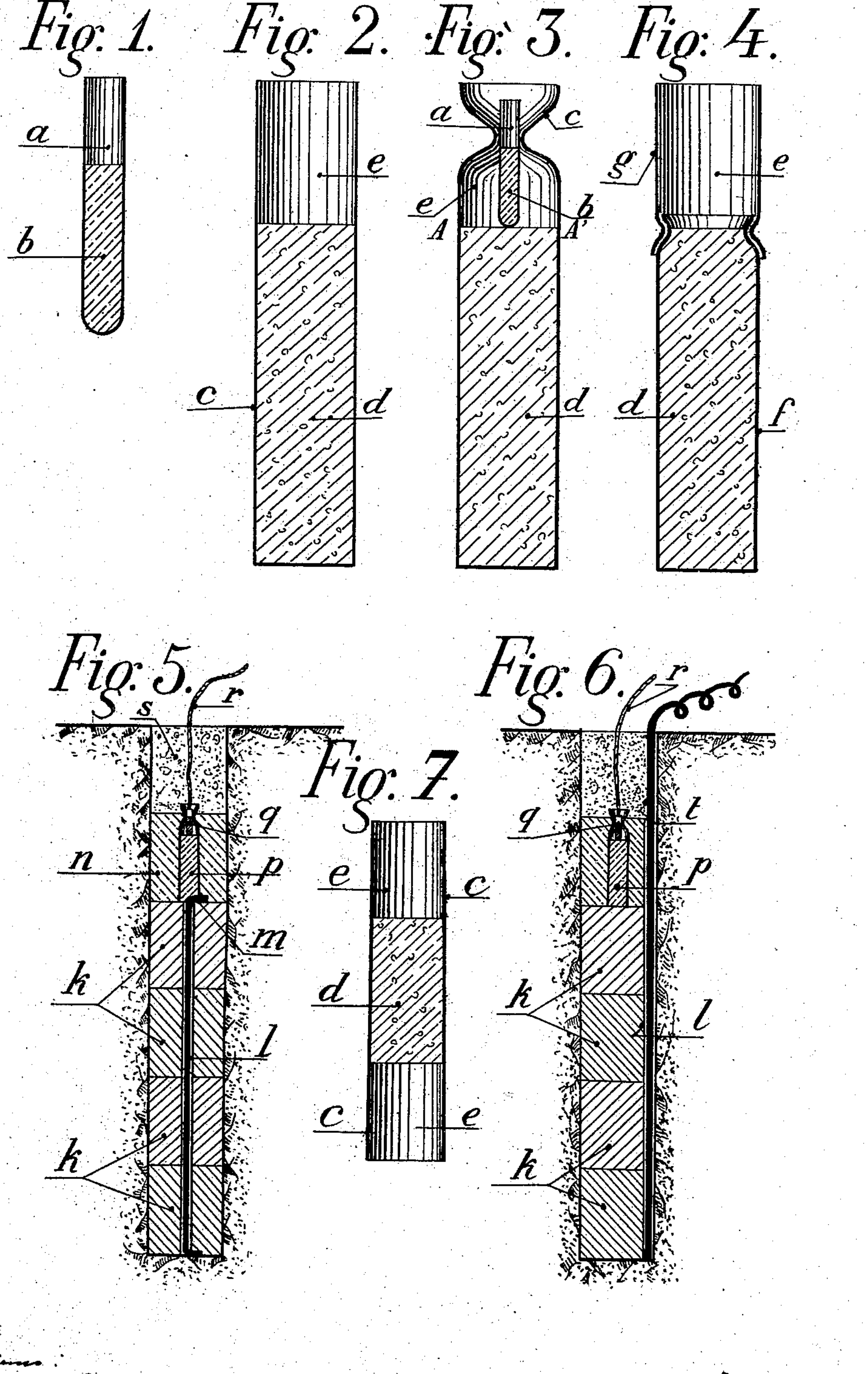
J. HARLÉ.

DETONATOR.

APPLICATION FILED OCT. 11, 1909.

982,208. Patented Jan. 17, 1911.



Witnesses:

Inventor.

Jean Harlé

by Attorney

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JEAN HARLÉ, OF ROUEN, FRANCE.

DETONATOR.

982,208. Specification of Letters Patent. Patented Jan. 17, 1911.

Application filed October 11, 1909. Serial No. 522,076.

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 certain new and useful Improvements in Detonators, of which the following is a specification.

There is a general tendency in the mining industry, to render the detonators more efficient and the present invention relates to an improved detonator whose detonating force is considerably greater than that of the detonators used up to now for the initial detonation of explosives, the manufacturing of said detonators being besides free from danger. Up to now it seemed to be impossible to manufacture commerically detonators which contain more than 2 to 2.50 grams of fulminate of mercury. The reasons herefor are, that on the one hand the compression of a longer column of fulminating material would cause irregularities of density and, on the other hand, would frequently cause accidental explosions. Such accidental explosions which occur at present in the manufacture of detonators are not very dangerous in consequence of the feeble charge employed but they would become very dangerous indeed as soon as the charge became of large quantity.

The improved detonator comprises in combination an ordinary fulminate of mercury cap and a reinforcing detonator, the two parts being united at the works before the shipping or at the place where the detonators are to be used.

In the accompanying drawings Figure 1 represents in elevation the ordinary detonator to be used for the manufacture of the improved detonator. Fig. 2 represents the reinforcing detonator. Fig. 3 shows in vertical section an improved detonator. Fig. 4 shows a modified form of the reinforcing detonator. Fig. 5 and Fig. 6 show, by way of example, two modes of application of the improved detonator for the priming of a mine. Fig. 7 shows a modified form of the tube used for the reinforcer.

The improved detonator is composed of an ordinary detonator or fulminate of mercury cap, which is however of considerably smaller dimensions than those used at present, and which consists (Fig. 1) of a small metal tube *a* which contains a feeble quantity *b* of fulminate of mercury or of any other suitable fulminating material.

The second part of the improved detonator, the reinforcing detonator (Fig. 2) consists of a metal tube *c* of fairly large diameter which contains an explosive compound *d* but no fulminating substance. Said tube *c* is only partially filled with the explosive compound *d* so that at the upper end of said tube *c* a hollow space *e* is obtained.

The two parts, the ordinary fulminate of mercury cap and the subsidiary or reinforcing detonator, are united in any suitable and convenient manner, for example, as shown in Fig. 3, by tying-up the upper end of tube *d* after the fulminate of mercury cap *a* has been inserted, said cap being thus securely maintained in the upper hollow end *e* of the reinforcing detonator.

As charge for the reinforcing detonator preferably an explosive compound is used which combines brisance with force, such as for example picric acid, trinitrotoluol, trinitrobenzene, trinitrotoluene, tetranitromethyl-anilin and so forth. If the improved detonator is destined to be used in mines exposed to fire-damp, the explosive compound *d* may comprise alkaline salts, nitroguanidin, or, generally, any substance which is susceptible to prevent the inflammation of the gases or to reduce the detonating temperature. In this particular case the wall of tube *c* could also be made much thicker.

In manufacturing said reinforcing detonators, the compound *d* could be in the usual manner compressed in a tube *c* which is closed at one end, but this process is expensive and the density of the charge is not always uniform. In order to avoid these inconveniences the compression of the explosive compound is preferably effected by successive drawing-out in rolling mills or drawing-benches of a short tube of very large diameter filled with the explosive compound, and closed at both ends. Said tube is then drawn out until it has assumed the desired diameter, whereupon it is sectioned into tubes of suitable length. In this manner a perfect agglomeration is obtained so that the explosive compound in said tube sections forms a compact and adherent block which remains in the tube without its ends being obturated. The metal tube need not be of soft metal but it preferably is chosen of demi-hard metal, such as copper or brass.

In order to form a reinforcing detonator, the upper end of a section of the tube filled

with the explosive compound, which in this case is of greater length than necessary, is freed from the explosive compound, so as to form the hollow space *e* (Fig. 3) or, as shown in Fig. 4, a tubular joint *g* is placed upon the upper end of the tube section *f* filled with the explosive compound *d*, the said tubular joint *g* forming the hollow space *e*. The tubular joint *g* can be securely connected with tube *f* in any suitable and convenient manner. Finally, as shown in Fig. 7, the tube for the explosive compound *d* can be of double the length required, so that both its ends are free from the compound thus having a space *e* at each end of said subsidiary detonator. This reinforcing detonator is to be cut in two parts at the middle so as to form two detonators.

It could appear *a priori* that this device would be useful only with such explosives which detonate with difficulty, such as the anti-fire-damp explosives; this is however not the case and numerous practical experiments have proved that this device offers great advantages and particularly an appreciable increase of efficiency with any of the mining explosives. These results are easy to explain. In fact, with the ordinary priming, the detonation of the charge of the mine is provoked by a detonator of very small dimensions, practically a point only. The propagation therefore is effected by spheric waves for a considerable distance, wherefrom results, as this mode of propagation determines a progressive decrease of the explosive wave, that the detonations frequently become incomplete. However with a subsidiary or reinforcing detonator of large diameter and which occupies the entire length of the priming cartridge, the whole quantity of the explosive of said cartridge is submitted to the detonating action wherefrom results that properties of high brisance are communicated to the explosive of the cartridge which thus becomes a real "detonating-cartridge". Herefrom follows that the primer acts upon the charge of the mine as if there were a detonator of considerable force at the upper end of the charge, occupying the entire section of the blast-hole and exciting the charge upon its entire section. The propagation therefore is effected immediately by flat waves and with regard to good transmission and complete detonation with maximum efficiency all the special properties are won for the explosion which characterize this kind of waves.

It is quite obvious that this reinforcing detonator must increase the brisance of the priming cartridge, but it is impossible to say in which proportion. Experiments have shown that the increase of brisance is quite considerable. These experiments consisted in detonating successively on identical lead blocks, first a cartridge containing 100 grams of a mining explosive with an ordinary detonator, secondly a similar cartridge with an improved detonator whose reinforcing detonator contained picric acid and was of 8 millimeters of diameter and 5 centimeters long. The impressions on the lead blocks differed considerably and the difference in favor of the improved detonator attained about 40% with the Favier explosives and cheddites. This reinforcing detonator therefore causes quite a considerable increase of brisance, and not only an increase of little importance. I further want to point out, that all parts of the improved detonator contribute in a very rational manner to increase the brisance of the priming cartridge. In fact, the fulminate *b* (Fig. 3) merely serves for provoking the detonation of the explosive compound *d*, which effect is obtained in a proper manner owing to the metal tube *a* which accentuates the effect of brisance of the fulminate *b* and insures the transmission of the detonation upon the surface A—A′ of the explosive compound *d* in a much more secure manner than if the fulminate were freely placed upon said surface. On the other hand, the envelop *c* permits to obtain the maximal shock which is effected by the explosive compound *d* upon the explosive charge of the mine which surrounds the same so that this explosive does not decompose itself with its proper detonating speed but with a much higher speed which fully explains why the effects of high brisance have been obtained on the lead block.

It is obvious that, owing to its special manner of action the improved detonator can be advantageously used with any explosive compound in mines, but it is particularly valuable for all such explosives which detonate badly, such as for example dynamite-rubber, the Favier explosives, the anti-fire-damp explosives, the explosives which are made with potassium chlorate or sodium-chlorate and so on. If used with the Favier explosives and the chlorate explosives the reinforced detonator permits to employ priming cartridges which are strongly compressed and consequently very dense and procure the double advantage of yielding very considerable effects of brisance and of being very little hygroscopic. Thus one of the causes for the frequent misfires is removed, which consists in the use of moist priming cartridges.

With the improved reinforced detonator there is no reason why the weight of the priming cartridge should be reduced as much as possible as is done at present; it is instead advisable to increase the weight of the priming cartridge so that the cartridge primed by the reinforced detonator and

which itself serves as a detonator should be increased so as to constitute an appreciable part of the total charge.

The use of the reinforced detonators is not limited to the charges for mines; this primer will be utilized advantageously for the priming of hail-rockets, ruptive cartridges for military purposes, charges of projectiles and torpedoes. The reinforcer will sometimes be of very large diameter, wherefrom results however no difficulty whatsoever. Generally spoken it will be advisable to increase the efficiency of fulminate of mercury caps wherever they are employed by means of the reinforcing detonator according to the present invention. The improved detonator further permits to simplify the priming of charges of blast-holes for their entire length or depth by means of detonating tubes, which simplification results from the well known fact, that the detonation of a cartridge of brisant explosive such as for example dynamite No. 1, is sufficient to provoke the detonation of a detonating tube which has previously been placed against the cartridge. As the reinforced detonator communicates to any explosive for mines a brisance which can be compared with the brisance of the dynamite No. 1, the detonating tube can be made to detonate by means of a reinforced detonator. Therefore, if the cartridges are centrally perforated, all the cartridges with the exception of the priming cartridge will be telescoped upon a detonating tube of appropriate length. This charge which does not comprise any detonator can be pushed into the blast-hole without any special precaution. Hereupon the priming cartridge with the reinforced detonator is inserted and pushed in so that it comes well in contact with the charge of the blast-hole, the end of the detonating tube which projects from the upper part of the charge having previously been bent and slightly split so that a perfect contact between said detonator or priming cartridge and the detonating tube is insured.

Fig. 5 shows by way of example such an arrangement, k representing the cartridges which compose the charge proper; l is the detonating tube on which the same are telescoped, m is the upper bent and split end of said detonating tube; n is the priming cartridge; p is the reinforced or subsidiary detonator, q the fulminate of mercury cap and r is the fuse which traverses the plugs s of the blast-hole.

If the cartridges should not be centrally perforated, the detonating tube l can be arranged laterally; in this case the various cartridges k are successively pushed into the blast-holes so that they are in contact with the detonating tube l and finally the priming cartridge with the reinforced detonator is inserted. An arrangement such as has just been described is shown in Fig. 6. It would be advisable to cut off the detonating tube l at t only after the priming cartridge n has been inserted. Thus it is not necessary to bend the detonating tube l when the various cartridges are being inserted. The cutting off of the detonating tube can be effected in any suitable manner and by means of any suitable instrument. It would even be sufficient to previously notch the detonating tube slightly at the proper point and to tear its upper end off, the tube being well and securely maintained by the cartridges k.

In the manner described the dynamites and other explosive compounds which are not formed into cartridges can be primed without the necessity to conduct the detonating tube through the plug s of the blast-hole.

I claim:—

An improved reinforced detonator comprising in combination a metal tube of comparatively large diameter and considerable length having an empty part at its upper end, a strongly compressed charge of suitable explosive compound which does not contain fulminate of mercury filling said tube up to said empty upper part, an ordinary fulminate of mercury cap of very small dimension located in the upper empty part of said tube, substantially as described and shown and for the purpose set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

JEAN HARLÉ.

Witnesses:
ALFRED FREY,
H. C. COXE.