

[54] **PROCESS FOR THE MANUFACTURE OF COMBUSTIBLE CASES FOR FUEL CHARGES OR EXPLOSIVE CHARGES**
[75] Inventor: **Curt Berger**, Sackingen, Germany
[73] Assignee: **Henry Wallengerg & Co., Aktienbolag**, Stockholm, Sweden
[22] Filed: **Apr. 2, 1970**
[21] Appl. No.: **24,943**
[52] U.S. Cl. **102/97, 102/43 R, 102/101, 102/DIG. 1**
[51] Int. Cl. **F42b 9/18, F42b 9/30, F42b 9/16**
[58] Field of Search **102/97, 24, 43, 100, 102/101, 103, DIG. 1**

[56] **References Cited**
UNITED STATES PATENTS
1,940,657 12/1933 Woodford 102/43 R
2,405,104 7/1946 Mydans 102/97
2,982,211 5/1961 Beal et al. 102/DIG. 1

Primary Examiner—Robert F. Stahl
Attorney—McGlew and Toren

[57] **ABSTRACT**
The manufacture of cases for fuel charges or explosive charges such as cartridges, shells, tubes for rockets and cases for mines of combustible materials such as nitrated cellulose comprises nitrating layers of reinforced nonwoven fabrics in a known manner, combining the nitrated layers one upon another, drying the laminate thus obtained, preparing sections in the form of developments of the shape of the cases from said laminate, partially dissolving or softening respectively and shaping the sections into said cases. The cases may be coated for storing with a protective layer of swellable natural or synthetic polymeric material which in turn may be provided with a hydrophobic insulating coating. Preferably the laminate is prepared in a way that the nitrogen content of the nitrated nonwoven fabric layers increases from the outer periphery to the interior of the cases.

8 Claims, 2 Drawing Figures

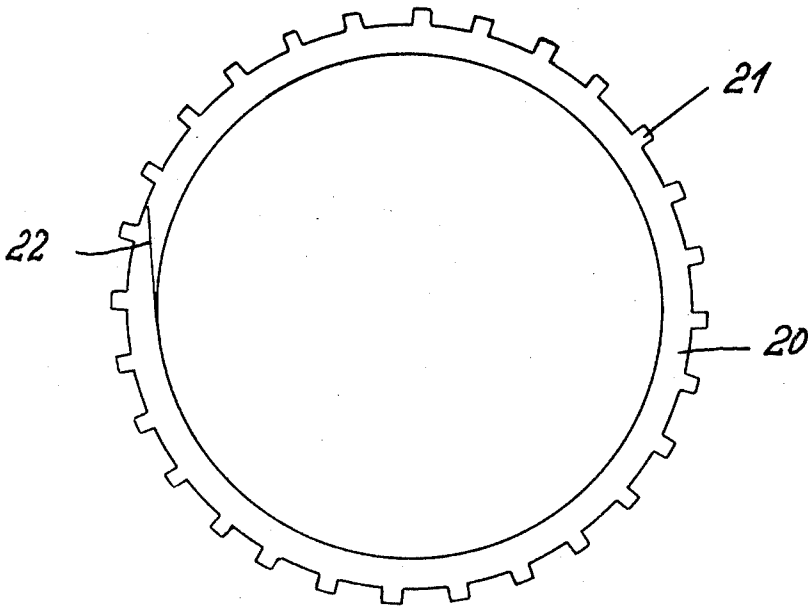
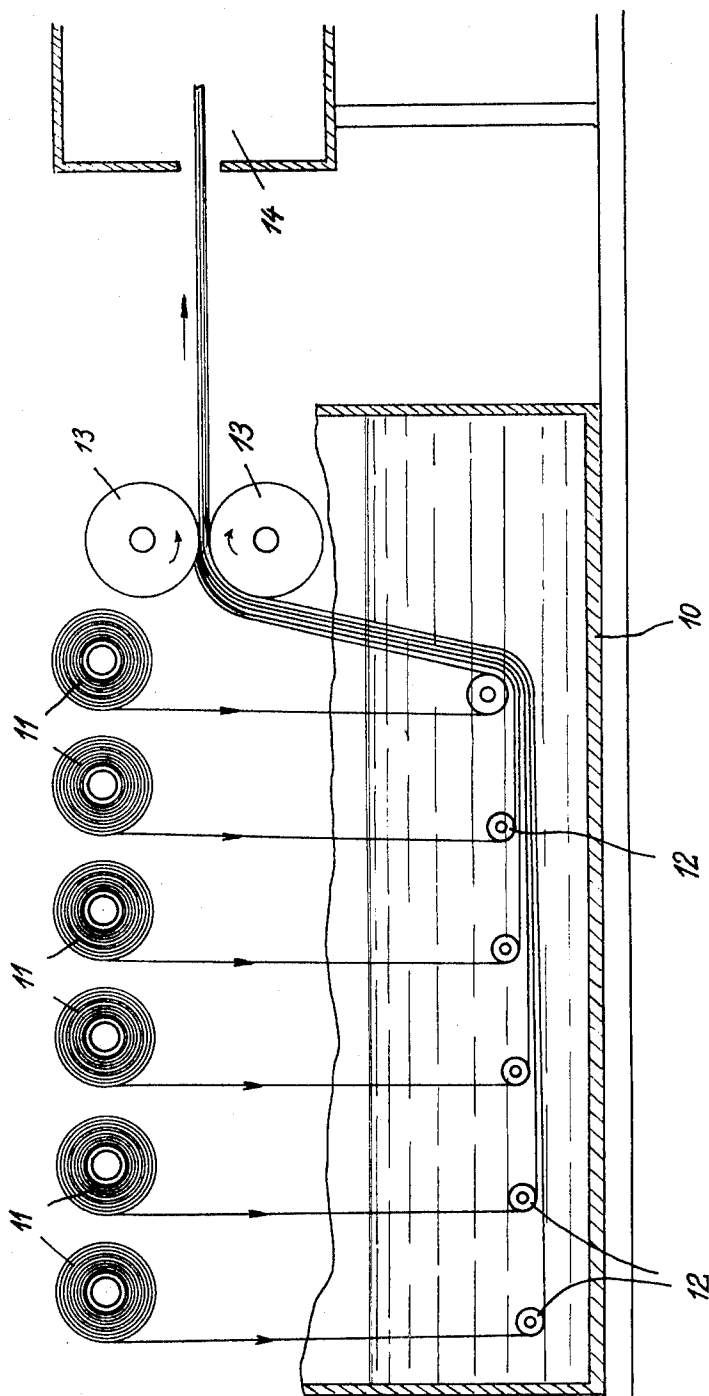


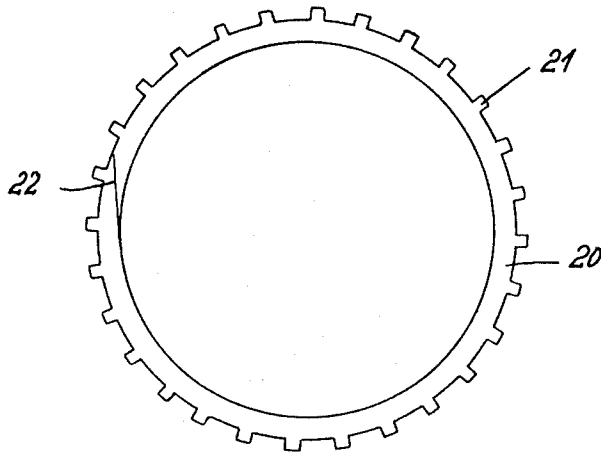
FIG. 1



INVENTOR.

BY CURT BERGER
Muegler and Toren
 ATTORNEYS

FIG. 2



INVENTOR.
CURT BERGER
BY *Marble and Toren*
ATTORNEYS

PROCESS FOR THE MANUFACTURE OF COMBUSTIBLE CASES FOR FUEL CHARGES OR EXPLOSIVE CHARGES

BACKGROUND OF THE INVENTION

Cases for explosive charges such as cartridges or shells for conventional firearms from metal are known into which the projectiles or bullets are rolled. Further cases for explosive charges are known which undergo more or less complete combustion while igniting the charge. Simultaneously it is desired to provide sufficient mechanical strength and resistance of the cases to steam and sea water as required. Unfortunately the quite different shapes and sizes of the cartridges or cases require undesirable large storage facilities.

Furthermore it must be required that such cartridges and cases for explosive charges have a minimized adverse effect to firearms in which they are used. This aim is easily reached by using cartridges from metal; whereas cases made from combustible materials must not interfere with the use of the firearm by combustion residues.

It is known to use nitrated cellulose as combustible material for cartridges and shells for ammunition which meet the desired requirements to a far extent. Besides powder mouldings from nitro-cellulose nitrated paper board have been used for manufacturing cartridges and shells. However, the use of pure nitrated cellulose for this purpose is bound to certain requirements which are frequently difficult to provide because of the dangers connected with handling the material. In view of this cartridges or shells for ammunition have been developed which contain only partly nitrated cellulose derivatives. Cellulosic materials which are firstly shaped into the desired form and subsequently are nitrated have the disadvantage that the nitration procedure is difficult to control, so that it is nearly impossible to attain the required sequence of combustion caused by the flames of the explosion. Additionally, a large stock of moulds for the manufacture of cases is required for adapting the cases, such as cartridges and shells, to the large number of different shapes and sizes required by the various kinds of use.

SUMMARY OF THE INVENTION

Object of the invention is to provide cases, shells and the like for fuel charges or explosive charges made from combustible materials such as nitrated cellulose. Such cases for explosive charges may be, inter alia, cartridges or shells for guns, tubes for rockets and cases for mines of different kind which may have various shapes and sizes, while cartridges have to meet special requirements because they are mainly designed to fit to special kinds of firearms in particular with respect to caliber, etc.

Further object of the invention is in particular a process for the manufacture of such cases, shells and the like consisting of completely combustible materials which process is simpler to operate and greatly enhances the provisions required for the economical, successful, and safe manufacture of such cases, shells and the like.

The process of the invention comprises nitrating individual layers of a nonwoven fabric in a known manner, combining said nitrated layers by stacking one upon another, drying the laminate thus obtained, preparing from said laminate sections having shape and size of the

development of said cases, shells and the like, partially dissolving or softening respectively said sections, and shaping said sections into said cases, shells and the like by rolling or by other known methods. The layers of nitrated nonwoven fabrics are drawn through a bath of dissolved nitrocellulose and adhesively combined one upon another in a number corresponding to the desired strength of the cases, shells and the like.

Preferably the layers of the nitrated non-woven fabrics differ with respect to their nitrogen content. Thus, for instance the inner layers may have a nitrogen content of about 11.9 percent whereas in the region of the outer periphery of the case said layers may have a nitrogen content of about 6 percent. This provides the advantage that the combustion of the outer layers proceeds slower and that the walls of the explosive chamber are not heated to an undesirable extent. In any case the complete combustion of the total material without forming residues will take place. In order to secure a proper arrangement of the outer and inner layers when forming the cartridge or shell or case these layers may be colored differently.

In order to make sure that the layers of the nonwoven fabrics are properly nitrated and combined it is advantageous to provide the layers with a reinforcement of filaments, i.e. to combine them with an extremely light woven cotton fabric prior to subjecting them to nitration. The layers of nonwoven fabric and of woven fabric may be needled together in this case. Both layers may be freed from any sizing material and/or fat separately or in form of the combination. The thus combined layers will be drawn through the nitrating bath in the manner indicated above. In general also cotton light tissues or knitted fabrics may be used instead of nonwoven fabrics so far as these materials meet the demands for high porosity materials. In addition the surface of the filaments of the fabrics may be roughened, if desired.

The laminated sheet material obtained in this manner is punched or formed by a suitable procedure to produce sections which correspond in shape and size to the required dimensions of the cases, shells or the like for ammunition or explosive charges. The proper manufacturing of the cases or shells is carried out by usual operations such as rolling or the like. Smooth overlapping seams are formed, e.g. by providing inclined tapered edges of the sections.

A further embodiment of the process of the invention in its application to the manufacture of cartridges comprises providing longitudinal grooves or reinforcing ribs respectively by rolling or pressing the laminate.

For storage purposes the finished ammunition shells or cases are provided with a protective coating of a film-forming swellable natural or synthetic polymeric material or its derivative. This coating is preferably coated again with a hydrophobic protective layer which is not sensitive against moisture in order to make the cases or shells according to invention vapourproof and resistant against sea water.

In the process of the invention the nitration of the layers of nonwoven fabrics is carried out in a known manner. Also for shaping of the sections known procedures and apparatus may be used.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 shows an apparatus for nitrating and combining the fabric layers;

FIG. 2 is an embodiment of a cartridge shell in a cross sectional view.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1 the process is carried out in the following manner: layers of nonwoven fabrics of natural or regenerated cellulose such as staple fibers of about 30 mm staple length are nitrated optionally after being enriched with oxygen. The concentration of the nitration bath and the duration of the treatment are controlled in a manner to provide a nitrogen content of the fibers of generally between 10.5 and 11.5 percent. Subsequently the fabric layers are stabilized, e.g. by washing and boiling respectively in order to inhibit or prevent spontaneous combustion.

The fabric material thus treated is drawn through a trough 10 of the apparatus as shown in FIG. 1. Above the trough 10 the nitrated fabric layers are arranged as in the form of rolls 11 in a manner that depending from the number of fabric layers which are to be combined these layers may be drawn from the rolls 11 by guide rolls 12 into the bath of dissolved nitrocellulose as adhesive material contained in the trough 10. The predetermined number of nitrated layers is subsequently drawn through the nip of squeeze rolls 13 into a drying device 14. In the drying device 14 the solvents of the adhesive material used are evaporated. As a result a breadth of nonwoven fabric consisting of adhering nitrated layers of a predetermined thickness is obtained. The laminated sheet material is cut to length if to be stored. If a larger number of fabric layers is combined in order to obtain ammunition shells of greater diameter the layers may be subjected to pressure. In this case, however, care must be taken to maintain the porous structure of the nitrated fabric laminate.

The laminated sheet material taken from the drying device 14 may be processed in a known manner such as by punching of sections to shape shells and cases for ammunition or rockets or the like.

An embodiment of a cartridge as shown in FIG. 2 comprises a laminate of nitrated layers 20 of nonwoven fabric which are combined one upon the other. Ribs 21 extend over the periphery of the shaped laminate. The shell in the form of a ring shaped cylinder is glued together at a sloping seam 22 thus forming a pressure resistant body. The over-lapping seam at 22 may be secured by a nitrocellulose adhesive which sets hard on drying.

The process of the invention permits the manufacture of cases or containers for fuel charges or explosive charges having any shape and thickness. From the laminated sheets of predetermined thickness, as taken from the drying device, developments of single cartridges, for instance, are manufactured such as by punching or cutting. The hard sheet like sections are advantageously softened in a container through which blends of softening agents and/or solvents adapted to soften the hard material are circulated. These agents or solvents allow softening of the material within a short period. Subsequently the softened sections are transferred into the final shape by procedures such as rolling, stamping, or pressing in order to produce shells or cartridges or the like. During manufacture of cartridges as shown in FIG. 2 ribs 21 are formed which may also

be provided, if desired, at the inner surface of the shell.

The softener used should increase the resistance of nitrocellulose at low temperatures and should not inhibit the inflammability of the case or shell. Preferred softeners are phthalic and phosphoric acid esters such as dibutyl phthalate, benzyl butyl phthalate, diethyl phthalate, tributyl phosphate and the like. As solvents medium or low boiling esters and ketones such as butyl acetate, amyl acetate, methylcyclohexanone, acetone and the like are preferred.

A typical solution of nitrocellulose as used as adhesive for combining the fabric layers may consist of 50 parts of low boiling solvents, such as acetone or an ester, 30 parts of collodion of low viscosity which is soluble in ester solvents, 10 parts of softener and 10 parts of medium boiling solvents, all parts referring to parts by weight.

The process of the invention is advantageous in that by nitrating nonwoven fabric material layers a complete combustion of the material is guaranteed. By controlling the staple length of the fibers used for the nonwoven fabric the mechanical strength of the final material may be controlled. By nitrating single nonwoven fabric layers it is possible to manufacture a porous material which increases the combustion rate of a shell made thereof without having a detrimental effect on its strength properties. The manufacture of the material in the form of a sheet like laminate permits storage at a minimum of space and a simplified manufacture of final cases, shells and the like from single laminate plates or combinations thereof depending from the forms and usages envisaged.

By providing reinforcing ribs or grooves at the outer periphery of the shells the proceeding combustion is enhanced because the flames of the exploding charge extend to parts of the outer side of the shell. Simultaneously the ribs which may also extend at the inner surface of the shell provide increased mechanical strength.

The nonwoven fabric material which may be processed in any number of layers may advantageously consist of a material which is combustible without forming residues because of its chemical or natural composition. Particularly preferred materials are such that have been consolidated to nonwoven cellulose fabrics without using additional adhesives.

What is claimed is:

1. A casing for explosive or propellant charges, comprising a confining wall composed of a nitrocellulose matrix in which are embedded a plurality of superimposed layers of nitrated combustible textile fiber fabric, the individual fabric layers being adhesively united by the nitrocellulose of said matrix, and said individual layers having a different nitrogen content, the nitrogen content of the layers decreasing towards the outer surface of said wall.
2. A casing as claimed in claim 1, wherein the nitrated fabric is non-woven.
3. A casing as claimed in claim 1, further comprising a protective coating on the outermost of said superimposed layers to protect and seal the confining wall.
4. A casing as claimed in claim 1, wherein said textile fibers have a length of about 30 mm.
5. A casing as claimed in claim 1, wherein said fabric has a rough surface on one or both sides to form a fibrous face.

5

6

6. A fabric as claimed in claim 1, wherein said fabric comprises at least two layers which are united by needling.

consists of cotton.

8. A casing as claimed in claim 1, wherein the fabric has a filament reinforcement.

* * * * *

7. A casing as claimed in claim 1, wherein the fabric

5

10

15

20

25

30

35

40

45

50

55

60

65