Dec. 15, 1936. F. R. WILSON 2,064,581

EXPLOSIVE MANUFACTURE

Original Filed Jan. 24, 1931 2 Sheets-Sheet 1

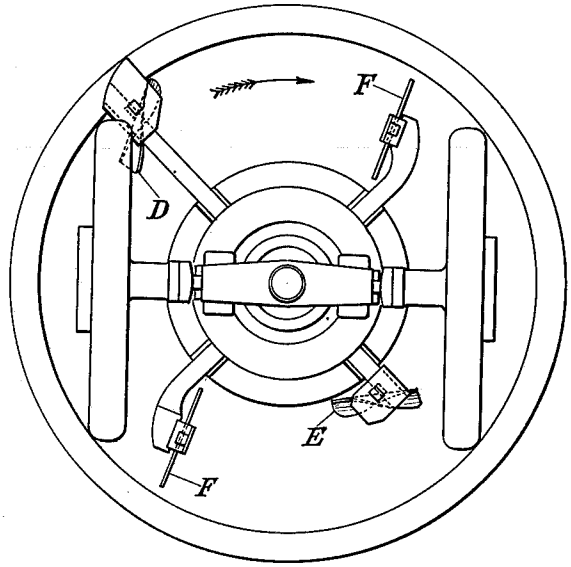



FIG. 1

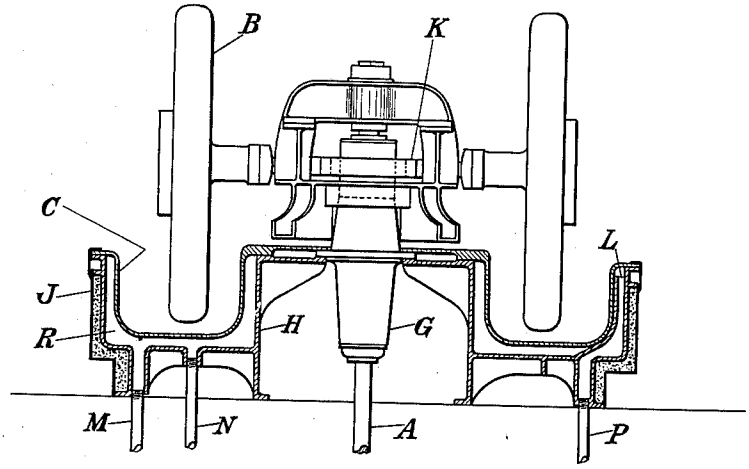



FIG. 2

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EXPLOSIVE MANUFACTURE

Original Filed Jan. 24, 1931 2 Sheets-Sheet 2

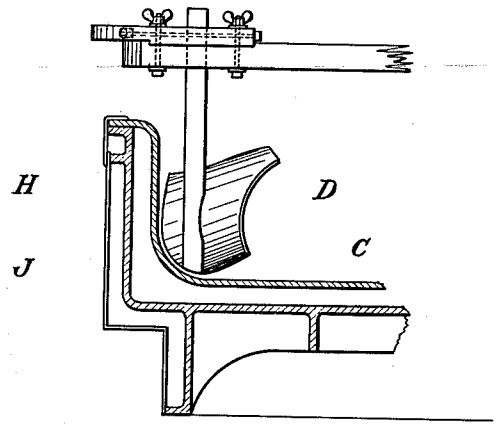



FIG. 3

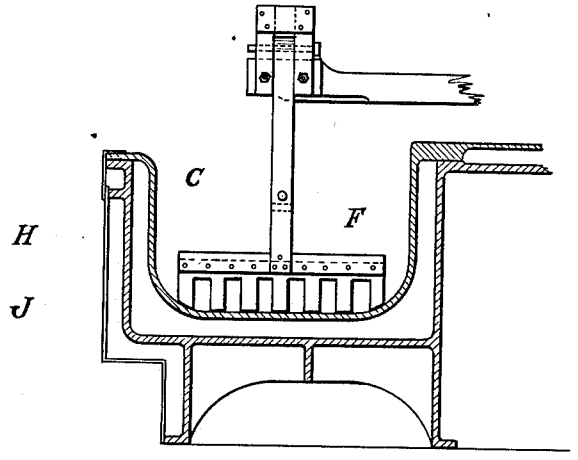



FIG. 4

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Patented Dec. 15, 1936 2,064,581

# UNITED STATES PATENT OFFICE

2,064,581

## EXPLOSIVE MANUFACTURE

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Original application January 24, 1931, Serial No. 510,944. Divided and this application July 29, 1933, Serial No. 682,766

9 Claims. (Cl. 52—22)

This invention relates to the manufacture of explosive compositions, and more particularly to an apparatus and process for use in mixing dynamite ingredients of both the non-gelatinous and the gelatinous types.

This application is a division of my copending application Serial No. 510,944, filed January 24, 1931.

Dynamite compositions in general comprise usually mixtures of a liquid explosive ingredient, for example, nitroglycerin, with solid ingredients which may be explosive or non-explosive. In order that the dynamite may have a maximum explosive effect, it is essential that a very intimate mixture be made of the nitroglycerin with solid materials. Various kinds of apparatus and various processes have been suggested for this purpose heretofore, all of which have had certain disadvantages.

In general, dynamite compositions may be divided into two types, namely, non-gelatinous explosives and gelatinous explosives. The non-gelatinous dynamites are those in which there has been a simple mixture of the nitroglycerin with the solid ingredients, such that the explosive oil is completely absorbed and thoroughly mixed throughout the composition. In the gelatinous type of explosive, on the other hand, the nitroglycerin has been gelatinized to a greater or less degree, previous to its mixture with the solid ingredients of the dynamite, by the solution in the nitroglycerin of a small percentage of a gelatinizing agent such as nitrocotton. These gelatinous explosives are usually designated gelatin dynamites and, in some cases, gelignites. In the manufacture of the foregoing dynamite explosives, it has been the practice to use different forms of mixing apparatus, depending on whether the explosive to be mixed is of the gelatinous or non-gelatinous type.

In the mixing of the ingredients of non-gelatinous high explosives, the usual form of apparatus has consisted of a large receptacle in the form of a bowl, commonly constructed of wood into which the solid ingredients and the nitroglycerin are introduced. The intimate mixture of all the above ingredients is brought about by the passage of revolving runners or wheels through and/or over the materials in the bowl. Plow-like devices are provided to assist in this mixing action. The above form of apparatus has been preferred in the case of sensitive explosive mixtures, because of the fact that there is a minimum of moving parts, with little danger from friction.

It has been the practice, however, in the manufacture of gelatinous explosives, to mix the ingredients in a type of apparatus known as the "figure 8" bowl. This bowl, in cros-section, consists of two eccentric circles which come together in such a manner as to give an approximate figure-8 cross-section; a jacket is provided through which a fluid may be passed in order to control the temperature of the explosive. Two bronze agitators, on verticle shafts, work together in such a way that a kneading of the mass accompanies the mixing action. The advantages of this apparatus are the kneading action supplied and the provision afforded for temperature control.

Both gelatinous and non-gelatinous types of explosives have been mixed in still another type of mixer. This is of the horizontal type, the bottom section of which consists of a double trough. A jacket for temperature control is commonly provided. Two agitators, to which are attached paddles or metallic ribbons, provide the mixing by revolving horizontally in position above these double troughs. One example of this type of mixer is that covered by U. S. Patent 946,475, dated January 11, 1910, to Herbert Talley. The advantages of this type of mixer are the provision for temperature control, large capacity, and particularly the flexibility gained by its use for both types of explosives.

All three of the above described types of mixers have certain inherent disadvantages. The wooden mixing bowl is not satisfactory for gelatinous types of dynamite since it has no provision for temperature control. The figure-8 bowl has a plurality of moving metallic parts within the bowl, and for this and other reasons is considered hazardous. The horizontal type mixer is provided with a type of agitation not entirely suitable and satisfactory for the mixing or gelatinous dynamites in that the desired kneading action is almost entirely absent; in this case there is also a plurality of moving metallic parts within the bowl, and furthermore leakage of nitroglycerin frequently occurs at the openings through which the agitator shafts extend.

An object of my invention is to overcome the disadvantages of the prior art and to provide an apparatus and process that is not only satisfactory for all types of explosives compositions but at the same time produces better yields and improved uniformity of the product. A further object of my invention is to provide an apparatus for this purpose having a minimum of

metallic moving parts within the apparatus. Other objects will be apparent as the description proceeds.

These objects are accomplished by the following invention in which I have devised an apparatus and process which is capable of mixing all types of high explosive ingredients or compositions, and which combines the advantages of the different processes and forms of apparatus previously used for similar purposes. My invention has the further advantage that it yields an improved product and one having greater uniformity in composition. The process and apparatus which I have devised provides for the incorporation of the ingredients into an intimately mixed explosive composition which is effected among other things by the passage of revolving wheels through and/or over the material. In place of the wooden bowl heretofore used for this purpose, I have included in this combination among other things a metallic bowl, preferably constructed of bronze or equivalent non-sparking alloy.

By making this metal bowl with hollow walls, I am able to control the temperature of the ingredients during the mixing operation by means of water or other fluid medium of the desired temperature flowing through the walls. Plow-like devices are also provided, which are carried with and in front of the wheels. These plow-like devices are spaced at a predetermined distance from the walls of the bowl, and as they move around within the bowl, push the material to be mixed away from the walls toward the center, into the path of the mixing wheels. The distance at which the plows may be spaced from the walls depends upon the character of the explosive ingredients to be mixed, and particularly whether they are of the gelatinous or non-gelatinous type. For mixing the non-gelatinous explosives, for example, the plows may be satisfactorily spaced very close to the walls of the bowl. For mixing the gelatinous explosives, on the other hand, the density and plasticity of the material is such that the plows must be spaced at a greater distance from the walls of the bowl. The plows are made adjustable in order to adapt them for the purpose desired.

In the preferred form of mixing apparatus for my purpose, the wheels are constructed so that they may be raised or lowered into the mixing bowl as desired. It is the practice in mixing the ingredients of non-gelatinous explosives to set the wheels rather high in the bowl. No difficulty is met in mixing the nitroglycerin with the solid ingredients, because of the fact that the nitrogylcerin is added last to the mixture. In the case of gelatinous explosives, on the other hand, it is very desirable to add the nitrogylcerin first to the bowl and to bring about a preliminary gelatinization of the nitroglycerin with nitrocotton. This gelatinization step is usually carried out at an elevated temperature. According to one embodiment of my invention, however, means are provided for carrying out this preliminary gelatinization and for thorough mixing of the oil and the nitrocotton at the same time. This may be accomplished by employing an agitating device in combination with the revolving wheels, but separated in such a way that it may be raised and lowered as desired. Such an agitating device may vary in construction but I preferably employ a raking means for this purpose.

During the preliminary gelatinization of the nitrogylcerin, this agitator is adjusted into the lowered position so as to move through the ingredients to be mixed. Before adding the solid ingredients, however, I preferably raise the agitator or raking means so that it no longer passes through the materials to be mixed during the revolution of the wheels.

The invention is illustrated by way of example in the accompanying drawings in which Figure 1 is a plan view showing the relationship of the wheels and plows.

Figure 2 is a view in section and elevation of the mixing bowl.

Figure 3 is a view in elevation of one of the plows or scrapers.

Figure 4 is a view in elevation of the raking means.

Referring more particularly to the drawings, A in Figure 2 represents the vertical shaft on which the agitating means are suspended, C represents the mixing bowl for containing the ingredients to be mixed, G the central housing for the drive shaft A, which is supported by the casting H forming a part of the mixing bowl. A water-jacket is provided for the mixing bowl C by the space R between the bowl and the casting and supporting means H. A heating fluid may be introduced into the chamber R by means of the inlet N, and the fluid may be drawn off by an convenient means but preferably through the overflow L and outlet pipe P. A drain outlet M is also provided for removing all of the heating fluid in the chamber, and for removing sediment forming or accumulating in the chamber R. The jacket may be heat-insulated as shown at J. In Figure 1 the plow D is shown in operating position and attached to the shaft A so as to pass around the outer edge of the bowl as the shaft revolves, while the plow E is in a corresponding position with the inner wall of the bowl. It is preferable to have these plows move with the wheels and in front of them, and for this reason the wheels and plows are attached to the central driving shaft A. These plows may be adjusted in position as shown in Figure 3.

Figure 4 illustrates in elevation the agitator or raking means for mixing the nitroglycerin and the nitrocotton during the preliminary gelatinization. Two of these agitators may be used advantageously in the mixing bowl as shown at F in Figure 1, each supported by the central shaft A as shown in Figure 2. These agitators are adapted to be adjusted on their supporting arms and can be raised or lowered as desired. When in a lowered position, the agitator is close to the bottom of the bowl as shown in Figure 4. In raised position, on the other hand, the agitator is above the level of the mixture in the bowl. After the preliminary gelatinization has taken place, further agitation of the gelatinous explosive is best supplied by means of the wheels B.

While Figure 2 of the accompanying drawings shows the shaft A adapted to be driven by means below the apparatus, it is to be understood that the shaft A may equally well be driven by overhead driving means by merely extending the shaft A upward instead of downward.

While various non-sparkling alloys may be used in the construction of the mixing bowl C, I have found that one composed of substantially 94.8 to 96 parts of copper, 3 to 4 parts of silicon, and 1 to 1.2 parts of manganese is very suitable for this purpose.

The plows and agitating means are made of

non-metallic material and preferably of hard rubber, or the like, or of a resinous material. While the bowl itself is constructed of non-sparking alloy, the incorporating wheels are preferably made of non-metallic material. Wooden wheels covered with hard rubber are very suitable for this purpose.

By the term "dope composition" as used herein I mean to include compositions comprising inorganic oxidizing materials, such, for example, as potassium or sodium nitrate, or the like, or mixtures thereof, together with carbonaceous combustible materials such as the various forms of wood pulp or wood meal, ivory nut meal, bagasse pith, starch, cornstalks, corn meal, cotton seed hulls, or any of the various forms of these materials.

By the term "wheeling" as used herein I mean to include the step of revolving wheels or runners progressivley through the materials in the mixing bowl for manufacturing incorporated explosive powders. In performing this operation, the wheels ride upon the material as it becomes viscous and their weight carries the material in their path downward and outward so as to produce a thorough kneading and mixing of the ingredients.

A particular advantage of the process and apparatus of the present invention is that it is applicable to mixing compositions of all types of high explosives of the dynamite type, both gelatinous and non-gelatinous. It has the further advantage over previously known types of mixers in that it gives a product which is superior in properties to that obtained in prior art apparatus for manufacturing gelatin dynamites. The form of incorporation according to my invention gives a thoroughly mixed gelatin, and yet one whose plasticity and pliability has not been rendered inferior by too severe and constant a disintegration as has been the case with other apparatus for this purpose. Furthermore, the kneading action of the wheels results in a safer process for the manufacture of sensitive high explosives as compared with the rapid revolving of metal agitator blades of other forms of apparatus heretofore suggested for this purpose.

In operation the wheels are preferably moved slowly during the early stages of the process of mixing and the speed of the wheels is then increased with the increasing viscosity of the material.

As many apparently widely different embodiments of this invention may be made without departing from the spirit thereof, it is to be understood that I do not limit myself to the foregoing examples or descriptions except as indicated in the following patent claims.

I claim:

1. A process of manufacturing gelatin dynamite composition which comprises introducing nitroglycerin and gelatinizing material into a mixing container, agitating and mixing the material, heating the mixture during said agitation, "wheeling" the mixture, and controlling the temperature of the mixture during said "wheeling".

2. A two-step process of manufacturing gelatin dynamite composition which comprises, first, introducing nitroglycerin and gelatinizing material into a mixing container, agitating and mixing the material, heating the mixture during said agitation, and secondly, adding solid constituents to the mixture, "wheeling" the material, and controlling the temperature of the material during said "wheeling".

3. A two-step process of manufacturing gelatin dynamite composition which comprises, first, introducing nitroglycerin and gelatinizing material into a mixing container, agitating and mixing the material, heating the mixture during said agitation, and secondly, adding a solid to the mixture, "wheeling" the material slowly, then increasing the speed of the "wheeling" and controlling the temperature of the mixture during said "wheeling".

4. In a process of manufacturing gelatin dynamite compositions in which liquid explosive ingredients are incorporated with solid ingredients, the improvement characterized by progressively revolving non-metallic wheels through the ingredients, heating the ingredients to gelatinize the product, stirring and agitating the ingredients, while so heated, by moving the ingredients into the path of the wheels in the absence of sparking materials of construction.

5. The process of claim 4 in which the wheels are revolved in a circuitous route.

6. The process of claim 4 in which the agitating and stirring is conducted in the absence of iron and iron alloys that produce sparks that would ignite the dynamite.

7. The process of claim 4 in which the agitating and stirring is conducted in a copper-alloy lined heating chamber in the absence of iron and iron alloys that would produce sparks that would ignite the dynamite.

8. The process of claim 4 in which the wheels are of wood construction.

9. The process of claim 4 in which the tread of the wheels is of rubber-like material.

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