A. KOWASTCH.

BLASTING APPARATUS.

APPLICATION FILED MAY 31, 1911

1,049,735.

Patented Jan. 7, 1913.

3 SHEETS—SHEET 1.

Fig. 1.

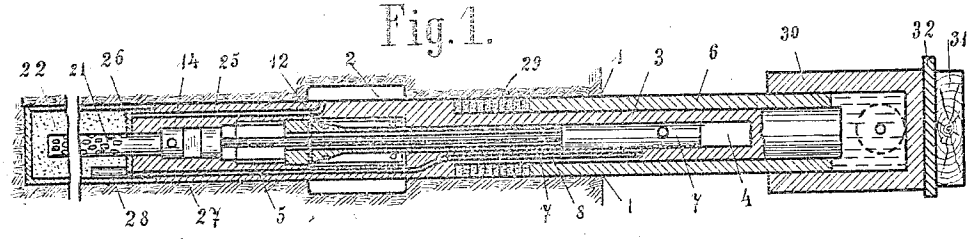


Fig. 2.

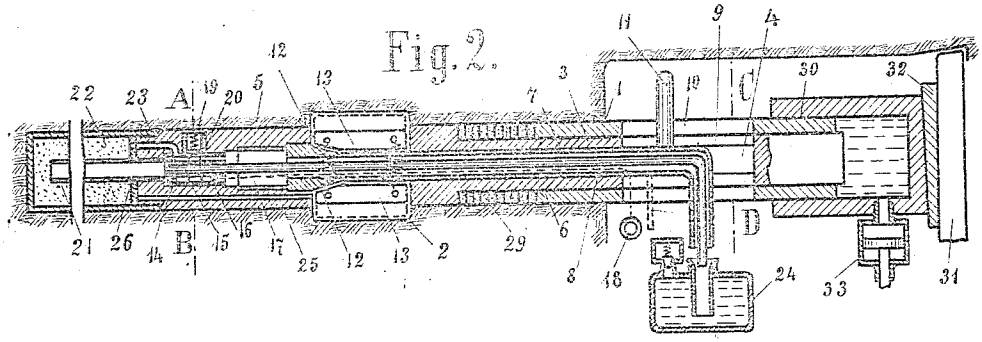


Fig. 2c

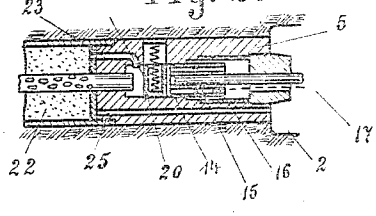


Fig. 2a

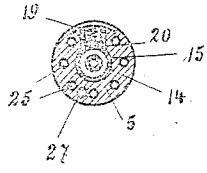


Fig. 2b

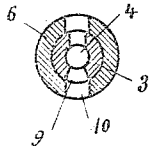
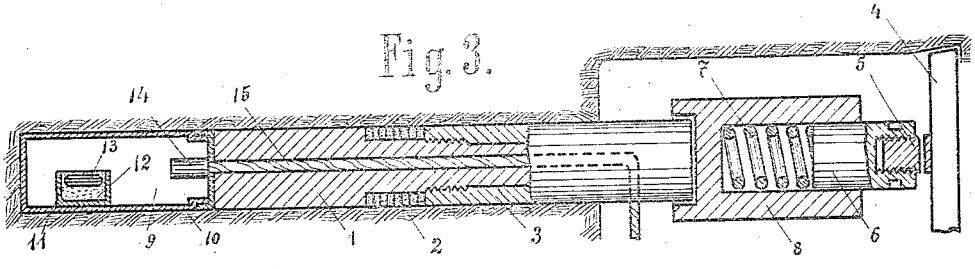


Fig. 3.



Witnesses:

Peter Meffert.

Carl Mauer.

Inventor:

Ambrose Kowastch.

A. KOWASTCH.

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3 SHEETS—SHEET 2.

Fig. 4.

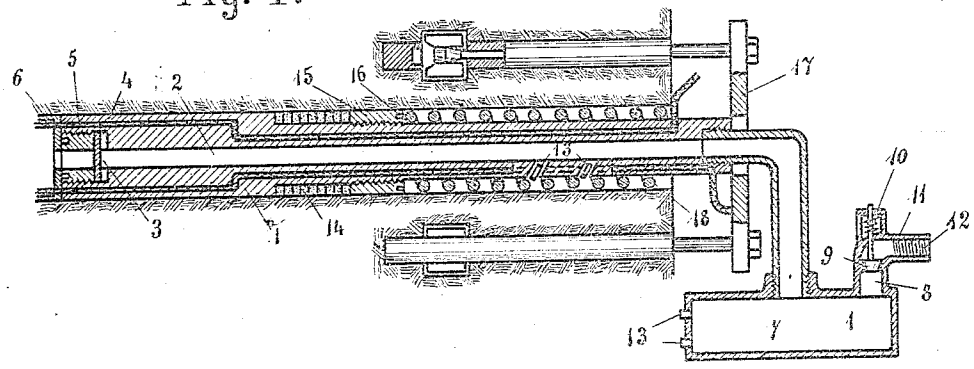
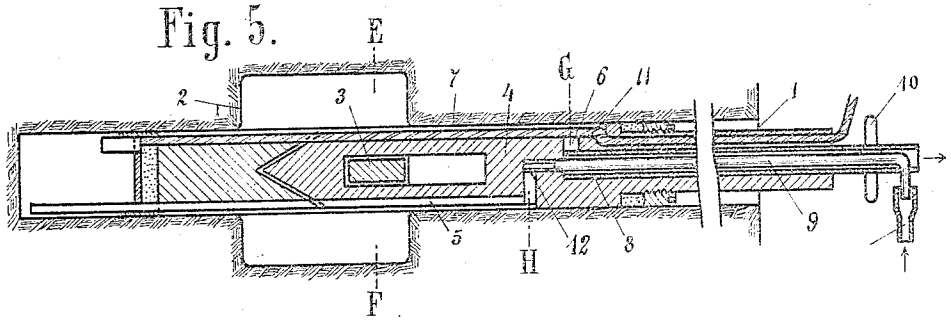


Fig. 5.



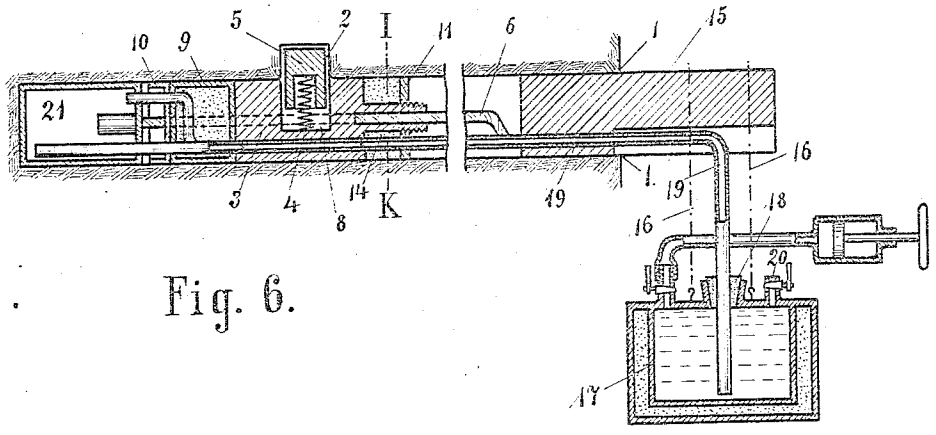


Fig. 6.

Witnesses:

Peter Heffert.

Carl Mauer.

Inventor:

Ambrose Kowastch.

A. KOWASTOH.

BLASTING APPARATUS.

APPLICATION FILED MAY 31, 1911.

1,049,735.

Patented Jan. 7, 1913.

3 SHEETS—SHEET 3.

Fig.5a.

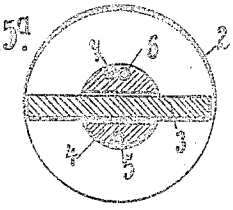


Fig.5b.

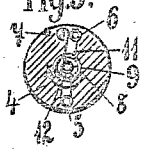


Fig.6a.

Fig.6b.

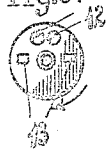


Fig.7.

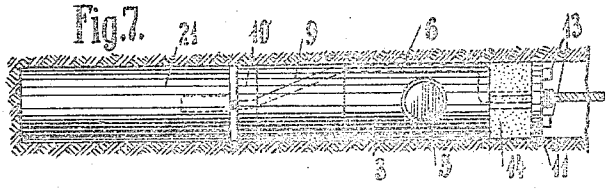
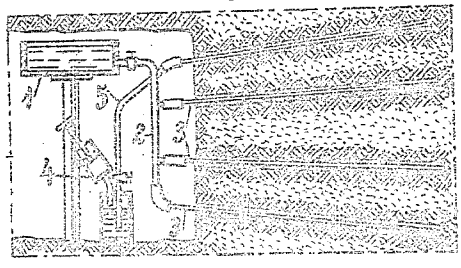


Fig.8.



Witnesses.
Arthur Mayer.
Henry Kasper.

Inventor.
Ambrose Kowastch.

UNITED STATES PATENT OFFICE.

AMBROSE KOWASTCH, OF BERLIN, GERMANY.

BLASTING APPARATUS.

1,049,735. Specification of Letters Patent. Patented Jan. 7, 1913.

Application filed May 31, 1911. Serial No. 630,408.

To all whom it may concern:

Be it known that I, AMBROSE KOWASTCH, a subject of the King of Prussia and German Emperor, residing at Berlin, in the Kingdom of Prussia and German Empire, have invented new and useful Improvements in Blasting Apparatus, of which the following is a specification.

In order to avoid the dangers connected with the storage, transport and manipulation of ready made explosives, it has been proposed to effect the mixture of the constituents forming the explosive immediately before use in the bore hole and to then immediately introduce the explosive thereinto. This method has however never been adopted in practice. In the case of explosives for the manufacture of which corrosive liquids are employed, the workman may have both hands and clothes easily injured by the spilling of the liquid during manufacture; in blasting by means of liquid air the preparation of the blasting charge is, it is true, effected with ease, but the blasting cartridge loses its strength in the bore hole if the shot be not fired in a very short time. (See F. Heise, *Explosives*, Berlin, 1904, p. 119.) According to the present invention these disadvantages are avoided by producing the explosive blasting charge ready for use and provided with a firing device in the bore hole itself. For this purpose there is formed first of all in the bore holes a closed blasting chamber which may be accomplished in various ways, but preferably by means of a tamping plug of rigid material, which is secured in the bore hole by a locking device and contains, in addition to the fuse or the conducting wires for electrical ignition, passages or tubes through which the constituents of the explosive can be introduced into the chamber from the outside and any gases which may be evolved in the preparation of the explosive, led away.

According to the nature of the explosive, the several constituents thereof may be introduced into the blasting chamber before it is closed, so that finally after the closing of the chamber, only the last constituent has to be introduced from outside, or all the constituents of the explosive may be introduced into the empty closed blasting chamber. For example if the explosive is to consist of nitric acid and nitro benzene, a suitable receptacle with nitro benzene may be first introduced into the bore hole, the chamber then tightly closed and the nitric acid forced by means of a pump or compressed air through a tube into the receptacle containing the nitro benzene. Or the empty receptacle may first be placed in the bore hole, the latter tightly closed and the liquids forced into the receptacle simultaneously or one after another. When the mixture of the liquids is completed, their ignition may be effected in any suitable manner. In any case the explosive can be so produced in the bore hole that a spilling of the liquid does not take place. If one constituent of the explosive be a solid body it is preferably introduced before the blasting chamber is closed, the introduction may however be effected subsequently, if the body is in the form of a powder, or is finely subdivided, so that it can be conveyed by means of a liquid or air. Thus blasting by means of liquid air and solid oxidizable substances such as wadding, wood charcoal, wood pulp or the like can be carried out in a particularly advantageous manner, if these substances be introduced into the bore hole in the form of a cartridge, the hole then closed and the liquid air forced into the cartridge. This method affords the special advantage that premature vaporation of the air which would weaken the blasting action, can be limited to the shortest space of time practically possible. According to the nature of the lining for the bore hole, the closing device may be completely closed after the introduction of the desired quantity of liquid air or similar liquid to be vaporized in the bore hole, and consequently all the gas held back therein for increasing the blasting action. It is in the use of liquid air in particular that such evaporation takes place in an unfortunate manner in these methods which have been proposed hitherto, for between the preparation of a blasting charge ready for use, provided with a fuse and closed in from the outside by the tamping and the firing thereof, a certain time always elapses, particularly when several charges are to be fired simultaneously.

An indispensable proviso in the carrying out of the method is that in all cases ignition in the closed blasting chamber is avoided in the preparation of the explosive. No substances can therefore be used which, when chemical ignition methods for example are employed, immediately explode when

they are brought into contact with each other and therefore render the addition of other substances for the purpose of forming a blasting charge impossible. The appliances serving to carry out the process may be constructed in manifold ways according to the nature of the explosive. A few of such appliances are illustrated in the drawing.

Figure 1 shows an appliance in horizontal section and Fig. 2 the same appliance in vertical section which may be used for blasting by means of liquid air in particular. Figs. 2^a and 2^b are cross-sections on the lines A—B and C—D of Fig. 2; Fig. 2^c is a vertical section of a broken off portion of the arrangement shown in Fig. 2, the movable parts being in another position than in Fig. 2; Figs. 3, 4 and 5 are vertical sections of modified forms of my new device; Figs. 5^a and 5^b are cross-sections on the lines E—F and G—H of Fig. 5; Fig. 6 is a vertical section of a further modification of my invention; Fig. 6^a is a cross-section on line I—K of Fig. 6; Fig. 6^b is a front view of the disk 11 of Fig. 6; Fig. 7 is a plan of the arrangement shown in Fig. 6; Fig. 8 is a vertical section of another modification of the device forming the object of my invention.

The bore hole 1 in which is made an enlargement 2, is nearly filled up by a plug 3 consisting of a suitable material, metal, etc. If the bore hole is not of the same diameter along the whole of its length, the plug is made to fit the bore hole approximately. The plug 3 has a central passage 4 running through it to its end situated next to the blasting chamber, while its opposite end is a solid cylinder which is adapted to work fluidtight or gastight in the hollow cylinder 6. In the passage 4 and coaxial therewith is placed a tube 7 and inside this in its turn with ample clearance and rigidly connected thereto is a tube 8. To enable the tubes 7 and 8 to be moved axially the cylindrical portions 3 and 6 are provided with recesses 9 and 10, (Figs. 2 and 2^b,) and on the tube 7 is placed a handle 11 which passes through the slots 9 and 10. At its rear end the tube 7 carries conical jaws 12, which when the tube is pulled forward force the locking parts 13 apart and into the enlargement 2 of the bore hole and so secure the plug therein. At the rear end of the tubes 7 and 8 and lying in the prolongation thereof are short tubular pieces 14 and 15. These tubular pieces are rigidly connected to each other at a mutual distance apart and can be drawn back by a chain 17 which is attached to a projection 16 on the tube 15, passes through the tube 7 to the mouth of the bore hole and there terminates in a handle 18. At the rear end of the block 5 is also a closing valve 20 which is controlled by a spring 19 and which immediately the tubular pieces 14 and 15 are drawn back shuts them off, (Fig. 2^c). By suitably modifying the arrangement the tubes 14 and 15 could be shut off separately. The tube 8 also, which serves as an inlet tube, may be used as an outlet tube, and in like manner the outlet tube 7 may be used as an inlet tube. To the rear end 5 of the plug 3 is attached a tube 21 which reaches into the blasting chamber 22 and is perforated. A passage 23 in the rear end of the plug 3 connects the blasting chamber 22 with the interior of the tubes 14 and 15 so that gases can therefore pass out of the blasting chamber 22 through the passage 23 into the space between the tubes 14 and 15, thence into the space between the tubes 7 and 8 and from there into the open air. As long as the tubes 7 and 8 or 14 and 15 are not closed by the valve 20, liquid air or gases or liquids can be introduced from a receptacle 24 through the tubes 8, 15 and 21 into the blasting chamber 22. The liquids may also carry with them solid bodies in the form of powder.

In the rear part of the plug 3 are provided passages 25, (Figs. 1, 2 and 2^a), which connect the blasting chamber 22 with the enlargement 2 of the bore hole. When the bore hole is being charged these holes are closed by a disk 26 with a packing disk lying in front of it and the thickness of which is of such dimensions that the gas pressure produced by the explosion in the blasting chamber can not perforate it. The explosion only perforates the disk at the points where the passages are and allows the gases to pass through them into the enlargement 2. Finally there is inserted in the plug 3 and in a passage provided for it the fuse 27, which terminates in the primer 28. In the case of many explosives this latter may be omitted, as where the bore hole is securely tamped the danger of the lining thereof being driven out is avoided and the use of simple flame ignition is therefore rendered possible. The part 3 is separated from the part 6 by a packing 29, the purpose of which is to bar the way into the open air of any gases which may penetrate thereinto. The cylindrical part 6 slides in the hollow cylinder 30, which is filled with water, oil or the like and is supported against the prop 31 by the wedge 32 or in some other manner. The pressure for forcing up the part 6 may be produced by a pump 33.

The operation of the device shown in Figs. 1, 2, 2^a, 2^b and 2^c is as follows: After the elements of the device have been assembled, the plug 3 and dependent parts are introduced into the bore-hole, whereafter the hollow cylinder 6 is pressed against the packing 29 by the mentioned hydraulic means or the like, such as the hydraulic cylinder 30 to be seen in Fig. 1. Now, said hydraulic cylinder 30 or the like is locked in its position by the prop 31 and the wedge 32. Further,

the tubes 7 and 8 are drawn forward by means of the handle 11, so that the conical jaws provided at the rear end of the tube 7 force the parts 13 apart into the enlargement of the bore hole so as to lock the plug therein. During the whole time the explosive, for example liquid air, is conveyed through the tube 8 past the tube 21 into the blasting chamber 22, and the gases developed in the blasting chamber can escape through the passage 23. As soon as a sufficient quantity of explosive has passed into the blasting chamber the combined tubes 14, 15 are drawn back by means of the chain 17 and handle 18, whereafter the spring-actuated valve 20 closes the outlet of the inner tube 15 so that no explosive can any more enter into the blasting chamber. Now, the explosive in the blasting chamber can be fired by the tape fuse or other igniting device, and by the pressure produced by the explosion gases the disk 26 is perforated and a small portion of said gases can escape by the passage 25, while the main part of the gases exerts the intended blasting action.

By means of the apparatus described it is possible to combine in the blasting chamber 22 constituents of explosives be they tough or easily fusible, gaseous or hard, (in the form of powder or dust), and by this means to produce the explosive in a manner free from danger, at the place where it is used, that is to say in the blasting chamber itself. The mixture of the several constituents may be effected by blowing in air. In order to prevent solid or liquid constituents from coming out of the blasting chamber when blowing in the air there is placed in front of the outlet opening of the outlet tube a filter or sieve which is not shown in the drawing.

If one or two or more of the constituents of the explosive evolve gases, or if gases be evolved from chemicals in the bore hole or in the blasting chamber itself, the simple apparatus shown in Fig. 3 may be employed. It consists of the block 1, the packing 2 and the tube 3, which by screwing it on to the block 1 compresses the packing 2 and causes it to bear firmly against the walls of the bore hole. To prevent the pressure which is produced in the bore hole during the preparation of the cartridge from driving the apparatus out, the abutment 4 is provided, which by means of a screw-threaded bolt 5, a piston 6, a spring 7 and a cylindrical portion 8 elastically supports the tamping plug consisting of the parts 1, 2 and 3. By means of this arrangement the pressure which is produced in the bore hole during the preparation of the cartridge is utilized to still more firmly compress the packing under the increasing pressure.

A mixture of oxygen and hydrogen may be produced as the explosive in the blasting chamber 9. The oxygen may be introduced in the form of liquid air into the blasting chamber which is lined out with a capsule 10. When this explosive is chosen there is placed in the capsule 10 a vessel 11 containing zinc dust 12 and upon it an easily breakable vessel 13 containing sulfuric acid. There is also provided an ignition device 14 which is set in operation by a fuse or an electric wire 15. The pressure of the vaporizing liquid air breaks the glass vessel 13, the sulfuric acid is poured into the zinc and evolves hydrogen and an explosive mixture of hydrogen and oxygen is produced in the bore hole or blasting chamber. If a body which evolves no pressure in the bore hole be selected as one constituent of the explosive, and if the production of another constituent is only to take place after introduction into the bore hole, a passage may be provided in the block through which a striker conically shaped at its front reaches into the blasting chamber. By means of a push or blow a bottle containing a reagent can be broken in the bore hole and caused to initiate the production of a further constituent for completing the explosive mixture.

In the apparatus shown in Fig. 4 the means for securing it in the bore hole are placed at the mouth of the latter. At the same time the apparatus possesses a further peculiarity, namely the release from the pressure outwardly at the moment of the explosion. It is easy to so modify this construction that the external means for holding the apparatus in the bore hole is replaced by internal means and internal means may also be in addition to external means. In the interior of the block 1 is a passage 2, which at the end next the charge is closed by a plate 3 in front of which may be placed a packing 4. The plate 3 is held in position by a hollow plug 5 screwed in. Behind the plug is a turned up packing 6. The plate 3 is of such dimensions that the strongest pressure produced by the evolving gases in the blasting chamber during the preparation of the explosive cannot perforate it, but yet the pressure of the explosion perforates it and thereby affords a portion of the explosion gases an outlet out of the bore hole. The explosion gases escaping in this way pass along a straight, or as shown in the drawing a bent path, into a receptacle 7, which is provided with one or more outlets 8, in which a valve 9 held down by a spring 10 is raised by the pressure and an outlet thus afforded to the gases. On the outlets 8 are placed projections 11 in which are inserted spiral shaped plugs 12 or other suitable devices for absorbing the heat and thereby extinguishing the flame. The tube 2 and the vessel 7 may, instead of being filled with air, be filled with water, carbonic acid and other substances for extinguishing

the flame and be provided with openings closed by stoppers 13. By the pressure of the explosion gases these stoppages are driven out and the coal which comes down and the head or end of the gallery can be subjected to a spraying with gas or water by the action of the explosion gases. The apparatus is rendered liquid and gas-tight by the packing 14 which consists of some suitable material, such as asbestos, etc., and is compressed by a nut 15 which is tightened up by a spanner inserted in the holes 16. Two or more securing devices serve to secure the cross bar 17. Against it bears the spring 18 so that the means for holding the apparatus in the bore hole is elastic. By slightly modifying the appliance shown in Figs. 1, 2 and 3 one or more other substances may be introduced into the explosion chamber for the purpose of obtaining explosive mixtures with the bodies produced by the electrical decomposition.

Fig. 5 shows an arrangement for holding the apparatus in the bore hole in which there is inserted between the blasting charge and the means for holding the apparatus in the bore hole a part or parts which provide elasticity at the instant of the explosion. The strength of this part or these parts is so calculated that should the blasting charge produce any pressure in the bore hole before the explosion ensues, the parts resist it, yet are shattered by the pressure of the explosion and driven into the enlargement of the bore hole. In this way the pressure upon the means for holding the apparatus in the bore is lessened, which in the case of some coal prevents the apparatus from being driven out of the bore hole and in general reduces the wear of the means for keeping it therein. The bore hole 1 again has an enlargement 2 in which the bolt 3 engages, (Fig. 5[a]). The block 4 contains three passages 5, 6 and 7, of which the passage 5 is the inlet passage, the passage 6 the outlet passage and the passage 7 the passage for the firing wire. As in the arrangement shown in Figs. 1 and 2 there are in the interior of the block two tubes 8 and 9 which are rigidly connected to each other and can be rotated by a handle 10. Each tube has at its rear end an opening, the tube 8 having an opening 11 and the tube 9 an opening 12. In the position shown the tubes 9 and 8 communicate with the passages 5 and 6 respectively through these holes, (Fig. 5[b]). For the purpose of preparing the charge the tube 9 is connected with the filling vessel by means of the hose 13. After the charge has been prepared the passages 5 and 6 are shut off by turning the arms 10.

The appliances described are intended to permit of being used repeatedly. It is however desirable, in order to make the use of the process general in practice to have gas and fluidtight explosion chambers the locking and packing of which are so simple and cheap that the use of the apparatus once only offers no obstacle to the employment of the process from a monetary point of view. Fig. 6 shows such a gas and fluidtight blasting chamber locked in vertical section and Fig. 7 is a plan view thereof. In the bore hole 1 is an enlargement 2 of any desired shape and size. Several enlargements may also be provided. Into the bore hole fits a plug 3 consisting of any desired material of suitable strength and from which a bolt 5 controlled by a spring 4 can emerge for the purpose of entering the enlargement of the bore hole. The bolt may also be moved outward by its own weight or by lift or tension or by the pressure of the gases in the interior of the bore hole, in short in any desired manner. The plug 3 is traversed by three passages 7, 8 and 6, (Fig. 6[a]), for the inlet and outlet and for the firing wire. These passages may be reduced to two or one in which the others are inclosed, similar to that shown in Figs. 2 and 5. Behind this plug may be conveniently placed a paper bag 9 filled with some plastic tamping material and behind this again may lie a turned up packing ring 10. The outlet tube is either turned up in the paper bag or in front of the cartridge in order to catch and carry away at the top any escaping gases. At the side of the plug next the mouth of the bore hole is likewise placed a layer of plastic packing material 14, through which the inlet and outlet passages are formed by pieces of tube inserted therein; the firing wire 6 running along the side of the plug, (Fig. 7), is bent up in front and passed through a radial slot in the central tube projecting from the plug and screw threaded externally. On to this screw thread is screwed a disk 11. In addition to the central screw threaded passage the disk 2 has openings 12, (Fig. 6[b]). When the blasting chamber is being charged the openings 12 lie in the continuation of the passages 7 and 8 through the plug. After the preparation of the charge has been completed, the inlet and outlet tubes are drawn back and the plate 11 is screwed on by the aid of a spanner which fits on to the projections 13. By this means the packing composition 14 is compressed and the openings in the passages closed.

For the purpose of convenient filling a plug 15 is pushed into the front end of the bore hole and around it are slung chains or cords 16 from which the vessel containing the substance to be introduced is suspended. Into this vessel passes a stopper 18 which closes it tightly. If liquids which give off gases, such as liquid oxygen or hydrogen for example, are to be introduced, the safety cock 20 is closed, so that the

liquid and gases are conveyed into the blasting chamber 21 under the rising pressure. If liquids which do not produce any pressure or bodies in the form of powder or dust are introduced into the blasting chamber, the necessary pressure is produced by a pump. After filling is completed the plug 15 and the vessel 17 together with the inlet and outlet pipes are removed. The tamping plugs may obviously be also constructed in another form. If circumstances permit of it the blasting chamber may also be closed by the ordinary tamping plug of filling material, loam, sand and the like instead of a rigid tamping plug. The tubes for the subsequent introduction of explosive constituents into the blasting chamber then pass through this tamping plug. The lining plugs may also be provided in addition to the locking device with the packings common to lining plugs.

So far it has been assumed that always one bore hole is to be charged and fired. It is obvious however that several bore holes may be charged in the manner described and then fired. This may be conveniently done in the manner shown in Fig. 8. 1 is a receptacle placed upon a raised stand and containing any desired blasting liquid. From the receptacle leads a pipe 2 to which are connected the supply pipes 3 leading to the several bore holes. If the blasting chamber is above the level of the blasting liquid contained in the receptacle 1, the liquid must be forced into it by a special pump 4 through a pipe 5. When liquid air is used the pump may be dispensed with even when the level of the several bore holes is above the surface of the liquid in the receptacle 1, provided the receptacle be closed airtight. In such case the pressure produced by the evaporations of the liquid may be utilized to force the liquid into the blasting chamber.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States is:—

1. In combination with a blasting chamber and an igniting device, an apparatus for producing blasting charges, comprising a tamping plug secured in the bore-hole by a locking device and closing tightly said blasting chamber, said tamping plug being provided with a channel for receiving said igniting device, an obturable inlet passage, through which constituents of explosives can be introduced before closing the blasting chamber, and an obturable outlet passage permitting the escape of air and gases during the filling of the bore-hole, substantially as described.

2. In an apparatus for producing explosive blasting charges, the combination with inlet and outlet passages coaxial to each other and to the tamping plug, of means for obturating both passages together, substantially as described.

3. In an apparatus for producing explosive blasting charges, the combination with inlet and outlet passages coaxial to each other and to the tamping plug, of valves adapted to close said passages either together or separately, substantially as described.

4. In an apparatus for producing explosive blasting charges, the arrangement of inlet and outlet passages or tubes, whose ends are formed of telescoping tube pieces, a pulling device adapted to draw said telescoping tube pieces back in the blasting chamber, and a valve adapted to close said passages or tubes by its own weight substantially as described.

5. In an apparatus for producing blasting charges, the arrangement, of a tamping plug, a plate preferably held in position by screwing and adapted to be perforated under the influence of the explosion, a channel arranged in said tamping plug, and a vessel or receptacle connected to said channel, said vessel or receptacle being adapted to take up a part of the explosion gases, substantially as described.

6. In an apparatus for producing blasting charges, the combination of a vessel or receptacle, a channel in connection therewith, and stoppers to be blown off under the influence of the explosion, substantially as described.

7. In an apparatus for producing blasting charges, the combination of a vessel or receptacle, an outlet tube, and a safety valve closing said outlet tube, the latter containing means for absorbing the heat of the flame, substantially as described.

In witness whereof I have hereunto signed my name this fifteenth day of May 1911 in the presence of two subscribing witnesses.

AMBROSE KOWASTCH.

Witnesses:
PETER MEFFERT,
HENRY HASPER.