

Fig. 1.

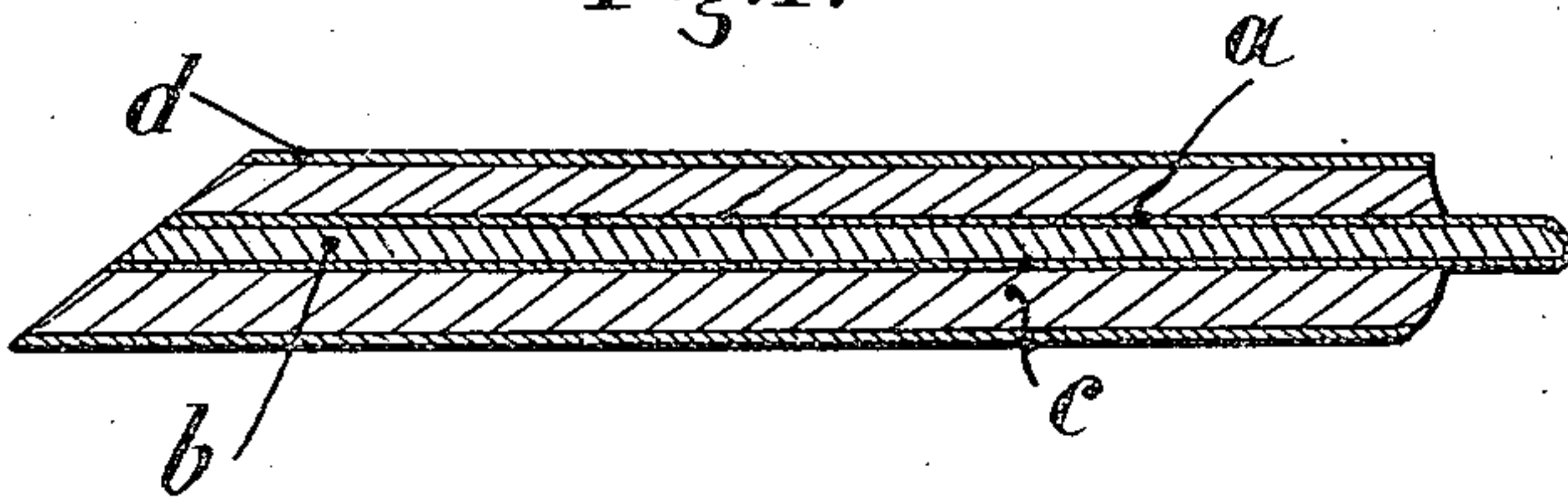


Fig. 2.

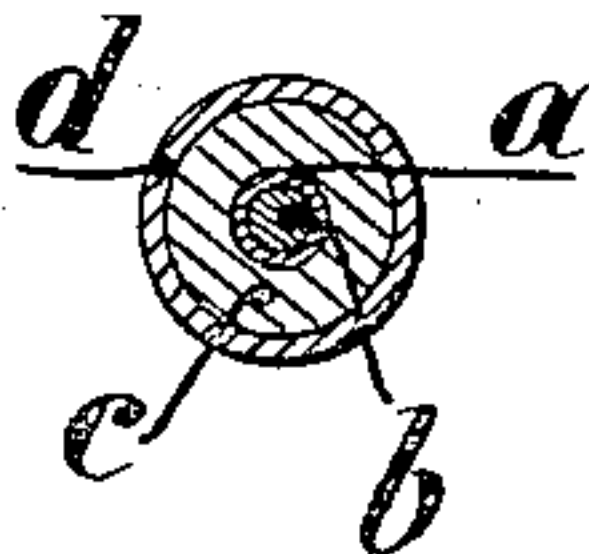


Fig. 3.

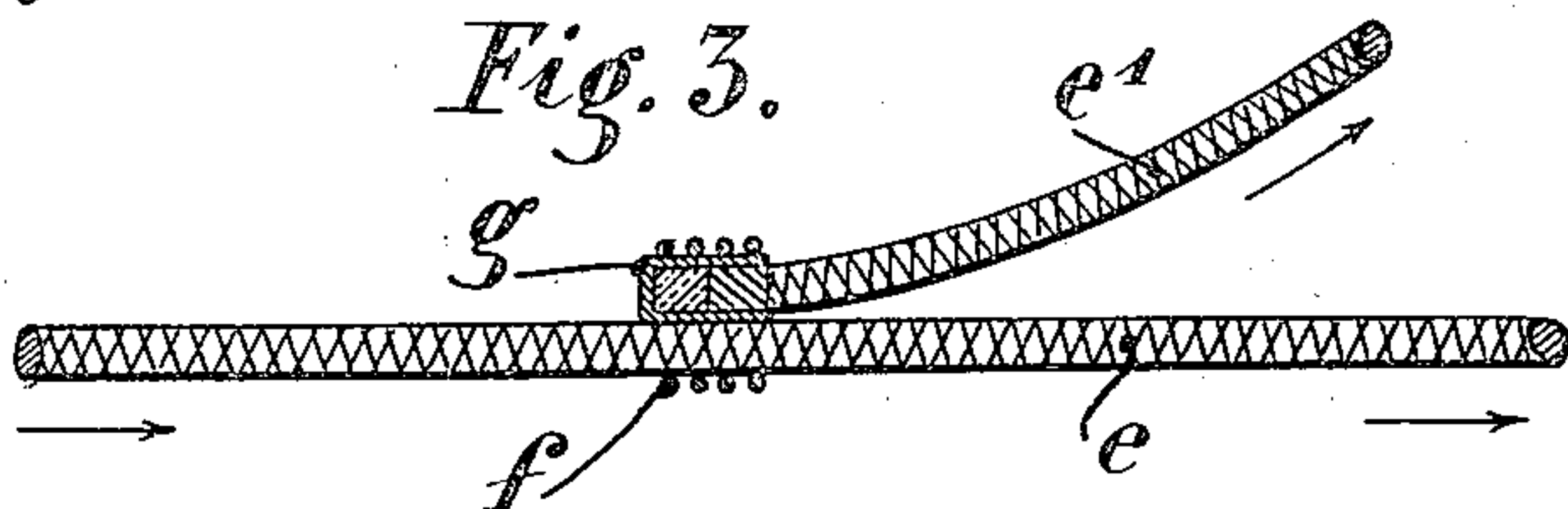


Fig. 5.

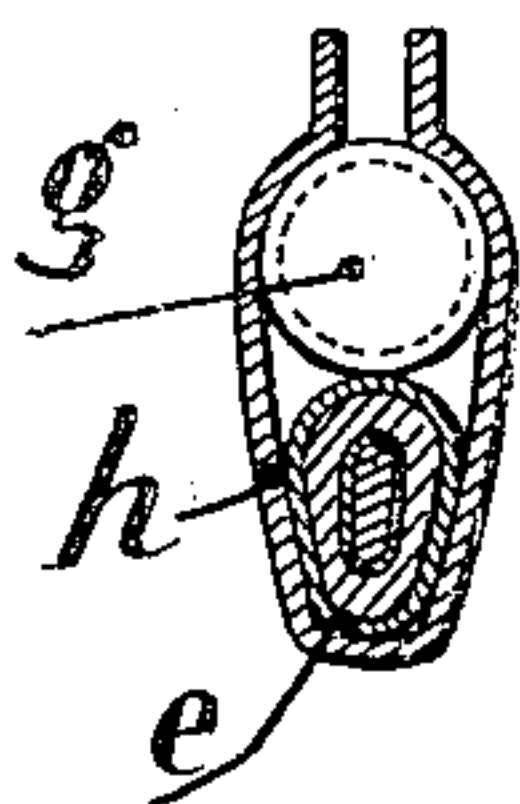


Fig. 4.

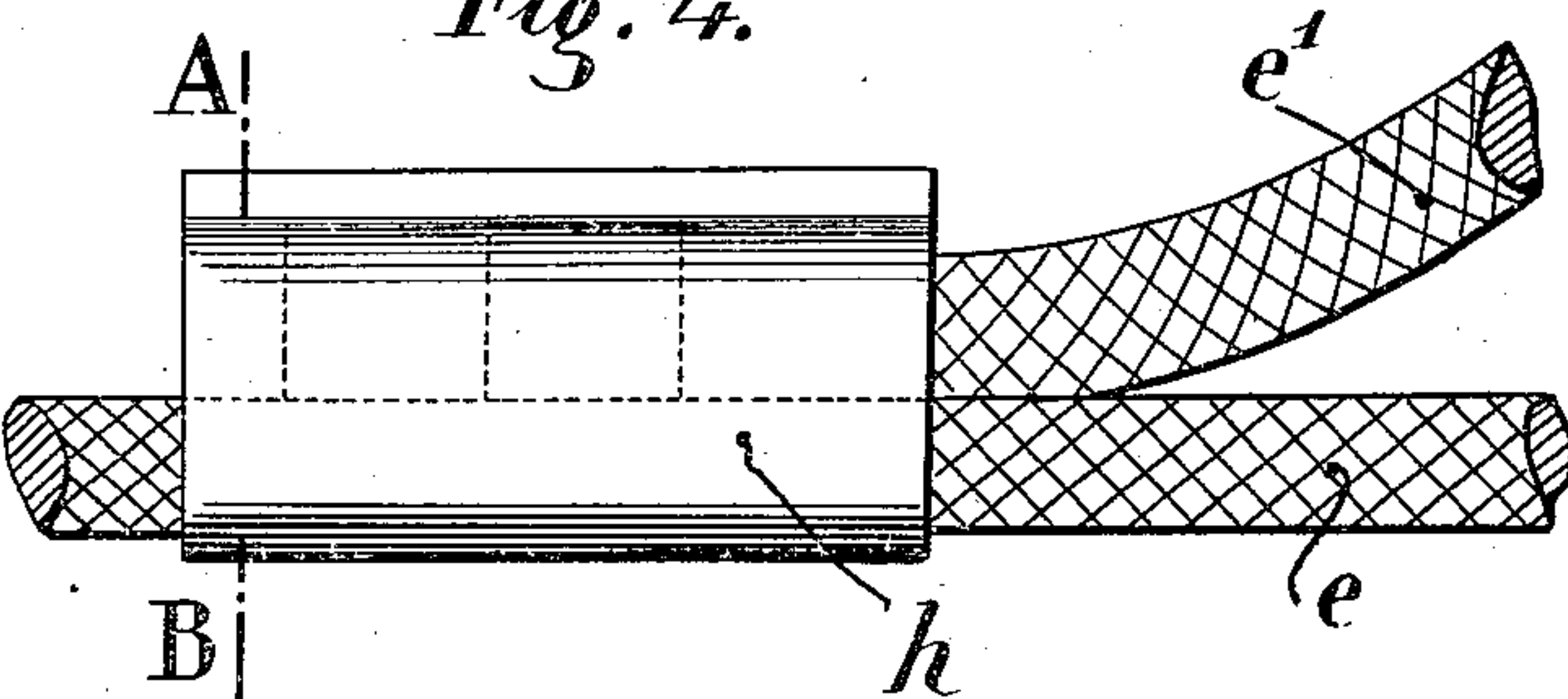


Fig. 6.

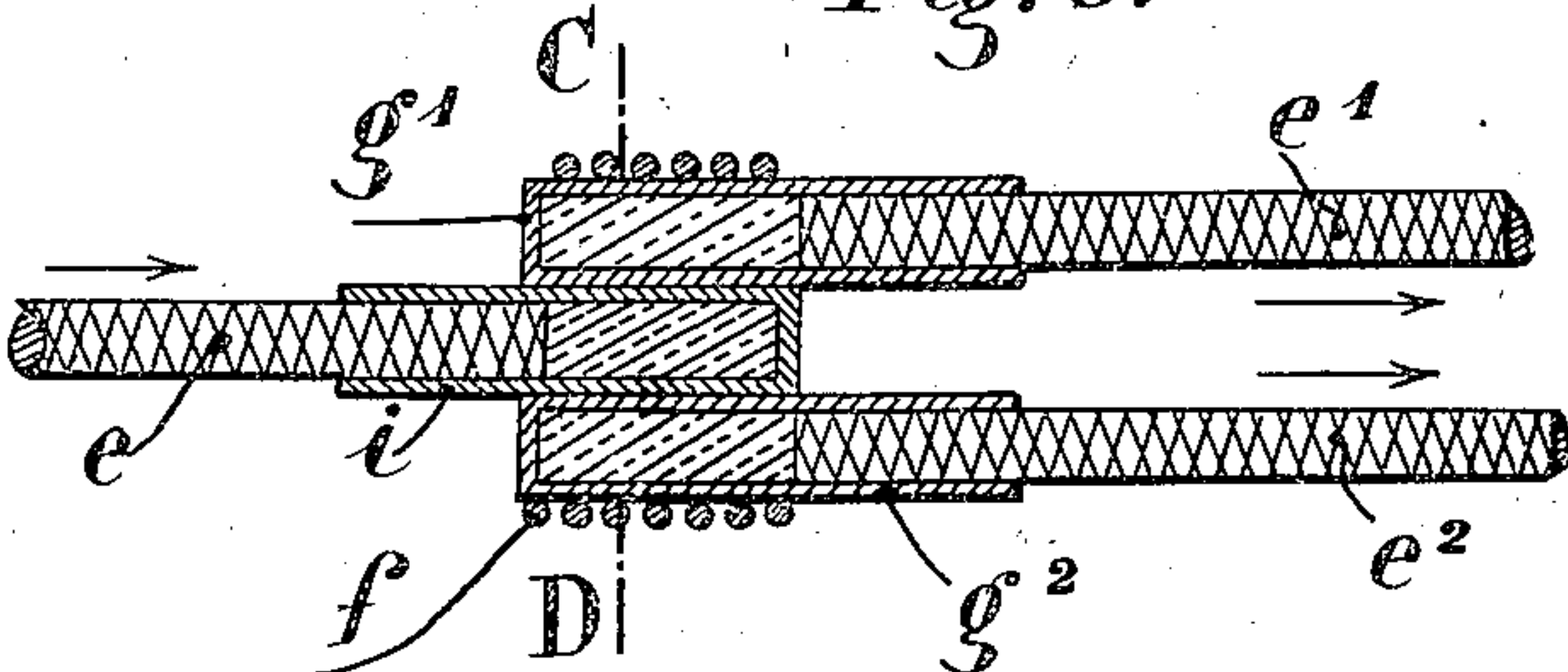


Fig. 7.

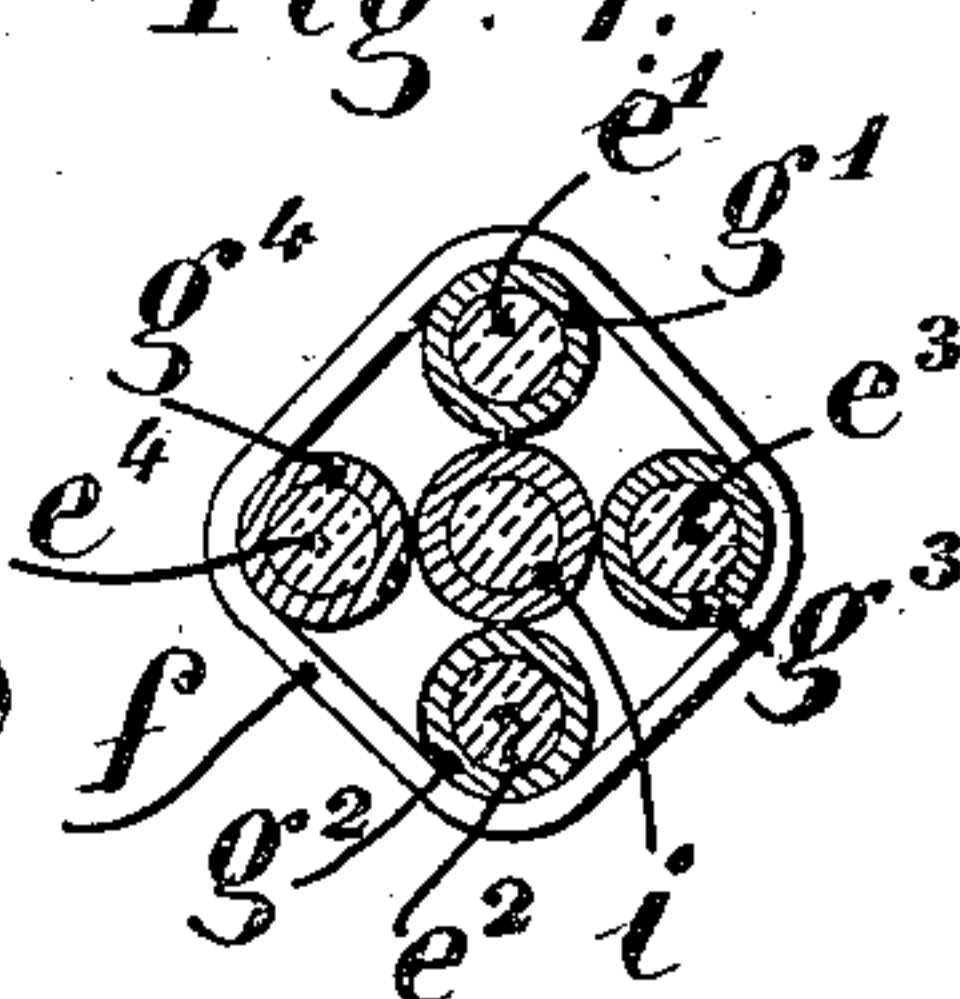
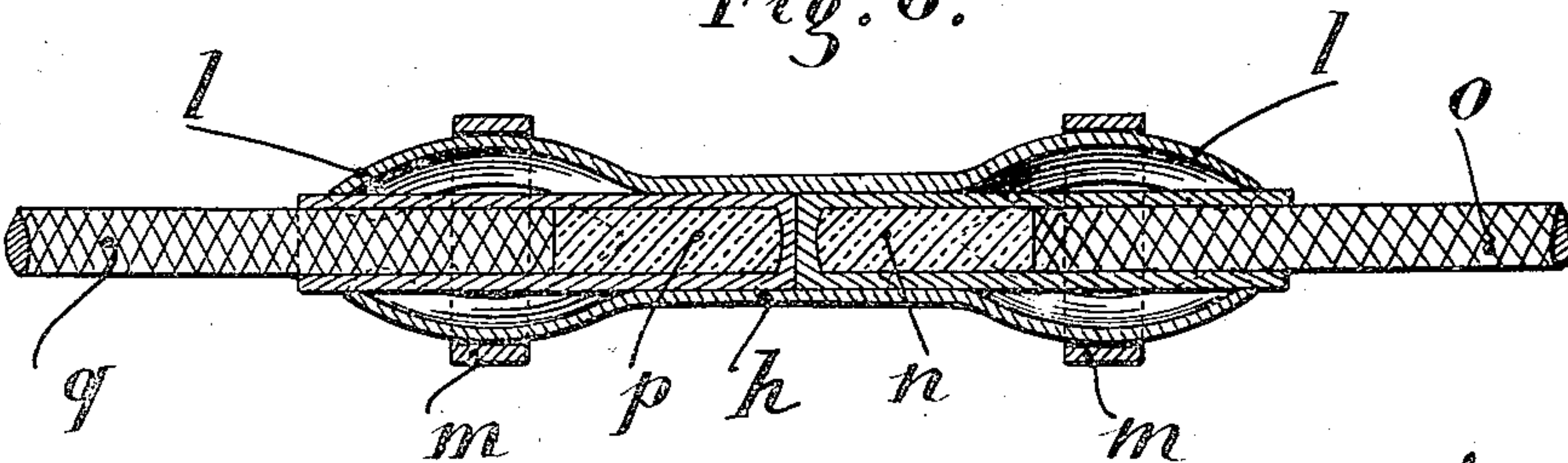


Fig. 8.



Witnesses

L. D. Doolittle

H. G. Gering

Inventor

Jean Harlé

His attorney



# UNITED STATES PATENT OFFICE.

JEAN HARLÉ, OF ROUEN, FRANCE.

## FUSE WITH DOUBLE ACTION.

No. 927,968.

Specification of Letters Patent.

Patented July 13, 1909.

Application filed February 4, 1908. Serial No. 414,281.

*To all whom it may concern:*

Be it known that I, JEAN HARLÉ, a citizen of the French Republic, and resident of Rouen, France, have invented new and useful Improvements in Fuses with Double Action, of which the following is a specification.

The fuses or detonating tubes which are actually employed in pyrotechnics can be divided in three categories:—1.—The slow fuses charged with black powder, the speed of combustion of which does not exceed several centimeters per second (slow fuses Bickford. 2.—The quick fuses also charged with black powder, but having a speed of combustion attaining several hundreds of meters per second (instantaneous fuses Bickford. 3.—The detonating tubes which are charged with an explosive, the detonating speed of which attains several kilometers per second.

It is evident that a detonating tube or fuse, which according to the manner in which it is ignited, belongs either to the first category or to the third one, that is to say, which, at will, can consume slowly and serve as a fuse, or detonate instantaneously and serve as detonating tube, would render great services, particularly for military purposes, where it is important to reduce the number of fuses in service. There have already been made numerous trials in this respect, all experiments having however been directed to the search of a special explosive, adapted to consume slowly or to detonate, according to how it is ignited. There have been produced particularly tubes filled with fulminate of mercury; but these experiments have never given a satisfactory result. The fuses obtained either consume too quickly or too irregularly; further, they are too sensitive with regard to mechanical actions, so that their use necessitates precautions which are inadmissible for practical use. One has tried to diminish the sensitiveness of the fulminate of mercury by phlegmatizing the same, but then the fuses can act only as detonating tubes, belonging to the third category. Further, the experiments made for chlorated explosives have not given satisfactory results.

The object of the present invention is a fuse at double action, which entirely fulfils all the practical requirements. This fuse is characterized by the fact that instead of being filled with a single explosive, it contains

two explosive charges, one of which, the gun-powder, insures slow action, while the other, which is an explosive, secures the instantaneous detonation. In principle there are juxtaposed a fuse of the first category and a detonating tube of the third category; but the difficulty consisted in securing the regularity and the security of the two modes of operation, without increasing the diameter of the fuse over the usual diameter of fuses and detonating tubes, say 5 mm., 5 maximum; on the other hand, there had to be avoided any reaction of the one explosive upon the other and particularly to be prevented that the heat, produced by the combustion of the gun-powder, provoked the detonation of the explosive.

The fuse according to the present invention fulfils all these conditions; it is represented, by way of example, in the accompanying drawings.

Figure 1 is a longitudinal section through the fuse; Fig. 2 is a cross section through the same; Figs. 3 to 6 represent how, with this fuse, branchings off and priming can be effected. Fig. 7 is a vertical section of Fig. 6 and Fig. 8 represents in longitudinal section a double clamp.

This fuse essentially consists of a detonating tube which forms the central core and is composed of a lead-sheath *a* and a filling *b* which consists of a suitable explosive, such as trinitrotoluene, trinitrobenzene, trinitrophenic acid etc. To insure the operation of such a fuse, the explosive core *b* must have a diameter of at least 1 mm. and the sheath must be without fissures. This detonating tube is extremely flexible, like a wire, and, for obtaining the novel fuse, it is only necessary to replace the central wire which is frequently used in the manufacture of the slow Bickford fuses, by the said detonating tube. With some care, the gun-powder *c* is easily drawn along with said central detonating tube and forms a regular layer between said tube and the outer plaited sheath *d*, and there can be made fuses a hundred meters long without provoking a rupture of the tube *a*. The fuse thus obtained looks exactly like the ordinary fuses, but contains an explosive central core *b* and an annular layer *c* of gun-powder, the two explosives being separated the one from the other by the lead tube *a*.

This fuse is of great flexibility and at the same time of great resistance. The detonat-



ing tube *a* is protected by the plaited cover *d* and by the layer of powder *c* so that it is effectively protected against accidents during its manipulation and transport. Its operativeness is always assured. As regards the slow fuse proper, it does not greatly differ from the ordinary Bickford fuses, and its action is in every point similar to the action of said fuses.

The security of these fuses at double action is absolute; the detonation cannot be effected by violent shocks or blows through energetic friction, nor through inflammation. The dangers are not greater than those of an ordinary Bickford fuse containing nothing but black powder.

It is to be understood that the central core *b* can be made from different explosives; the one which has given the best results is a tube filled with trinitrotoluene, the lead-sheath *a* of which had 2 mm. of diameter. The finished fuse was of a diameter of 5 mm. and weighed 40 gr. per meter. The speed of combustion through simple ignition was of about one centimeter per second. The fuse burned regularly and the trinitrotoluene burned without influencing the combustion of the black powder. The detonating speed obtained by exciting the tube by means of a detonator of fulminate of mercury, was 4400 meters per second. One has detonated tubes which were longer than 100 meters, without any interruption of detonation and there has not been traced any residue of the black powder, said gun powder being completely destroyed through the detonation of the trinitrotoluene.

With this fuse at double action branchings off can be made by simply tying each branch-fuse against the main-fuse after the branch fuse has been provided with a detonator of fulminate of mercury.

Fig. 3 represents a main-fuse *e* to which, by means of a thread *f*, the end of a branch-fuse *e'* is tied which previously has been provided with a detonator *g*.

Figs. 4 and 5 represent a special joint which permits to dispense with the thread *f*. This joint is made from sheet iron and consists of a clamping plate *h* which has a spring like action and which receives first the main fuse *e* whereupon the detonator *e* fixed at the end of the branch fuse *e'* is inserted in one end of the plate. The detona-

tor *g* is securely pressed against the fuse *e* through the spring like action of clamp *h*. To obtain several branchings off, from the same point of the main fuse, this main fuse is cut off at this point, as shown in Figs. 6 and 7, its end is covered with a detonator *i* and several detonators *g*<sup>1</sup>, *g*<sup>2</sup>, *g*<sup>3</sup>, *g*<sup>4</sup> are tied against said detonator *i* each of which covers the end of a branch fuse *e*<sup>1</sup>, *e*<sup>2</sup>, *e*<sup>3</sup>, *e*<sup>4</sup>.

Finally, to facilitate the initial priming of a fuse according to the present invention, with the view of detonating the same, a double clamp is used, such as shown in Fig. 8, which is composed of a central part *h*, the inner diameter of which is equal to the outer diameter of the primers of fulminate of mercury, while at each of its end this central part is prolonged by the curved prolongations *l* which are kept open through their elasticity, but can be closed by means of the rings *m*. If this apparatus is to be used, the end of the fuse *o* is covered with a detonator *n* which is inserted to about the middle of part *h*; then the ring *m* is moved so that the fuse is securely maintained in its position; the primer *p*, which covers the end of the fuse *q* serving as primer, is then inserted into part *h* from the other end until it touches the detonator *n*. Fuse *q* is then secured in its position by the corresponding ring *m* being moved. Under these conditions, when fuse *q* is ignited which acts as slow fuse, it will provoke the detonation of fuse *o* acting as detonating tube. One has to be careful, that the arms *l* of the clamp be short enough so that they only come in contact with the metal sheath of the detonators and not with the fuses *o* and *q*. This priming arrangement can be exposed for a very long time to any weather without losing its operativeness. In certain cases, the detonator *n* can even be dispensed with and the fuse *o* can be directly placed against the detonator *n*.

What I claim is:—

A fuse with double action essentially consisting of a detonating tube of small diameter and of an annular layer of black powder surrounding said detonating tube and an outer cover of suitable shape and material.

JEAN HARLÉ.

Witnesses:

E. LANCUNET,  
G. CARTIER.