

## LIQUID FIRE AS A WEAPON

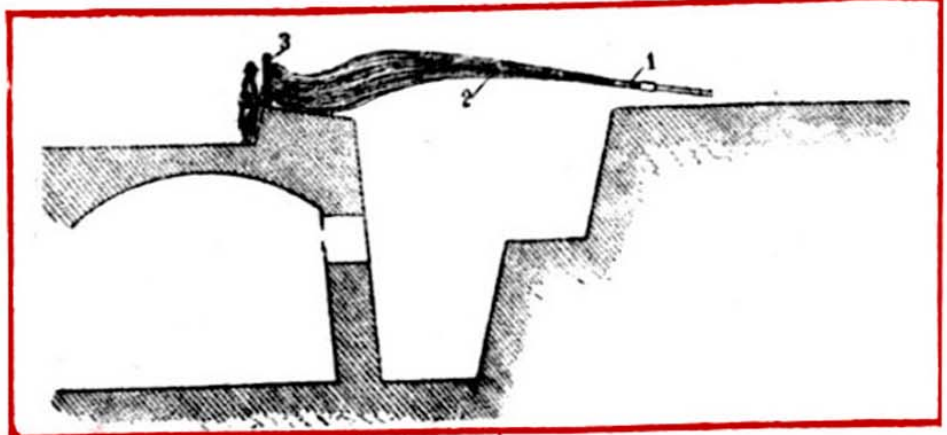
**A**MONG THE CURIOUS REVIVALS of ancient or medieval modes of attack in the present war none perhaps is more interesting than the German use of the old "sea-fire," or of something that seems to resemble the descriptions of that Byzantine precursor of gunpowder. The device is simplicity itself: nothing but a blazing jet of combustible liquid. If we are to believe the daily papers, something of this sort was suggested to General McClellan during our own Civil War, and summarily rejected by him as not in consonance with the principles of modern warfare. Evidently the Central Powers do not agree with this dictum; but then a number of ideas of what constitutes propriety in warfare have suffered somewhat rudely during the present contest. A contributor to *The Scientific American Supplement* describes the flame-throwing device as follows:

"Among the many scientific tools of destruction employed in the war, the so-called *Flammenwerfer* of the Germans—a more or less hoselike apparatus for hurling jets of flaming liquid—holds an important place, as much by virtue of the moral effect produced as by any material damage achieved, even tho the latter may be considerable. Contrary to the generally accepted notion, this idea of projecting upon the adverse trenches and their occupants a rain of liquid fire was no sudden afterthought of the German mind. It was conceived, studied, and perfected for several years before the war, and its history may be traced [in the German patent office.

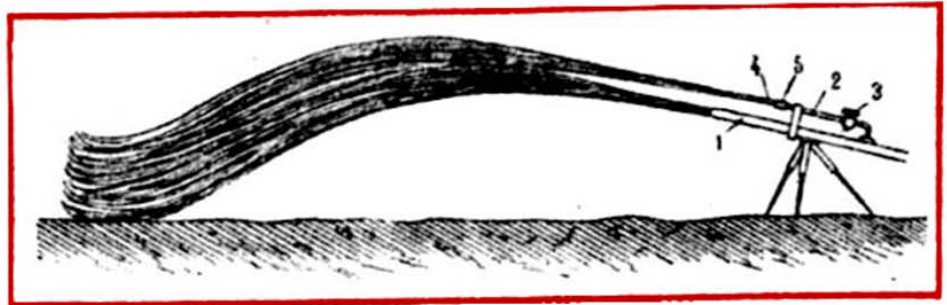
"In the earliest models, the combustible liquid was propelled by a gas-condenser out of a portable or fixed reservoir, and was lighted by some automatic device as it escaped from the nozzle of the projecting instrument. Subsequent improvements have been made with the sole object of overcoming certain disadvantages inherent in this model.

"With the instrument described, the flaming jet can make its effects felt at a distance of forty or forty-five yards, but is not capable of exceeding that range effectively, because of the consumption of the liquid in transit. Further, with the main jet thus in ignition at the mouth of the apparatus, enough heat is given off to embarrass seriously the operator.

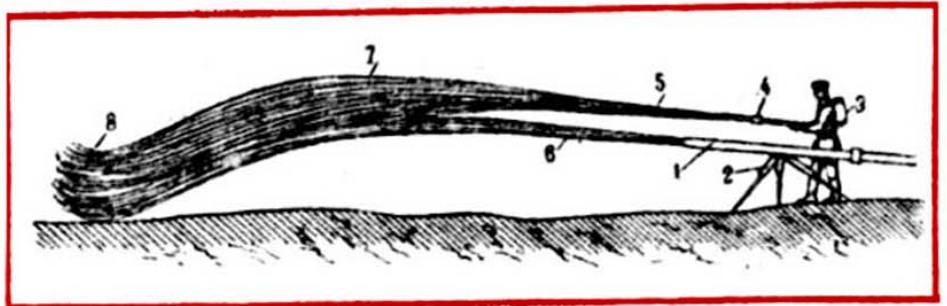
"These facts made clear the desirability of a method of ignition whereby the inflammable fluid would not begin to burn until it had almost, or quite, reached its objective. Not only would useless consumption of the fuel be thus avoided, but the effective range would be increased, and the effects of the instrument, at a given range, greatly heightened.



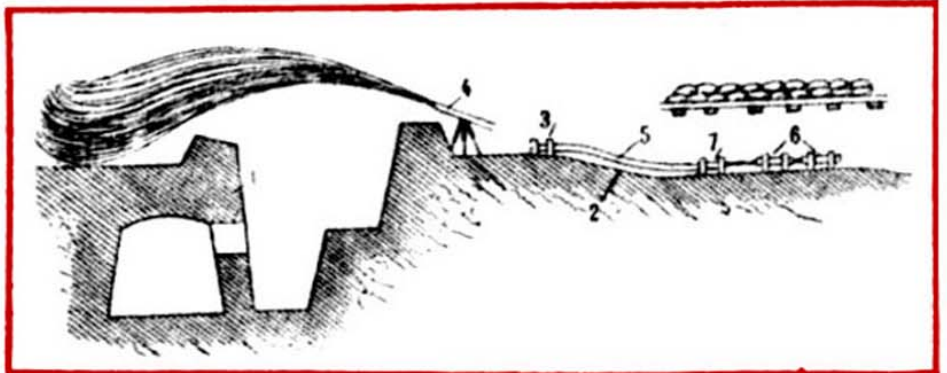
EARLY TYPE OF "FLAMMENWERFER." FLAME DEFLECTED BY A SHIELD



"IMPROVED" TYPE, WITH ATTACHED IGNITION-JET.



"IMPROVED" APPARATUS, WITH SEPARATE IGNITION-JET.



HOW THE DEVICE IS FED FROM A PROTECTED RESERVOIR.

TYPES OF FLAME-PROJECTORS.

The fluid is shot from the two barrels simultaneously, but only that from the upper one ignites automatically. This small, burning stream is so directed that it unites with the larger, non-burning one at any desired point, and then, of course, ignites the large jet. The small stream is then shut off, the large one continuing to flow.

The flames do not spread backward along the jet toward the nozzle, but are carried forward to the target, and, striking the ground, form a veritable sheet of fire, which continues to ignite the fluid as fast and as long as it falls.

"Only at this one point is the large jet in contact with the flame. All combustion, therefore, takes place at the spot where it will do the most good—or harm; and at that point a very severe conflagration takes place, much more severe than is possible when the combustible fluid wastes its substance upon the air between gun and target. It is especially to be noted that flexibility of fire is not sacrificed. By gradual change in the trajectory, the objective can be shifted without interrupting the continuity of the ignition; so that the field may be developed in any direction desired, and a rain of fire of any sort whatever produced. Further, instead of allowing the liquid to burst into flame at the moment of impact, it is often advantageous to let it flow for some time 'cold,' until the entire objective region is saturated, then, turning on the kindling jet, to produce a holocaust throughout that region.

"The method of expulsion of the jet from the apparatus, as well as means of combustion, has been greatly improved. As indicated above, in the earliest *Flammenwerfers* devised by the Germans, the inflammable liquid was driven from its reservoir by pressure of carbonic acid or other gas. But, on account of the extraordinary powers of absorption manifested toward all gases by the hydrocarbons best adapted for use as the basis of liquid fire, the best part of the expulsive

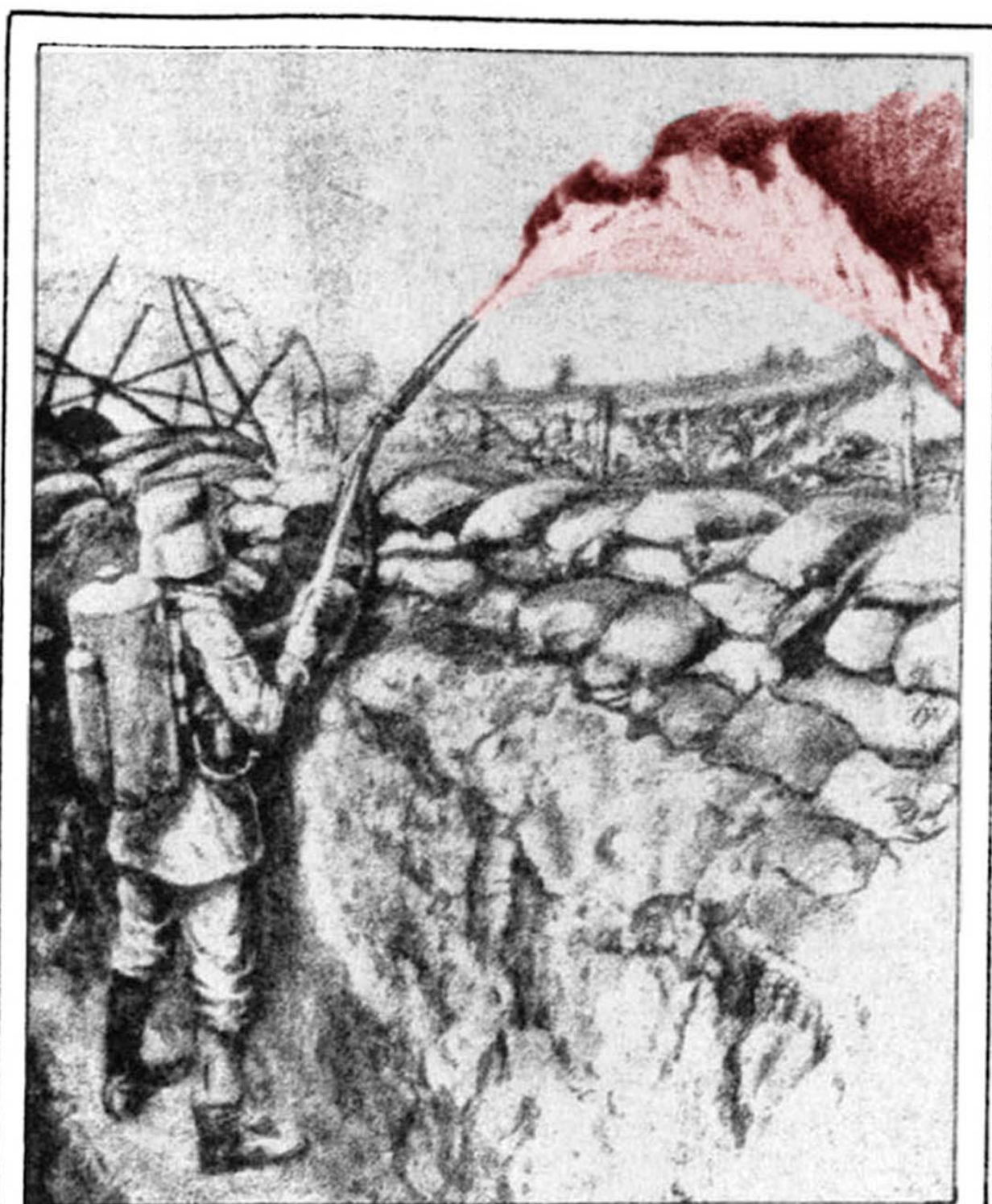
gases was merely dissolved in the liquid. Not only did this cause a direct and serious diminution in pressure, but it led to mixing of liquid and gas; so that as the fluid issued from the nozzle it no longer exhibited the uniform and compact structure necessary for accurate aiming and efficient combustion, but was composed of a frothy, bubbling mixture of liquid and gas, which, putting forth but feeble opposition to the atmospheric resistance, had its range materially shortened. All these difficulties are obviated by the substitution of a mechanical pump, or, if safety or convenience demand that the reservoir shall be at a considerable distance from the firing-line, several pumps in series as motive power in the expulsion of the liquid from the gun.

"The liquids most commonly employed in these *Flammenwerfers* are the low coal-tar oils resulting from the distillation of tar at a pressure of six atmospheres or more. The particular compound most used by the Germans is a mixture of gasoline and nitch. Under combustion this gives off a thick, grayish smoke, which not merely obscures the vision of those under fire, but has an intolerable odor."



PORTABLE APPARATUS FOR PROJECTING FLAMES

A. carbonic acid; G. gas; P. gasoline; R. valve; I. igniter for lighting the inflammable liquid; J. flame.



OPERATING A FLAME-PROJECTOR IN A GERMAN TRENCH.