APPARATUS FOR MIXING AND BLENDING DIVERSE COMMUNICATED MATERIALS

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11 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus is provided for mixing and blending within a container diverse communicated materials to provide a uniform blend. The apparatus includes means for supporting the container in such a way as to move the container in an orbital path while maintaining a line of reference of said container in the plane of rotation of the container parallel to a line in a fixed reference frame.

This application is a continuation-in-part of my application Ser. No. 592,012 filed Nov. 4, 1966, now abandoned, which was a division of application Ser. No. 324,404, filed Nov. 18, 1963, now United States Patent 3,311,275.

This invention relates to apparatus for mixing and blending diverse communicated materials and more particularly to apparatus for mixing and blending explosive communicated materials to provide a uniform mixture thereof.

In the manufacture of explosives, the explosive composition generally is produced by mixing and blending various communicated or granular component materials. Often, such communicated materials are not harmful in their free or uncombined state, but become explosive when mixed and blended. In the prior art it has been the practice normally to mix and blend such component materials by depositing them in predetermined amounts in tumbling container and tumbling the materials to provide the desired mixing and blending. The mixed and blended materials then are transferred to charge cases which are capped and crimped to complete the explosive product. Such a method of mixing explosives, however, has been found to be extremely hazardous, in that the explosive materials are likely to ignite or explode at any stage of production. It has been found that the probability of explosion or combustion particularly is high during the tumbling operation, during the transfer of the blended material from the tumbling container to the charge case and when the cap is inserted into the charge case and the open edges of the case are crimped to firmly secure the cap.

Accordingly, it is the principal object of this invention to provide an improved apparatus for making explosive products.

An object of this invention is to provide an improved apparatus for mixing and blending explosive communicated materials in making explosive products.

A further object of this invention is to provide an improved apparatus for mixing and blending explosive communicated materials to provide a uniform blending of such materials.

A still further object of this invention is to provide an improved apparatus for making an explosive product from highly flammable or explosive materials which reduces the probability of an explosion during the production of the explosive product.

A still further object of this invention is to provide an improved apparatus for making a photoflash product.

Another object of this invention is to provide a photoflash product having increased illumination in comparison to conventional comparable products.

Other objects and advantages of the present invention will become more apparent to those persons skilled in the art in the following description when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a front view of the apparatus used in practicing the method of the present invention, having portions thereof broken away;

FIG. 2 is a top plan view of the apparatus illustrated in FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3—3 in FIG. 1;

FIG. 4 is a vertical cross-section of a charge case containing the component materials prior to the mixing and blending operation; and

FIG. 5 is a cross-sectional view taken along line 5—5 in FIG. 3.

In accordance with United States patent 3,311,275 a method of making an explosive from highly flammable or explosive materials, generally comprises depositing the component materials in a charge case, sealing the case to prevent leakage of the contents, and subjecting the case containing such materials to forces applied in diverse directions. It is preferred that the component materials be deposited within the charge case in layers or strata in ascending specific gravities and the charge case containing such materials be subjected to forces applied longitudinally and transversely, which will cause the materials having a higher specific gravity to migrate and become interspersed among those materials of lower specific gravities. It is contemplated that the forces applied to the charge case to cause such flow or migration of the communicated materials be provided by any suitable means, including vibrating and orbiting the charge case containing the materials.

Specifically, in practicing the method of the invention to produce a photoflash product, the component materials including 40% by weight aluminum powder, 30% by weight potassium perchlorate, and 30% by weight barium nitrate are deposited in a cylindrical aluminum charge case 10 in strata, as illustrated in FIG. 4 of the drawings. The component materials are introduced into the charge case in the order of ascending specific gravities with the aluminum powder having the lowest specific gravity deposited on the bottom, the potassium perchlorate deposited as the next layer, and the barium nitrate deposited on the potassium perchlorate. As illustrated in FIG. 4, two sets of strata as described, may be provided in a single charge case. Threadedh mounted in the bottom wall 11 is a brass detonating fuse 12, having a portion 13 containing a suitable explosive composition, preferably 95.5% by weight barium chlorate and 4.5% by weight boron, which extends into the bottom layer of aluminum. The charge case is sealed by placing an aluminum cap 13 on the top layer of material and crimping the upper end 14 of the charge case to firmly
secure the aluminium cap 13. The charge case, as illustrated in FIG. 4, then is mounted in a blending apparatus as illustrated in FIGS. 1 through 3, which is operable to rapidly rotate the charge case in a smooth orbital path, thereby applying longitudinal and transverse forces to the particles within the casing. The forces applied by the rapid orbital movement of the charge case cause the barium nitrate particles having the highest specific gravity and to a lesser extent the potassium perchlorate particles having a specific gravity greater than the aluminium particles, to migrate downwardly, causing them to become interspersed within the case, thereby providing a uniform mixing and blending of the materials within the casing. The radius of the orbital path, the speed of the orbital motion and the orbiting time are adjusted to provide the desired uniform mixing and blending.

Referring to FIGS. 1 through 3 and 5, there is shown an apparatus for mixing and blending the materials contained in a charge case, as described. The apparatus specifically comprises a reference frame 15, including a vertically disposed mounting plate 16 on which there is mounted a gate of units 17 and 18 which are identical in construction and which are adapted to operate in synchronization. Although the construction and operation of the unit 17 will be described hereinafter, it is to be understood that the unit 18 has an identical construction and operation.

The mounting plate 16 is provided with a horizontal opening 19, having an enlarged bore 20 and a rearwardly disposed bore 21. Mounted on the mounting plate 16 within the bore 21 is a cylindrical bearing housing 22, having an enlarged bore 23 disposed at the rearward end thereof. The bearing housing is supported at its forward end by means of a plurality of bolts 24. Mounted in the bore 20 in the mounting plate and in the bore 23 of the bearing housing, respectively, are bearing members 25 and 26 spaced apart by means of a cylindrical bearing spacer 27. Bearings 25 and 26 rotatably support a rotatable member, a shaft 28, having a reduced rear end portion 29 and a collar 30 disposed at the forward end thereof which is disposed in the opening 19 of the vertical mounting plate. The bearing member 26 is locked in position by means of a lock nut 31 threadedly engaged on the rearward end of the enlarged portion of the shaft 28, and an inner member 32 having a hub portion 33 engaging the bearing member 26. The retainer member 32 is rigidly secured to the bearing housing by means of a plurality of bolts 34. Mounted on the reduced portion 29 of the shaft 28 is a sprocket member 35 which is operatively connected to the sprocket member 35 of the unit 18 by means of a timing chain 36 to provide synchronous drive between the drive shafts of the two units. Also mounted on the reduced portion 29 of the shaft 28 is a pulley 37 which is driven by a suitable motor 38, having a pulley 39 by means of a drive belt 40. As illustrated in the drawings, the motor 38 is adapted to drive the shafts of both of the units 17 and 18 by means of the drive belt 40.

The forward end of the shaft 28 is provided with a stub shaft 41 having a parallel axis offset radially relative to the axis of shaft 28. The stub shaft 41 is provided with a bearing member 42. Support means in the form of a circular mounting plate 43 having an annular flange portion 44 is rotatably mounted in the bearing member 42. The flange portion has an externally threadend portion for threadedly mounting a bearing lock nut 45 thereon. The forward end of the bearing 42 is engaged by a bearing retainer washer 46, which is secured to the reduced portion of the stub shaft by a suitable bolt.

Rigidly mounted on the front face of the mounting plate 43 is a clamping block 47, having a pair of parallel grooves 48 and 49 in the front face 50 thereof, each having a semicircular cross-sectional configuration. The clamping block 47 cooperates with a clamping block 51, having similar grooves 52 and 53 in an opposed surface 54 which engages the front face 50 of the clamping block 47 so that corresponding grooves register to form clamping surfaces for a pair of cylindrical charge cases. The block 47 is provided with a clamping bolt 55 disposed axially relative to the axis of stub shaft 41, which extends through a suitable opening in clamping block 51. The threaded end of the bolt 55 is provided with a nut 56 for rigidly clamping blocks 47 and 51 together.

The axes of the circular openings in the clamping blocks provided by the registered grooves in the abutting faces thereof are maintained in a vertical orientation by means of linkage means in the form of a tie bar 57 which interconnects mounting plates 43 and 43' of the units 17 and 18 and prevents the rotation of the mounting plates. It will be appreciated that as the mounting plates carrying the clamping blocks are rotated by means of their respective shafts, the charge cases 10 clamped therein will be maintained in a vertical orientation so that axial and radial forces will be applied to the particles within the cases.

A view of the fact that the detonating fuses are sensitive to abrupt jolts and jars, which would tend to detonate the same, it is important to eliminate any excessive vibrations within the apparatus. This essentially is accomplished by journaling the shafts of the units in bearings as described and providing the timing chain 36, which synchronizes the drive of the shafts. The timing chain 36 operates to provide a smooth orbiting motion of the cylindrical charge cases, eliminating the effects of undesirable vibrations in the frame of the apparatus. Although only two cases are shown mounted in each set of clamping blocks of each unit, it will be appreciated that modifications of the clamping block are possible to accommodate additional charge cases.

Although the speed of the shafts will depend to a large extent on the size of the units and particularly the radius of the orbital path, it has been found that suitable mixing and blending results can be obtained by orbiting the charge cases at frequencies up to and including ultrasonic frequencies, 2400 revolutions per minute being a preferred speed for the apparatus shown in FIGS. 1-3 and 5. It has also been found that the proposed novel method of mixing and blending such explosive materials can be provided by otherwise applying forces for interspersing the particles, including the drive and vibratory elements therefor. The mixing and blending particularly can be suitably accomplished by agitating or vibrating the cases in a direction having a component transverse to the layers of material to be mixed at frequencies up to and including ultrasonic frequencies.

It will be apparent to those skilled in the art that while the device shown in particularly convenient and has many advantages, it may be modified in many respects other than changes in speed. For example, only a single support means need be employed and many more than two may be employed as desired. Furthermore, the nature of the linkage employed to maintain the attitude of the supported containers will vary particularly with the number and type of support means employed. The function of the linkage in all cases is the same, i.e., maintaining the container in a predetermined attitude relative to said reference frame in the plane of rotation of said container. Viewed another way, this function is to maintain a line of reference of said container in the plane of said container parallel to the line in a fixed reference plane.

It will be evident that there are a number of other changes, adaptions and modifications of the present invention which come within the province of those skilled in the art.

What I claim is:

1. An apparatus for mixing and blending in a container diverse comminuted materials to provide a uniform blend, comprising:
   a reference frame,
support means for said container rotatable relative to the frame so as to describe a repetitive orbital path, and
linkage means connected to the support means and movable in a fixed repetitive pattern to maintain said container in a predetermined attitude relative to said reference frame in the plane of rotation of said container.

An apparatus for mixing and blending in a container diverse comminuted materials to provide for a uniform blend comprising:

- a reference frame,
- a rotatable member rotatably supported by said reference frame,
- support means for said container rotatably supported on said rotatable member to be rotatable about an axis parallel to, but offset from, the axis of rotation of the rotatable member relative to said reference frame, and
- linkage means connected to the support means and movable in a fixed repetitive pattern to maintain said container in a predetermined attitude relative to said reference frame in the plane of rotation of said container.

An apparatus for mixing and blending diverse comminuted materials in at least one container to provide a uniform blending thereof comprising:

- a reference frame,
- a rotatable member rotatably supported by said reference frame,
- support means for holding said at least one container, rotatably mounted on a portion of said rotatable member, having a parallel axis of rotation offset from the axis of said first rotatable member in a predetermined attitude relative to said reference frame in the plane of rotation of said container parallel to a line in a fixed reference plane, and
- means for driving said rotatable member.

An apparatus for mixing and blending diverse comminuted materials to provide a uniform blending thereof according to claim 3, wherein said rotatable member comprises a first shaft rotatable relative to said reference frame, and said mounting means comprise a second shaft disposed on one end of said first shaft having a parallel axis offset from the axis of said first shaft.

An apparatus for mixing and blending explosive comminuted materials deposited in a container to provide a uniform blending of such materials within the container comprises:

- a first bearing housing secured to said frame, said bearing housing being rotatable about an axis parallel to, but offset from, the axis of rotation of said first rotatable member relative to said reference frame, and
- linkage means including a rigid link pivotally connected at one end to said reference frame and at the other end to means associated with the second rotatable member and movable in a fixed repetitive pattern to maintain said at least one container in a predetermined attitude relative to said reference frame in the plane of rotation of said container.

An apparatus for mixing and blending diverse comminuted materials to provide a uniform blend according to claim 6 wherein separate support means for another container is rotatably supported on said second rotatable member to be rotatable about an axis parallel to but offset from, the axis of rotation of said second rotatable member relative to said reference frame and the rigid link is pivotally interconnected at its opposite ends to corresponding parts of said respective support means.

An apparatus for mixing and blending diverse comminuted materials in at least two containers to provide a uniform blending thereof comprising:

- a reference frame,
- first and second rotatable members having parallel axes rotatably supported in said reference frame, support means, each holding at least one of said containers, rotatably mounted on a portion of each of said first and second rotatable members having a parallel axis offset from the axis of its respective rotatable member,
- means operatively interconnecting said support means of said first and second rotatable means for maintaining the respective supported containers in predetermined orientations,
- means operatively interconnecting said first and second rotatable members for synchronizing the drive thereof and maintaining the attitude of said containers relative to one another and the support frame, and
- means for driving said first and second rotatable members.

An apparatus for mixing and blending diverse comminuted materials to provide a uniform blend thereof according to claim 3, wherein said rotatable member comprises main drive shafts rotatably supported said reference frame and said mounting portions of said main drive shafts comprise shafts disposed on one end of each of said main drive shafts each having a parallel axis offset relative to its respective main drive shaft.

An apparatus for mixing and blending diverse comminuted materials to provide a uniform blend thereof according to claim 8, wherein said synchronizing means comprises sprocket members mounted on said main drive shafts and an endless timing chain operatively engageable with said sprocket members.

An apparatus for mixing and blending explosive comminuted materials deposited in cylindrical containers to provide a uniform blending of such materials within the containers comprising:

- a reference frame,
- a pair of operative units mounted on said frame, each of said operative units comprising a first bearing mounted in said frame, a bearing housing secured to said frame, a second bearing mounted in said bearing housing, a first shaft rotatably supported in said first and second bearings, a second stub shaft having a parallel axis offset relative to the axis of said first shaft disposed on one end of said first shaft, a third bearing mounted on said stub shaft, a mounting plate rotatably mounted on said third bearing, a first clamping block mounted on said mounting plate, said first clamping block having at least one recess and a second clamping block adjustably mounted on said first clamping block having at least one recess cooperable with the recess in said first clamping block to provide a space for receiving said container.

An apparatus for mixing diverse comminuted materials in at least one container to provide for a uniform blend comprising:

- a reference frame,
- first and second rotatable member rotatably supported by said reference frame, support means for said at least one container rotatably supported on said first rotatable member to be rotatable about an axis parallel to, but offset from, the 75
clamping block to provide a circular recess for receiving a container containing said explosive comminuted materials, a sprocket member mounted on said first shaft, a tie rod interconnecting the mounting plates of said units for maintaining the axes of containers mounted in the clamping blocks thereof vertically orientated, an endless timing chain operatively engaging the sprocket member of said units for synchronizing the drive of the shafts thereof and drive means operatively engageable with the first shaft of each unit.

References Cited

UNITED STATES PATENTS

2,127,706 8/1938 Talbot ------------- 259—54
3,159,384 12/1964 Davis ------------- 259—72

ROBERT W. JENKINS, Primary Examiner
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,497,183 Dated February 24, 1970

Inventor(s) Dwight O. Corey

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 31, correct the spelling of "prevent"
Column 3, line 8, correct the spelling of "particles"
Claim 5, first line, "A" should be --An--;
line 5, "rame" should be --frame--.
Claim 6, line 1, after "mixing" insert --and blending--

SIGNED AND SEALED
SEP 8 - 1970

(SEAL)

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