No. 716,768. Patented Dec. 23, 1902.

R. W. SCOTT.

EXPLOSIVE CHARGE FOR GUNS OR OTHER USES.

(Application filed May 31, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

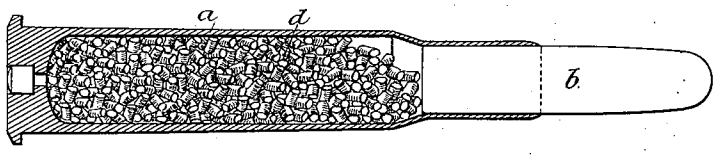


Fig. 2.

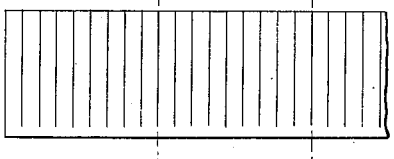


Fig. 3.

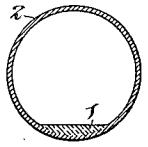


Fig. 4.

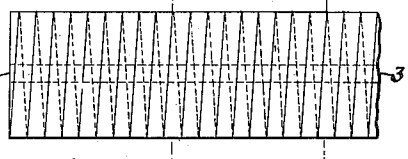


Fig. 18.

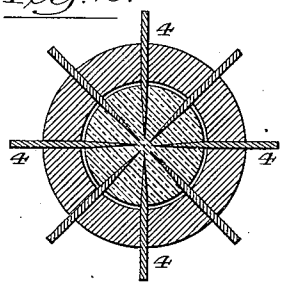


Fig. 5.

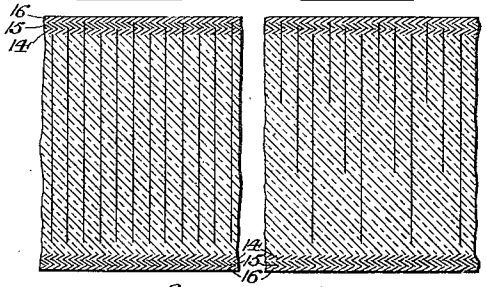


Fig. 6.

Fig. 7.

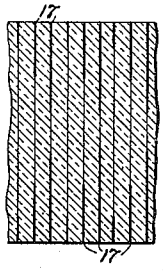


Fig. 19.

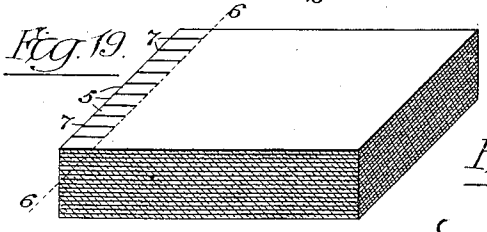


Fig. 20.

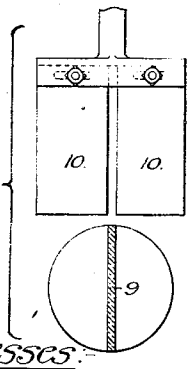


Fig. 22.

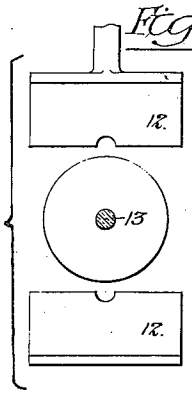
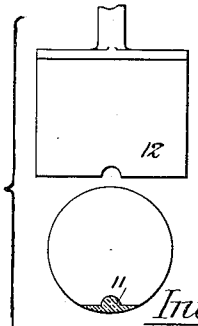


Fig. 21.



Witnesses:
Louis H. Y. Whitehead.
Herman E. Metius.

Inventor:
Robert W. Scott
by his Attorneys:
Howson & Howson

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(No Model.) 2 Sheets—Sheet 2.

Fig. 8.

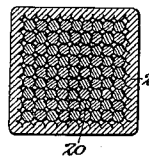


Fig. 9.

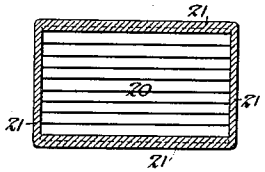


Fig. 10.

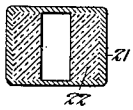


Fig. 11.

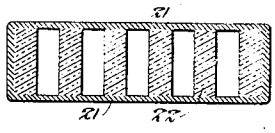


Fig. 12.

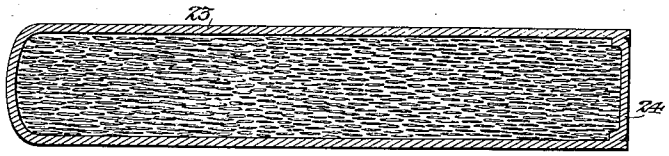


Fig. 13.

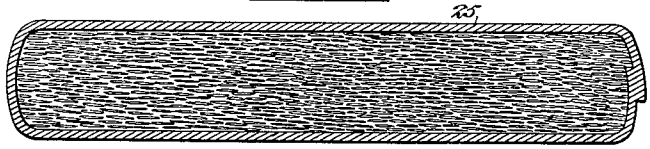


Fig. 14.

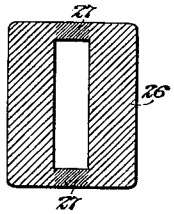


Fig. 16.

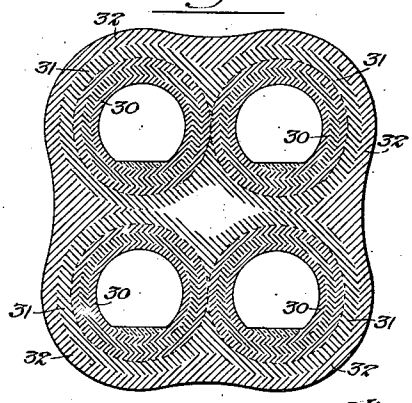


Fig. 15.

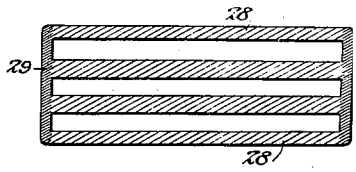
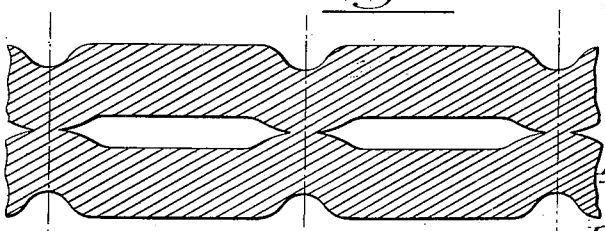


Fig. 17.



Witnesses:-
Louis M. Whitehead.
Herman C. Mehlig.

Inventor.
Robert W. Scott
— by —
His Attorneys
Howson & Howson

UNITED STATES PATENT OFFICE.

ROBERT W. SCOTT, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO LOUIS N. D. WILLIAMS, OF ASHBOURNE, PENNSYLVANIA.

EXPLOSIVE CHARGE FOR GUNS OR OTHER USES.

SPECIFICATION forming part of Letters Patent No. 716,768, dated December 23, 1902.

Application filed May 31, 1901. Serial No. 62,665. (No model.)

To all whom it may concern:

Be it known that I, ROBERT W. SCOTT, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Explosive Charges for Guns or other Uses, of which the following is a specification.

The object of my invention is to provide an explosive charge designed to generate gas under moderate pressure at the beginning of combustion and then to increase the volume of gas, whereby if said explosive charge is intended to be used in a gun high velocity will be imparted to the projectile without generating such high pressure in the chamber of the gun as to incur any risk of straining or bursting the same.

In the accompanying drawings, Figure 1 is a sectional view of a gun-cartridge embodying my invention. Fig. 2 is an enlarged side view of part of a strand of explosive material prepared for producing the units of the charge of said cartridge. Fig. 3 is a transverse section of one of the completed units. Figs. 4 to 16 are views of other forms of explosive charges or units embodying my invention, and Figs. 17 to 22 are views illustrating various methods of making explosive charges in accordance with my invention.

Heretofore in order to overcome the inertia of a projectile with the least possible strain on the chamber of the gun grains or lumps of powder of the largest possible size have been used and shapes such as prisms or tubular forms have been resorted to in order to provide a superficial area decreasing as slightly as possible in proportion to the mass as each grain or lump was being consumed; but a limit in this direction is quickly reached, for if the grains or lumps of powder are too large, and consequently slow of combustion, it is impossible to obtain the desired velocity in the projectile, while if they are too small the chamber-pressures will be excessive. Even when composite charges are resorted to—that is to say, charges wherein large-sized grains are first seated next to the means of ignition and then smaller grains, and so on—but little if any advantage is secured, as the ignition of such a charge is practically simultaneous and the result in respect of pressure and velocity is substantially the same as though grains averaging in size between the largest and smallest grains composing the charge had been used. In modern so-called "smokeless" powders, other things being equal, large grains or strands of large diameter will burn more slowly than smaller grains or strands of small diameter, because less superficial area in proportion to mass is presented in the former case than in the latter, and it is now well established that combustion goes on regularly from the outside toward the center of such combustible body. With these facts in mind I have devised an explosive charge in which when the charge is first ignited the combustion will be relatively slow, and the projectile will therefore be started in its movement through the bore of the gun with comparative gentleness; but when the projectile is well under way the charge will burn quickly, the effect being that the chamber-pressure is materially reduced and the strains are distributed throughout the bore of the gun. Hence I am enabled to secure the ordinary velocity with reduced strain upon the gun, or with the ordinary pressure I am enabled to attain increased velocity of projectile, and, furthermore, owing to the gentleness with which the movement of the projectile is started, said projectile may be made in the form of a shell with high-power bursting charge without danger of being burst in the gun by the shock of starting.

In Fig. 1 of the drawings the metallic case of an ordinary small-arm cartridge is shown at *a*, the projectile at *b*, and my improved projecting charge at *d*. The charge may consist of any of the nitro powders now used or any explosive material containing in itself the elements necessary for its combustion and capable of developing by such combustion the desired degree of power.

In making the charge shown in Figs. 1, 2, and 3 a strand of comparatively large size is employed, the diameter or cross-sectional area of the strand, in fact, being so great that if it were cut into pellets having a length equal to the diameter or cross-section without fur-

ther treatment said pellets would be only partially consumed in the bore of the ordinary small-arm. Consequently the contained energy would not be utilized and the velocities and pressures attained would be low. In order, therefore, to secure the advantage of the low pressure of such a charge and at the same time obtain desirable velocity in the projectile, I divide the strand into thin slabs or flakes. For instance, supposing the strand to be .075 of an inch in diameter, I cut the same so as to form slabs or flakes of about .013 of an inch thick, or at the rate of seventy-five cuts to the inch, and in order that the strand may be handled with facility the incisions which form these slabs or flakes do not pass entirely through the strand, but leave a portion—say about one-eighth of the entire mass—uncut, as shown, for instance, at 1 in Fig. 3. After having the incisions formed therein, as shown, the strands are by preference passed through a solution of the nitropowder composition or other combustible gas-producing material containing the elements necessary for its combustion, such being referred to hereinafter simply as "solution," or in some cases the strands may be simply passed through a bath of a suitable solvent, such as acetone or a mixture of ether and alcohol, depending on the chemical composition of the material, this solvent serving to soften the strand on the exterior, so that contiguous surfaces become united and a sealed film or barrier is formed over the mouths of the nicks in the strand.

The film or barrier not only provides a hermetically-sealed closure or envelop for the nicked strand, but it unites with or forms part of the material of the strand, and hence will prevent access of the flame to the surfaces of the slabs or flakes until after the film is consumed, still freer access of the flame being permitted when the portion 1 of the strand has been burned away, so as to permit the slabs or flakes to fall apart.

The protecting film or envelop formed by passing the strand through the solution is shown at 2 in Fig. 3. In practice I have granulated the strand into pellets about one-eighth of an inch long, so that each pellet will be composed of nine flakes, presenting a superficial area increased by sixteen times the area of one end of the pellet as soon as the film or barrier 2 and the connecting-web 1 are destroyed and the flakes permitted to separate one from another. A pronounced advantage of this form of unit is that it is granulated fine enough to be fed in the usual manner through the ordinary loading-machine now in use in the Government arsenals and ammunition factories, and the charge can be weighed or measured to a nicety, whereas when a series of strands or a single rod or bar is used, as has been proposed, accurate charging is impossible, even in the arsenals and factories. The granular form is especially advantageous when used in cartridges for shotguns or rifles for target or sporting purposes, where the shooter, in most cases, prepares his own ammunition. When the fine grains or pellets are used, moreover, more uniform results are possible of attainment than if a single strand or a small number of such are used, as the relation of initial surface area to the area when the coating has been consumed is the average of all of the pellets, which will be about the same in all of the cartridges, whereas this relation in individual pellets or strands may vary somewhat, and therefore lead to irregular results when such individual pellets or strands or a few of them constitute the entire charge.

Experiments with a chronograph show that a thirty-six-grain charge of pellets formed from the strands before being treated in accordance with my invention gave a mean observed or instrumental velocity of but fourteen hundred and seventy-five feet per second, while a charge of the same weight treated in accordance with my invention and used in connection with the same weight of projectile as before gave a mean instrumental velocity of twenty-one hundred and fifty feet per second, indicating consumption of the charge in one case and not in the other. Moreover, by providing the nicked pellet with a protecting-film the rate of combustion at the beginning is no greater than in the case of the solid pellet. Consequently the projectile is started in the bore of the gun with comparative gentleness, and when the remaining gas-producing surfaces are attacked the projectile is moving and a larger and constantly-increasing space is afforded for the complete combustion of the charge and expansion of the resulting gases. Hence the pressure in the chamber of the gun is but slightly greater than when the solid pellet is employed.

Instead of forming incisions in the strand, as shown in Figs. 2 and 3, I may in some cases form a continuous spiral incision, as shown in Fig. 4, leaving a small central core 3, this plan having the advantage of producing a stronger strand, owing to the presence of the central core, and having the further advantage of being produced by an operation involving rotary motions only, with consequent greater production.

In some cases the strands may be slitted longitudinally—as, for instance, by drawing them through a die having inwardly-projecting knives, such as shown at 4 in Fig. 18, these knives projecting into the die sufficiently to leave a small core of the strand uncut at the center of the same, this strand being coated with a surface film of the solution, and the ends of the pellets cut from the strand being subsequently provided with a similar film, as also are the pellets shown in Fig. 4.

An explosive unit in accordance with my invention may be made by first rolling the

material in the form of thin sheets of the thickness desired for a flake, a number of these sheets being then stacked one on top of another, as shown in Fig. 19, and then subjected to pressure tending to force them together, while the edge 5 has a coating of the solution or solvent applied thereto, whereupon a strip may be cut off at the end of the slab by a knife cutting on the line 6, so as to produce a strip consisting of a series of long flakes held together by the edge film, this strip being subsequently severed into smaller pieces, as by knives cutting on the lines 7, which, however, do not sever the bottom strip, the latter serving to hold the several pellets together, but being susceptible of bending, so as to separate said pellets while they are dipped in the solution, thereby insuring the coating of the same on all sides, the pellets being then separated by cutting the bottom strip, whereby a completely enveloped unit with any desired number of subdivisions results.

Other means of making a composite unit or pellet from the sheets of material may be resorted to. For instance, the layer of sheets may be much thicker than is sufficient for a single unit or pellet and, being united by a film on the edge 5, may be completely severed on the dotted line 6 and likewise entirely separated on each of the lines 7, the elongated strips then being dipped or passed through the solution and finally granulated into units containing the desired number of slabs or flakes.

The forms of pellets shown in Figs. 2 and 3 may be made by a vibrating knife operating in conjunction with a suitable feeding apparatus for the strand, or a pellet having a central web of the material left standing—as, for instance, at 9, in Fig. 20—may be produced by a vibrating cutter having spaced knives, such as shown at 10 in said figure, adjustment of the knives from and toward each other resulting in the production of a web of any desired thickness.

The web 1, which unites slabs or flakes in a unit of the character shown in Figs. 2 and 3, may, if desired, have a central rib formed thereon, as shown at 11 in Fig. 21, by forming a nick in the knife 12, which produces the incision, and a pellet having a central core, such as shown at 13 in Fig. 22, may be produced by nicking both of the cutting-knives and moving the latter so that they will meet at the center of the strand.

A central rib, as shown in Fig. 20, or a central core, such as shown in Fig. 22, permits the strands to be readily coiled in long lengths and to be handled without danger of either fracture of the enveloping film or breaking of the strand.

In the case of a nicked or subdivided pellet access of the flame to the surface of the subdivisions may be delayed by passing the cord or strand after it has been nicked or slotted through a solvent of the material of which the strand is composed and then through a die of suitable size, for the cutting-knife, however keen, will raise more or less of a ridge or bur of the material about the mouth of the incision, and this bur when softened by the solvent and pressed down by the die will provide a hermetically-sealed covering for the mouths of the incisions.

When it is desired to increase the superficial area of the charge at more than one stage as combustion proceeds, the unit or pellet may be made as shown in Fig. 5, the strand being first slitted at the rate of, say, thirty incisions to the inch, then enveloped with a coating 14 of the solution, then again slitted at the same rate, the incisions occurring one-ninetieth of an inch from the first, then again given an enveloping coating 15, and finally slitted again in the centers of the remaining spaces and again coated, as shown at 16, so that when the first film is destroyed access is had to one-third of the incisions. When the second film is burned away another one-third of the incisions is presented to the action of the flame, and when the last film is consumed all of the gas-producing surfaces are supplying energy, and, if desired, the successive sets of incisions may be of different area, as shown, for instance, in Fig. 6.

Slabs or disks of the material may be united by means of films 17 of the solution, which films are of various depths or degrees of penetration between the disks, as shown in Fig. 7, part of the internal combustion-surface being thus exposed when the shallowest films have burned away, other portions of said internal combustion-surface being exposed when the next deeper films have been consumed, and so on until all of the internal combustion-surfaces are ignited.

In the units shown in Figs. 5 and 6 the first set of incisions form one member of a group and are closed by the single thickness of film 14, the second set form the second member of the group and are closed by a double thickness of film 14 15, and the third set form the third member of the group and are closed by a triple thickness of the film 14 15 16, and in the unit shown in Fig. 7 the internal surfaces of like area form one member of the group, the sealing-film presenting three different degrees of resistance to the action of the igniting-flame.

It will be apparent that when the units are formed of slabs, flakes, or disks, as described, the pressure exerted by the combustion of the external surfaces cannot "break down" the slabs, flakes, or disks composing the units, as might be the case if units of hollow form were employed; but even in the latter case, especially when the openings have been closed by films of the solution, lower pressures for the same velocity are secured.

Various plans other than the nicking and coating of the strand may therefore be adopted

in carrying out my invention. Thus in Figs. 8 and 9 I have shown a unit consisting of a bunch or group 20 of cords or strands of small diameter enveloped within a casing 21 of explosive material forming a hermetically-sealed envelop, which is united with the outer cords of the bunch or group, and in Figs. 10 and 11 I have shown units composed of perforated blocks or slabs 22, provided with envelops 21 of the same character as that shown in Figs. 8 and 9.

The envelops shown in Figs. 12 and 13 are in the form of sealed casings containing the grains, flakes, or other forms of unit of the explosive charge, the envelop in the charge shown in Fig. 12 consisting of a deep cup 23 of combustible gas-generating material, sealed at one end by a head 24 of similar material, which is united to the material of the cup, while in the charge shown in Fig. 13 the cup 25 has its ends overlapped and united together, it being essential to all of these forms of my invention that the barrier which protects the internal combustion surface or surfaces of the charge or unit from the flame shall present no joint or aperture through which the igniting-flame can pass, otherwise the purpose of the envelop or barrier would be defeated.

The union of the meeting edges of the elements of the envelop shown in Figs. 12 and 13 can be readily effected by rendering such meeting portions plastic by means of a solvent of the material of which they are composed and then pressing said meeting portions together while they are in this plastic condition. It is not, however, essential to the proper carrying out of my invention that a continuous sheath or envelop should be employed to retard access of the flame to the internal combustion-surface of the charge or unit. For instance, in Fig. 14 I have shown a tubular unit 26, in which the barrier consists simply of plugs or wads 27 of combustible material hermetically closing the ends of the central opening of the unit and united to the walls of said opening, or the ends of the tube may be sealed by simply dipping the same in the solution, so as to form sealing-films over the opening, and a unit 28, having a multiplicity of openings therein, may be treated in the same way—as shown, for instance, at 29 in Fig. 15.

A convenient means of closing the ends of the openings in perforated grains, pellets, or units is shown in Fig. 17. As the tubular strand issues from the die and is still in plastic condition it may be subjected at suitable intervals to a contracting pressure, which will close the opening or openings in said strand and unite the walls of the said opening or openings so as to seal the latter at the required intervals, the strand being subsequently severed at these sealed portions.

In Fig. 16 I have shown a composite form of gun charge adapted for use in large-caliber guns. In this view, 30 represents a number of units similar to those shown in Fig. 5, or which may be any of the other forms of unit illustrated, the bundle or fagot of these units being contained within a sealed sheath or envelop 31 of combustible gas-generating material, and a number of these sheathed or enveloped fagots being contained within a general sheath or envelop 32, forming a sealed casing or covering for the series.

It will be observed that the internal combustion-surface in all cases is of predetermined definite area and that the sealed barrier of readily-ignitible material forms a substantially integral union with the material of the unit.

By the use of a number of comparatively slow-burning envelops in this manner the generation of pressure can be closely regulated, there being a gradually-increasing area of combustion, owing to the gradual increase of superficial area in proportion to mass.

In the case of a cartridge prepared in accordance with my invention and intended especially for small-arms where a jacketed bullet is employed greater accuracy in the flight of the bullet will be attained, because there is not that distortion of the bullet which ordinarily takes place when it is subjected to the usual enormous pressure before its inertia is overcome, and the erosion of the "lead" or entrance to the rifling of the gun will be prevented. Moreover, bullets without the hard-metal jacket may be used, as their movement into the quick-twist bore will be started at such greatly-reduced pressure that they will not be nearly so apt to "jump" the rifling as is the case where a lead bullet is used in quick-twist bores and the chamber-pressures are excessive.

A projecting-charge made in accordance with my invention is of pronounced advantage in connection with a multishot ball-cartridge where the aggregate weight of the projectiles is necessarily in excess of the weight of the regular or service ball and both the single and multi shot cartridges are intended to be used interchangeable in the same arm. Hence the pressures and velocities should be, as nearly as may be, alike.

Some of the forms of charge shown—for instance, that of Fig. 7—are peculiarly well adapted to guns of large caliber.

It will of course be evident that the sheath, envelop, or other barrier which I use for temporarily protecting the quick-burning portion of the charge is distinct from a wad of paper or such like material, as it contains within itself the elements necessary to sustain combustion in a confined space, whereas a mere paper wad is not combustible without the access of oxygen from some source other than itself, and hence would not burn readily in the confined cartridge-chamber of a gun. It will also be evident that my invention is distinct from an explosive element consisting of

a disk or slab of quick-burning material contained within an envelop of slower-burning material, since in this case the disk or slab has no internal combustion-surface in addition to its external combustion-surface and the greater rapidity of combustion of the contained slab or disk is counteracted either wholly or in part by the constantly-decreasing area of the surface exposed for combustion, whereas my unit exposes a greater surface for combustion as soon as the barrier or envelop is burned away.

My invention is also distinct from that form of explosive unit which consists of a block or slab having perforations or cells the ends of which are closed by a disk or washer or by some other portion of the block or slab which merely forms a contact-joint, as experience has demonstrated that no such contact-joint affords an appreciable barrier to the products of combustion developed in the burning of modern gunpowders.

Although I have described my improved explosive charge as applied to gun-cartridges, it will be evident that it is equally adapted for use in explosive-engines, gunpowder pile-drivers, and the like.

The term "explosive unit" as used in the claims applies to all of the forms illustrated, whether such unit constitutes a complete charge or only an element of the charge.

It should be understood that the explosive-envelop, whereby the internal combustion-surfaces of an explosive unit made in accordance with my invention are hermetically sealed, is readily ignitible, and hence is distinct from a celluloid varnish such as has been proposed as a coating for explosive charges of guns and which is intended to form a waterproof coating that is difficult of ignition.

It will be noted that the outer peripheral surface of each of the explosive charges or units which I have illustrated is the one which is first ignited, and the area of this surface bears such relation to the area of the internal combustion-surface exposed when the barrier between the two has been burned away that there will not at that time be such undue augmentation of the area of the combustion-surface as to lead to a dangerous increase in the volume of gas generated, with accompanying dangerous increase of pressure.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. An explosive unit for generating moderate initial pressure, said unit having an internal combustion-surface of definite predetermined area in addition to the external peripheral combustion-surface and a hermetically-sealed barrier of readily-ignitible explosive material temporarily protecting said internal combustion-surface from access of the igniting-flame whereby access of the flame to said internal combustion-surface is prevented until said barrier is burned through.

2. An explosive unit for generating moderate initial pressure, said unit having an internal combustion-surface of defined predetermined area in addition to the external peripheral combustion-surface and a hermetically-sealed barrier of readily-ignitible explosive material which forms a substantially integral union therewith at the points of contact and temporarily protects said internal combustion-surface from access of the igniting-flame.

3. An explosive unit for generating moderate initial pressure, said unit having an internal combustion-surface of definite predetermined area in addition to the external combustion-surface and a hermetically-sealed envelop of readily-ignitible explosive material containing said unit, whereby access of the flame to said internal combustion-surface is prevented until the barrier formed by said envelop has first been burned away.

4. An explosive unit for generating moderate initial pressure, said unit having an internal combustion-surface in addition to the external combustion-surface and being provided with a hermetically-sealed envelop of readily-ignitible explosive material, which envelop forms a substantially integral union therewith at the points of contact.

5. An explosive unit for generating moderate initial pressure, said unit having a series of subdivisions connected so as to prevent separation until the connection has been burned away and being provided with a barrier of readily-ignitible explosive material which hermetically seals the spaces between said subdivisions and prevents access of the igniting-flame thereto until it has been burned away.

6. An explosive unit consisting of a strand having therein a series of incisions which extend only part way through the strand, and a film of readily-ignitible explosive material which hermetically seals the mouths of said incisions.

7. An explosive unit presenting a group of internal combustion-surfaces and a hermetically-sealed barrier of readily-ignitible explosive material temporarily protecting each member of the group from ignition, said barriers differing in extent whereby the different members of said group of internal combustion-surfaces will be exposed to ignition at different stages of combustion.

8. An explosive unit having a group of internal combustion-surfaces varying in area and a hermetically-sealed barrier of readily-ignitible explosive material temporarily protecting each member of the group from ignition, said barriers differing in extent whereby the members of the group of internal combustion-surfaces will be exposed to the igniting-flame at different stages of combustion.

9. An explosive unit having a group of in-

ternal combustion-surfaces, a hermetically-sealed envelop of explosive material temporarily protecting each member of the group from ignition, and a hermetically-sealed envelop of explosive material common to all and temporarily protecting the envelop members of the group.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT W. SCOTT.

Witnesses:
F. E. BECHTOLD,
JOS. H. KLEIN.