PHYSICS

Invisible Fences

Attempted Sabotage in Defense Plants Is Being Prevented by "Electric Eyes" Sensitive to Infra-Red

By PAUL KEARNEY

ON a pitch-black, rainy night a few weeks ago, a skulking intruder with a jimmy in his pocket crept silently across the large yard surrounding a war material warehouse. He had managed, undetected by the gateman, to scale the high wall. A watchman on his rounds had just turned the corner of the building and disappeared. There was ample time, it seemed to the skulker, to rush to the truck entrance of the building, pry open a lock and get inside. He took one more step forward, and glanced right and left.

At that moment a tiny white light shone on a panel in the guardhouse and a muffled bell sounded. Guards grabbed their pistols and went into action. The plant is several hundred feet long and has many entrances, but the guards ran unerringly toward the intruder, and nabbed him. Just what he was after isn't clear; he may be a mere thief but he could just as easily be a professional saboteur like those who caused the devastating fires and explosions of the first World War.

Today, thanks to an ingenious device recently perfected, this man and his fellows are running into a new kind of fence, which no one yet has been able to climb or evade. In more than 800 plants, this new barrier, which you can't see or feel, and can't pass undetected, is providing subtle and powerful protection. It is so effective that in 73 attacks in recent months, 54 of the marauders were captured, and the other 19 were scared away, empty-handed, by the almost instantaneous arrival of guards or police.

Walked into Trap

When the man with the jimmy crossed that yard, he walked into the most intricate and foolproof booby trap that modern science has been able to devise. The warehouse yard was honeycombed with invisible infra-red rays several hundred feet in length. No one could approach the building without breaking one of the tell-tale beams, and not even the cleverest saboteur with a full knowledge of the device could tell exactly when a broken beam would report his presence. Since each beam has its own signal in the control room, watchmen always know where to look for the intruder. And yet the beams are so selective that they ignore the interference of falling leaves or snow, fluttering birds or prowling cats. In many plants like the one described, the intruder does not know when he has betrayed himself, and quick capture is thus facilitated; in some plants, when a beam is severed pandemonium breaks loose automatically in the form of dazzling lights, shrieking siren and clanging gates.

The principle is that of the familiar "electric eye." A beam of light or of infra-red rays is directed at a sensitive bulb, setting up a tiny flow of current which is amplified by vacuum tubes. When the beam is broken, the current ceases to flow, and a mechanism is set in operation which will open or close doors, sound an alarm, or what-not. Until recently, however, these photoelectric devices operated efficiently only over short distances and indoors.

Protection Against Smugglers

Then an army major came to the laboratories of the American District Telegraph Company in New York—a firm specializing in protection against burglary and fire—and posed a problem. The Foreign Trade Zone on Staten Island was soon to be opened. At the piers within this zone, incoming freighters could transfer their cargoes, without going through customs, to other ships bound for foreign ports. To prevent smuggling, it was necessary to surround the zone with sure-fire safeguards. On the land side, a high fence and a force of guards would do the trick, but there remained about 3,000 feet of unprotected shore where vessels had to be prevented from entering without sanction. Solid barriers which would interfere with shiping were out of the question. The officer thought there might be some sort of light ray, sound ray or radio wave which would serve the purpose. The company turned the matter over to Maxwell H. A. Lindsay of its technical staff, a young Newfoundland-born engineer who has invented several photoelectric burglar alarm devices.

Mr. Lindsay's fence—a bar of light which crosses the water from one end of the zone to the other—was erected early in 1937 and has worked without a hitch ever since. An ordinary beam like the ones which open doors would be useless for the purpose. Its "eye" is not sensitive enough to react to light variations at that distance, and heavy rain, fog or sea gulls would intercept the ray and cause false alarms.

New Type Circuit

So for the long-distance ray device, a new type of circuit for the receiving end was invented, to make the photoelectric eye respond accurately to a distant light. At the other end, two 20-watt prefocused lamps with telescopic lenses are used, mounted one above the other, instead of the single light used before. This makes a thicker, more powerful beam, and birds or other objects likely to pass through it never block it entirely.

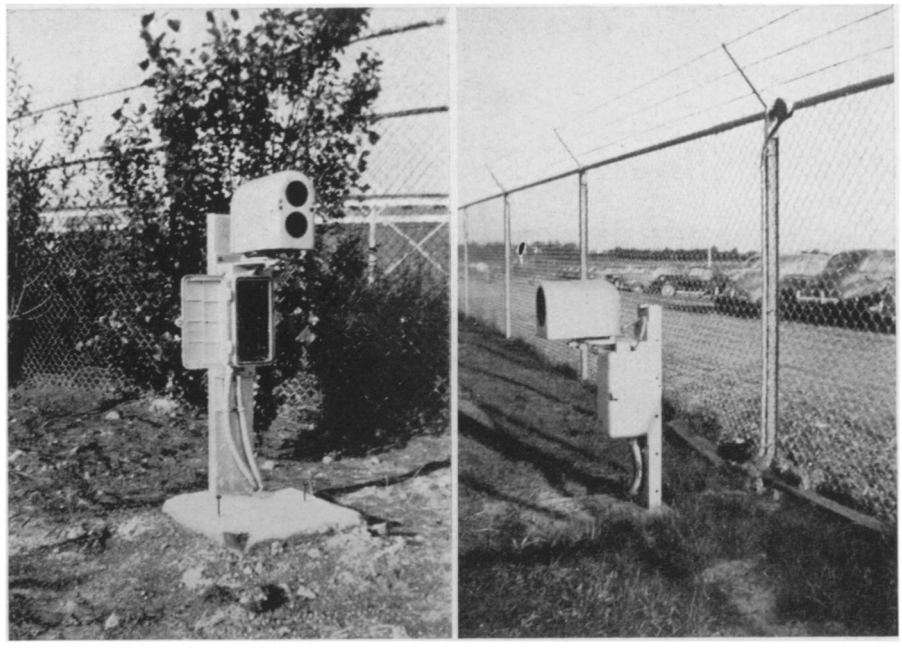
Nothing short of complete blocking by a solid object can break this long-range beam and send in an alarm. You can even drape a heavy winter overcoat over the "eye" without breaking the beam for enough light gets through to keep the circuit in operation. But strong sunlight or marine searchlights may fall upon the receiving end of the equipment without disturbing its smooth performance. The "eye" rejects their powerful glare, and obeys only the signal of its light source over half a mile away.

But the most important part of the whole device is a small metal disk which revolves in front of the lamp, chopping up the outgoing light beam into "slices" so thin that the human eye cannot detect them. The photoelectric eye, thousands of feet away, is adjusted to receive a signal of the same vibration as that served up by the revolving disk, or shutter. It ignores all other lights. No flashlight, however powerful, can deceive this new electric eye when there is dirty work afoot and its special beam has been blocked. And if by any chance some supermind of sabotage solved the combination of this intricate light signal, the equipment could be quickly attuned to another vibration.

At Staten Island the ray used is visible by choice, for the beam of light falling

upon the prow of a boat serves as a warning to the captain. In other installations, however, when invisibility is a desirable factor, an ingenious filter takes out the visible light and sends forth infrared beams which no one can see.

As installed in the grounds surrounding defense plants, the invisible beams add to the confusion of intruders by turning sharp corners. The beam may come through an inconspicuous hole in the factory wall, with the lamp concealed inside. It may travel 500 feet to a mirror concealed in a recess of the outer fence or wall, which reflects it (still invisibly) at an acute angle to the receiving "eye," also concealed, inside another part of the factory wall. Put four or five of these criss-cross beams around a plant, and the intruder hasn't a chance. To keep the mirrors from clouding in damp weather, small electric heaters are mounted behind them. And if a burglar broke one of the mirrors to put the device out of commission, the alarm would be sounded at once.



LIGHT TRAP

These two inconspicuous instruments form in combination the invisible fence to trap the invaders of defense plants. At the left is the light source, at the right, the photoelectric receiver.

Prevented Great Losses

The long beams have snared many thieves and prevented great losses in yards where materials are stored. One night in Detroit a few weeks ago, two pilferers trundled a wheelbarrow across the yard of a smelting plant. Before the barrow was half full the police arrived. The thieves had walked through an invisible beam. Similar reports pour in from all sections of the American industrial front. At an Akron plant, the beam caught five burglars in two weeks. In a factory yard at Fort Worth, Texas, the beam served to introduce to the police a man whom they had been longing to meet, and in four months an invisible fence installed by a Baltimore firm nabbed ten intruders and scared away eight others who heard the approaching police cars.

While details have not been released concerning actual military and naval uses of the new beams, it is known that the government has installed them in navy yards, naval bases and army bases—not to take the place of sentries but to supplement them in critical areas. For an airport they constitute ideal barriers which offer no physical interference with planes, and they are considered a godsend to such establishments as oil tank farms with their extensive areas.

The largest invisible fence to date is being installed in one of the nation's biggest aircraft plants. Here an area of several square miles is protected by 28 separate beams. With the equipment skilfully concealed, the invisible rays are interlaced in a spider web at varying elevations and angles. A brick wall has a beam running along the top so that no one can scale it undetected. Some of the roofs are crisscrossed with beams to prevent breaking through from above.

Not content to rest on their laurels, electronic engineers are constantly testing the new long beam and planning new uses for it. Last summer an infrared lamp, using the usual pair of 20-watt incandescent bulbs, was set up on a New York roof two miles away from a photoelectric cell, and perfect results were obtained. At present, the long beam is effective under certain conditions for distances up to three miles, and the "eye" can record a signal to which it is attuned from a light four miles away—a light of lower wattage than most reading lamps!

Limit to Beam's Length

At present the practical limit to the length of beam which can be used lies not in the device itself, but in the nature of the terrain to be protected. Because of the size of the average factory and because of elevations in the ground, most beams now used in defense plants run from 300 to 700 feet, but the same beams would be effective over much greater distances. At sea, the length of beam which can be used is limited by the curvature of the globe. With a beam more than three miles long, sending and receiving devices must be mounted several feet in the air to get the beam "over the hump." A longer beam would allow boats to "crawl under the fence" at each end.

Number of Possible Uses

A number of possible uses are obvious to engineers. With equipment mounted on camouflaged trucks, an invisible ray could be placed across the approach to a military position, and connected with guns so that they would automatically open fire upon an advancing enemy force. Mines at harbor entrances could be discharged in the same manner by enemy craft which break the beam. The present use of short beams to detect smoke in warehouses suggests that beams miles in length might be employed as forest fire detectors in critical areas. A fire warden equipped with supplementary weather reports to enable him to distinguish between fog and smoke alarms would thus be able to watch over many more square miles of forest than he can now observe.

Meanwhile the new fence is not only catching burglars and potential saboteurs every day, but is nabbing them with such split-second speed that they never have a chance to collect the dubious wages of crime.