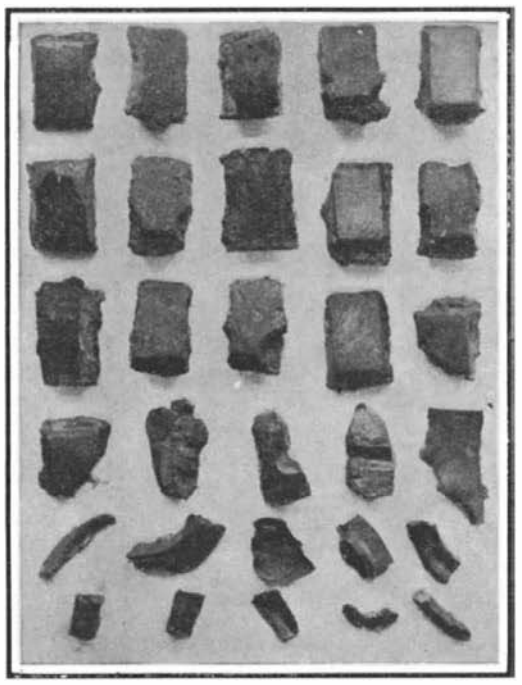
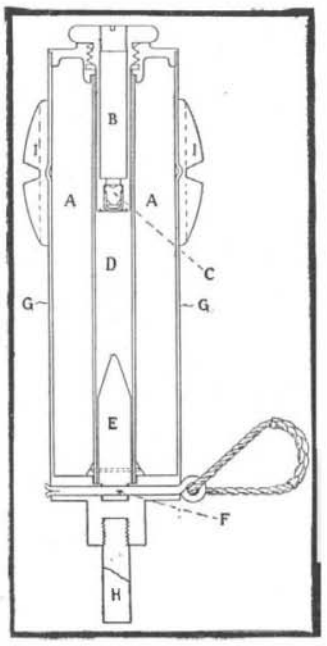
A NEW RIFLE-PROPELLED GRENADE.

Some interesting tests and experiments have been carried out in England with a new type of rifle grenade that has been recently invented by Mr. F. Marten Hale. This new missile was suggested to the inventor by the success that attended the use of hand-thrown grenades by the Japanese outside Port Arthur and in Manchuria for trench storming. In order to render such an arm of even greater utility and efficiency, he embarked upon a series of experiments toward the projection of the missile by means of the ordinary rifle. The scheme is similar to that embodied in Lieut.-Com. Davis's torpedo, recently described in these columns. It is possible by such weapon to discharge a shell from a protected position several hundred feet from the assaulted point, without any attendant exposure.



FRAGMENTATION OF GRENADE AFTER EXPLOSION.



SECTION THROUGH THE RIFLE-PROPELLED GRENADE.

A GRENADE WHICH IS HURLED BY A RIFLE AND EXPLODED AT THE TARGET.

Mr. Hale has succeeded in evolving a design of such character that no injury whatever is inflicted upon the rifle, or its use interfered with when bayoneted.

The accompanying illustrations will convey an idea of this new arm in use. In general appearance it resembles the ordinary pyrotechnic rocket with the head and tailpiece. The head or body is about 5 1/3 inches in length by approximately 1⅝ inches in diameter, made of stout brass tube. Into the bottom of the tube is screwed the tailpiece, which is about 9 inches long and which slides into the barrel of the rifle. The total weight of the grenade is approximately 22 ounces.

The central space of the casing *G* is hollow, and carries a tube *D*. Into the upper end of this tube is inserted the detonator *B*, secured in position by a milled head-nut. To the lower end of the detonator is attached the cap and anvil *C*, by means of which it is fired. The detonator itself is carried apart from the grenade in transport for safety, so that inadvertent explosion is impossible. The lower part of the hollow tube *D* carries the brass striker *E*, which, though sliding within the tube, is held in its position and prevented from creeping toward the detonator *B* during flight by the copper shearing wire shown. When the head of the grenade strikes the target this striker is released under the force of the impact, falls on the cap of the anvil *C*, and fires the detonator and the explosive charge *A*, carried in the annular space between the central hollow tube and the outer casing *G*. Passing through the base of the striker *E* is a copper safety pin with a cord loop attached. After the grenade has been fixed in the rifle barrel ready for discharge, the soldier gives the cord loop a pull, thus drawing out the safety pin, so that the striker is held in position by the copper shearing wire, as already described. The steel rod *H* fits closely in the barrel of the rifle, and also acts as tailpiece and balance to the grenade during its flight; moreover, it plays an important part in its propulsion. Around the external surface of the grenade casing, near the head, the steel shrapnel ring or weight *I*, serrated into 24 parts, is carried, which when the charge explodes, bursts into fragments flying in all directions. The explosive used is "tonite," equal to No. 1 dynamite. It embodies most of the high-explosive properties of compressed guncotton with the advantage that it can be exploded by an ordinary detonator without the use of dry primers. The explosive charge of the grenade weighs about 4 ounces.

With the elevation of the rifle at an angle of 30 degrees and using the British government blank cordite cartridge, the grenade can be thrown 450 feet. When a cartridge having a cordite charge of 45 grains instead of the regulation weight of 31.5 grains was used, the grenade was thrown 900 feet. The augmentation of the powder charge by approximately 50 per cent was found to inflict no ill effects upon the rifle, and ball cartridge could subsequently be used therewith with perfect success.

In carrying out experiments with the weapon, a hillock or mound was selected about 40 feet square and 10 feet in height, affording just such cover as that which an attacking party would use in a strategical forward movement upon a position. From the rear of this ridge a number of grenades were fired over the hillock, the range being such that they fell on low ground under the shelter of the opposite side of the ridge. The grenades fell and exploded with terrible effect, a large hole being torn in the ground where each grenade had struck the earth and exploded, while the fragments of the serrated weight ring were found scattered in all directions over a wide area.

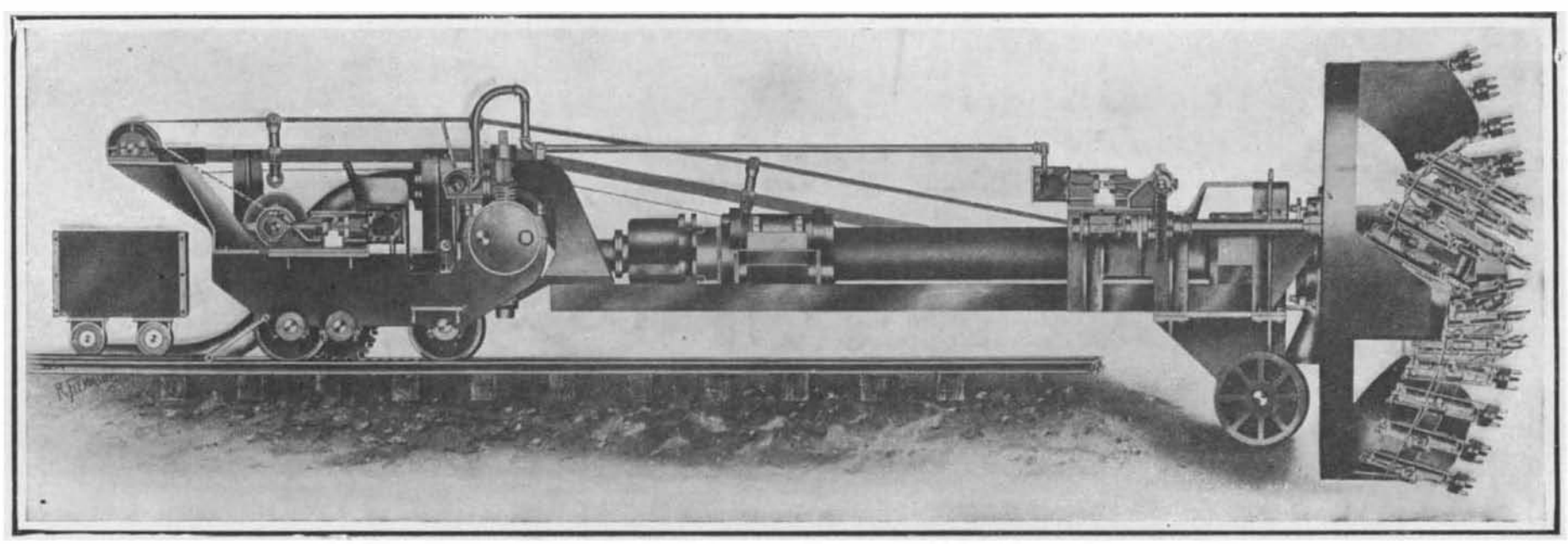
For the purpose of demonstrating the havoc that would be wrought in this manner, a number of screens of brown paper measuring 6 feet in height by 8 feet in length were erected in the vicinity of the spot where the missiles fell. These were either blown down by the force of the concussion or torn to shreds and riddled by the flying fragments. In another test a pit was prepared, 6½ feet deep by 8 feet long and 3½ feet wide. It was lined with 12 inches of concrete covered by 1-inch planking. The top of the pit was closed with nine heavy timber balks measuring 4½ feet long by 10 inches wide and 5 inches thick. A grenade was then dropped into this pit by suitable means. The resultant explosion hurled the top timber balks bodily into the air for several feet, and threw them on one side. Subsequent examination of the walls of the pit showed them to have been easily penetrated and the concrete backing extensively damaged and pitted. Altogether, 19 out of the 24 fragments of the ring encircling the grenade were recovered, the average weight of each of which was 9 grammes, while other pieces numbering 31 in all were picked up from behind the planking which they had pierced, the total weight of the fragments secured being 157 grammes, the largest piece of which weighed 10.3 grammes and the smallest 0.22 gramme. The extent of the fragmentation together with the ease with which the 1-inch planking had been pierced, even by small pieces only weighing 0.22 gramme, combined with the violence with which the timber balks covering the pit were thrown into the air, testifies to the death-dealing potency of this new invention.

Though so widely and terribly destructive in itself, the grenade is perfectly harmless unless detonated. In the course of an action, should a grenade be pierced by a bullet, the result would be quite negative. Convincing proof of this was shown by firing ball point blank at the grenade. The bullet simply pierced the casing and smashed the explosive charge, not the slightest detonation or explosion of the charge resulting.

A TUNNEL-BORING MACHINE.

The accompanying illustration shows a machine which has been designed to bore a rock tunnel by chipping away the face of the rock with a number of pneumatic chisel-headed hammers, the hammers being so placed on the machine that when the holding mechanism upon which they are mounted is rotated, every part of the opposing face of the rock is covered by the chisel. The design is the joint work of Mr. E. F. Terry of the Terry & Tench Company, in this city, and Mr. O. S. Proctor, of Denver. The whole machine is mounted upon a two-wheel truck at the front and a four-wheel main truck at the rear, the rear truck running on a 22-inch gage track laid along the center line of the tunnel. Centrally between the track rails is a duplex rack rail, which is engaged by a spur gear mounted on the truck, by which the whole machine is carried forward against the work. The front truck is provided with conical wheels suited to running on the invert portion of the circular tunnel as excavated by the machine. The main frame consists of a 20-inch I-beam laid on its side, at the rear end of which is

(*Continued on page 22.*)



A TUNNEL-BORING MACHINE WHICH CAN DRIVE AN 8-FOOT TUNNEL IN ROCK WITHOUT BLASTING.