the opportunities presented to observe the deficiencies of the countless number of devices will serve to build up better and more effective equipments for future protection.



A Bullet-Proof and Shell-Proof Mirror by Means of Which It Becomes Possible to Reflect Searchlight Beams Across "No-Man's-Land" into the Enemy Territory Has Become a Reality, Thanks to the Invention of the Present Liquid Mirror. The Searchlight Is Placed Well Under the Ground in Such a Position That It Is Very Difficult to Destroy, Even by Shell-Fire. The Mirror Is Composed of Fine Jets of Mercury or Other Suitable Liquid, Overlapping Streams of Which Are Squirted Skyward in the Manner Apparent from the Illustration and Which Tests Have Shown to Act as an Efficient Mirror for the Purpose.

THE SEARCHLIGHT IN WAR.

During the early stages of the war the searchlight was found to be of great service in sweeping over the territory beyond the front trenches, known as "No Man's Land." Here it was found extremely difficult to protect the apparatus from the alert marksman stationed behind the enemy's line. Every imaginable ruse to hide the location of the searchlights was resorted to, such as shifting them from place to place; using several close together, operating one—then shutting off the light by shutters and putting the others into action—yet it would not be long before the enemy range-finders would find the mark and finally a well placed shot would end its career,

METALLIC MIRRORS NO BETTER THAN GLASS

Metallic parabolic mirrors were substituted for the more delicate glass types, but fared very little better at the hands of the enemy, who had become exceedingly skillful in quickly demolishing searchlight stations.

When this country entered into the conflict a new source of genius was brought to the assistance of the Allies, and among the most useful and much needed branches, the staffs of experts in the searchlight industries of several of the largest establishments in the world, were the first to whom was detailed the difficult problems of devising means to fill the requirements of the wrecked equipments of the Allies' forces and also to furnish better devices for our own army.

The then existing models of searchlights, which had proved to be defective, were replaced by many new types of design. Experience of the staff officers in the field pointed out that what was required to improve this branch of the service were designs that would produce searchlights that could be operated under cover of some kind of overhead protection, and at the same time enable our army experts to direct the beam at will toward the enemy. This type of light was sought for trench use where the beam was to be usually rotated on a horizontal plane.

After much study a type was actually constructed by an American concern in which the chief improvement was the mounting of a plain glass reflecting mirror that could be pivoted to the desired angle on a long tube. When in use, the only parts exposed to the gun fire and snipers of the enemy was the plain mirror. This scheme of course protected the major part of the apparatus from damage to a greater extent than the former models—but soon was discarded, as the exposed position of the second reflector served as an excellent target, and once shattered placed the plant out of commission. (The insert in the illustration gives a very good idea of what happened every time the plain mirror would be raised above the top of a trench.

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The Oracle

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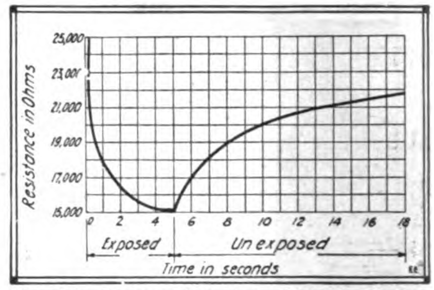
inertia can be readily seen by attempting to make a graph of the time it takes the cell to respond to light and the time of recovery. This is known as a *lag*. This can be greatly reduced by enclosing the cells in an exhausted glass tube. Not only will this decrease the *lag* in the cell, but also prolong the life of the cell considerably. Continued illumination projected on a cell causes a permanent defect which is generally known as fatigue, the cells then becoming very sluggish in their action and their sensitiveness gradually becoming less. The maximum sensitiveness of a selenium cell is toward the yellow-orange portion of the spectrum and hence light of that color will have a direct effect upon a cell. Likewise heat has been found to vary the electrical resistance of selenium in a very remarkable manner. At 80° C. selenium is a non-conductor, but up to 210° C. the conductivity increases, after which it again diminishes.



Graphic Curve Showing "Lag" of Selenium Cell or Time for Recovery.

All we could advise in this matter is that you either build your own selenium cells or enclose them in an exhausted glass tube and attempt to keep the cells covered when not experimenting with them. Perhaps a *photo-electric* cell would meet your need more exactly than selenium.

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It was of vital importance that something be done to safeguard the searchlight equipments from the ever increasing wave of destruction to which they had ben subjected.

An American engineer, who had specialized for many years in the use of searchlights under very novel circumstances, gave this difficult problem very serious thought and toward the close of the war conducted a series of tests that resulted in the production of a device which he named the "Bullet-Proof Mirror." This device was experimented with in model form under similar conditions to those which might be expected on the battlefields; smaller apparatus was employed, of course, than would be operated under actual military engagements, nevertheless this new departure in searchlight methods gave very satisfactory results.

To insure absolute protection against destruction by shell fire an underground chamber, the roof of which is approximately thirty feet below the surface, is excavated at the end of an inclined tunnel. This chamber contains the major part of the projector and generator units and many of the auxiliary mechanisms used in conjunction with the new liquid reflector apparatus, which is set up at the upper end of the inclined tunnel, referred to above. A second dugout, somewhat similar to the larger chamber, is provided for the men controlling the operations of parts of the outfit at the new mirror.

The apparatus creating the flat *fluid reflector* is possibly of more interest than the others and is of very simple construction.

DETAILS OF THE "BULLET-PROOF" MIRROR.

Three tubes, closely fitted together, have attached to the upper surfaces a series of

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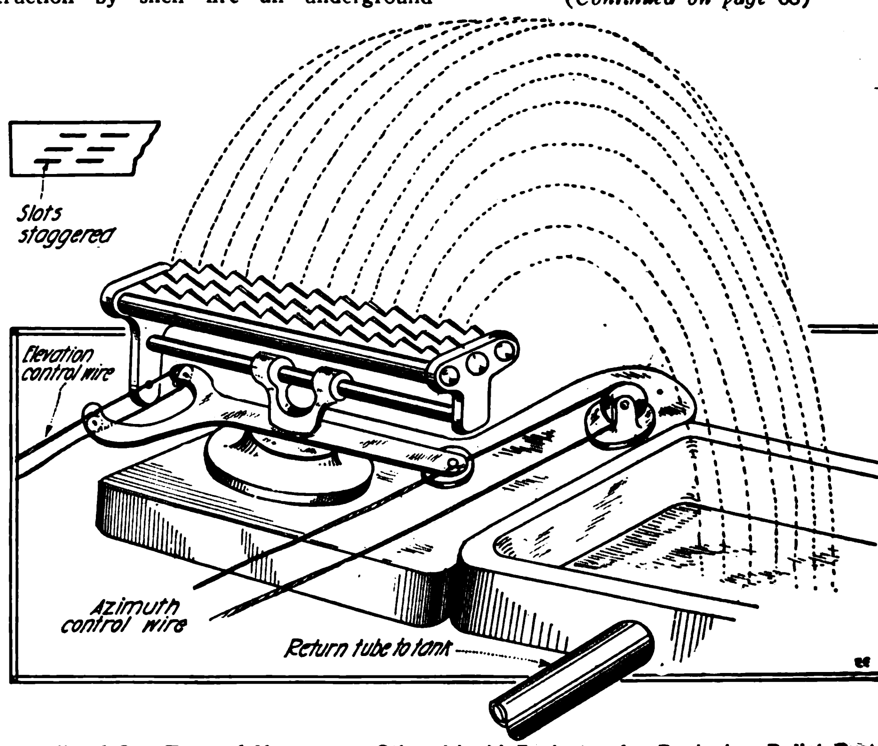

Details of One Type of Mercury or Other Liquid Projector for Producing Bullet-Proof Mirrors.