Aug. 23, 1949. F. DANIELS 2,479,727

ELIMINATION OF FISSURES WITH CARBON DIOXIDE

Filed July 23, 1947

Fig. 1.

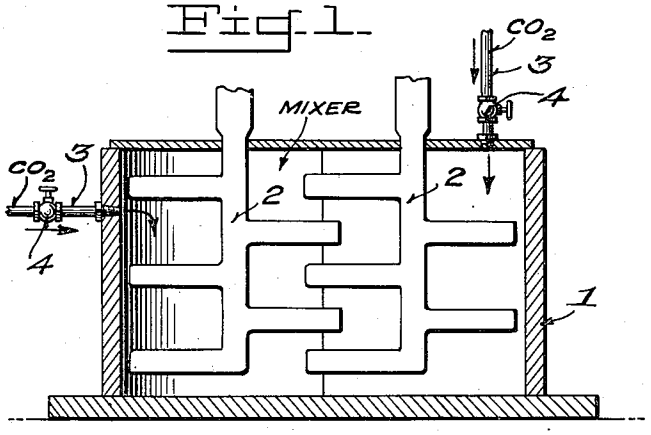


Fig. 4.

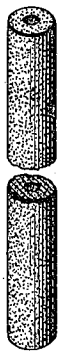


Fig. 2.

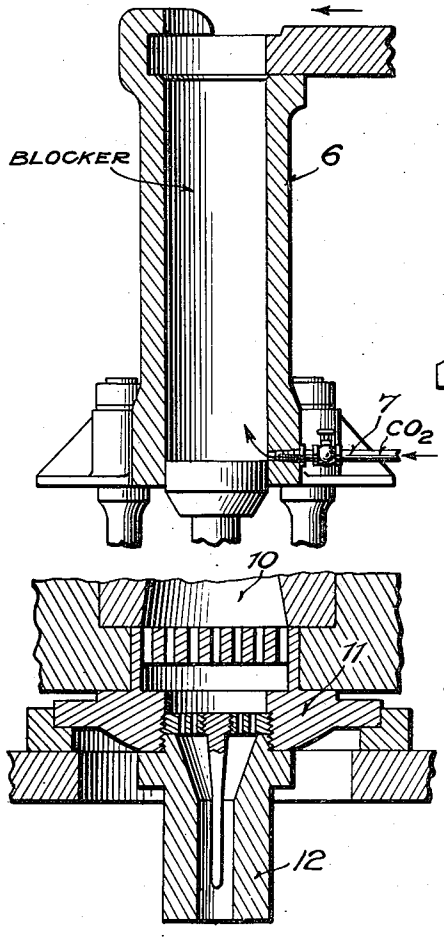


Fig. 3.

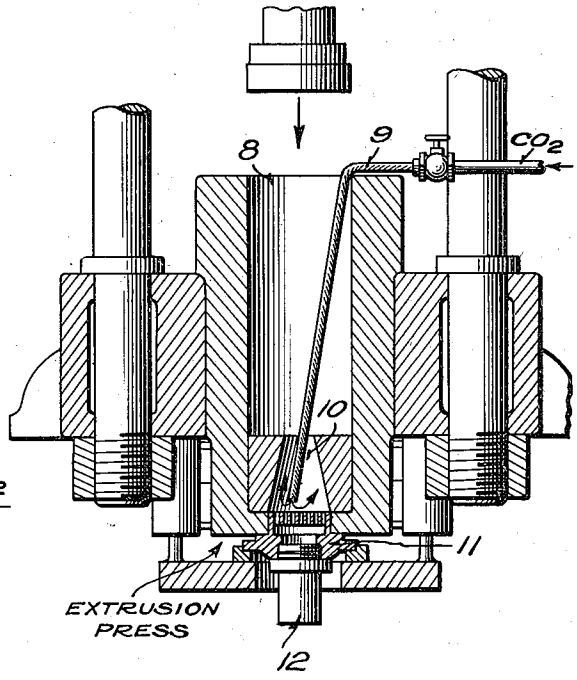


Fig. 5.

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ELIMINATION OF FISSURES WITH CARBON DIOXIDE

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4 Claims. (Cl. 18—48)

1

This invention relates to the production of extruded nitro-cellulose powder in stick form, and has for its primary object the elimination of holes or fissures from the final product.

When nitro-cellulose powder is extruded from a press, it often contains holes or fissures. These fissures are prevalent in solvent-extruded double base powder used for jet propulsion motors, but they may also be the factor in the preparation of other explosives as well as in the general manufacture of plastics. These fissures are a source of mechanical weakness and in the case of powder for jet propulsion they produce serious inequalities in the rate of burning; they also require elaborate inspection and rejection of a considerable fraction of the material.

These fissures are due chiefly to the presence of air bubbles that are trapped in the pressing. The insoluble gas leaves pockets or fissures when the gel sets. Carbon dioxide gas is from 20 to 50 times more soluble than air in this plastic material, and so will dissolve completely in the powder under the high pressure of the press leaving no gas bubbles.

In the performance of my invention CO_2 gas is swept into the bottom of the open press before introduction of the nitro-cellulose material and since it is heavier than air the CO_2 displaces the air which was originally present. The CO_2 dissolves in the nitro-cellulose gel under the high extrusion pressure, and slowly diffuses out of the extruded powder without the formation of bubbles.

In the drawings:

Figure 1 is a cross sectional elevation view of a powder mixer with means for introducing CO_2 gas,

Figure 2 is a cross sectional view of a blocking press for colloiding the powder subsequent to mixing, with means for introducing CO_2,

Figure 3 is a cross sectional view of an extrusion press for producing the powder in final form, with means for introducing CO_2,

Figure 4 is a perspective view showing a length of tubular powder after it has emerged from the press,

Figure 5 is an enlarged cross sectional view of a single die used in the press shown in Figure 3.

Figure 1 shows a mixer 1 having oppositely rotating paddles 2—2 for mixing the ingredients of the powder in order to secure a homogeneous distribution of the ingredients thereof. There are various types of mixers employed for this purpose, and the drawing is intended only to be illustrative of the general operation of mixing.

2

However, all of these mixers have the characteristic of entrapping some of the air originally in the container into the mixed material where it tends to produce air bubbles and fissures. In order to overcome this difficulty I provide means 3—3 for piping CO_2 gas under control of valves 4—4 into the mixer. CO_2 being heavier than air displaces the air from the mixer. This operation is performed prior to introduction of the powder ingredients into the mixer. When the mixing operation is completed it will be apparent that the only gas entrapped in the mixed powder is CO_2 gas.

The mixed powder is now ready to be put into the blocking press 6 where it is formed into a dense colloidal mass by subjecting it to a compression in the order of 3500 pounds per square inch. If there is air in the blocking press, it will be forced into the powder to form bubbles. To avoid this CO_2 gas is introduced, as shown at 7, prior to the blocking operation so that any gas entrapped at this stage of the manufacture will be CO_2 and not air.

The final operation from the standpoint of granulation of the powder, is extrusion through the graining press. An apparatus for performing this operation is schematically shown in Figure 3. Immediately prior to introduction of the block of powder into the chamber 8 of the extrusion press, CO_2 is introduced by means of a flexible hose 9 into the bottom of the press, as shown. It will be understood that after the initial extrusion from the press the expanding chamber portion 10 wil be full of powder from the preceding batch, and therefore the gas will not leak out of the bottom. After the tube 9 is withdrawn powder which has been colloided in the blocking press is inserted into chamber 8 and forced down by means of piston 12 so that it is extruded through die assembly 11, 12. An enlarged view of the die is shown in Figure 5 in order to make evident the structure whereby the powder emerges from the graining press in the form of a rope with one or more perforations, if desired. A tube with one perforation, as commonly employed in rocket propulsion powder is shown in Figure 4. This is subsequently chopped up into suitable lengths.

Experience has shown that the effect of introducing CO_2 in the steps represented by Figures 1 and 2 is sufficient to produce almost as great an increase in the percentage of acceptable powder due to elimination of bubbles and fissures as when used in all three equipments; however, I prefer to use CO_2 in all three types of equipment to

obtain not only the best possible powder but also because of the definite increase in safety since the presence of CO_2 rather than air in the vicinity of the powder reduces the danger of fires and explosion.

It will be understood that the showing of the drawings is schematic and that the powder can be introduced in any desired manner and still be within the scope of my invention, for example a small quantity of dry ice may be placed in each receptacle before introducing the powder, instead of using CO_2 under pressure with substantially the same results.

I claim:

1. The method of manufacturing nitro-cellulose powder composition substantially free of air bubbles or fissures due to occluded gas which comprises working the composition in an atmosphere of CO_2.

2. The method of manufacturing nitro-cellulose powder substantially free of air bubbles or fissures due to occluded gas which comprises mixing, blocking and graining the powder in an atmosphere of CO_2 gas.

3. The method of manufacturing nitro-cellulose powder substantially free of air bubbles or fissures due to occluded gas which comprises mixing and blocking the powder in an atmosphere of CO_2 gas.

4. A method of manufacturing nitro-cellulose powder composition wherein the powder ingredients are first mixed in a mixing machine, then compressed in a blocking press, then extruded through a graining press, which comprises displacing the air in each of the 3 powder processing devices by CO_2 gas immediately prior to processing the powder in each machine so treated, and processing the powder composition in said CO_2 atmosphere so that entrapped gas will be absorbed without the formation of bubbles.

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