April 29, 1930. A. E. ANDELIN 1,756,328

METHOD AND APPARATUS FOR FORMING PLASTIC EXPLOSIVES INTO STRINGS

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Fig. 1.

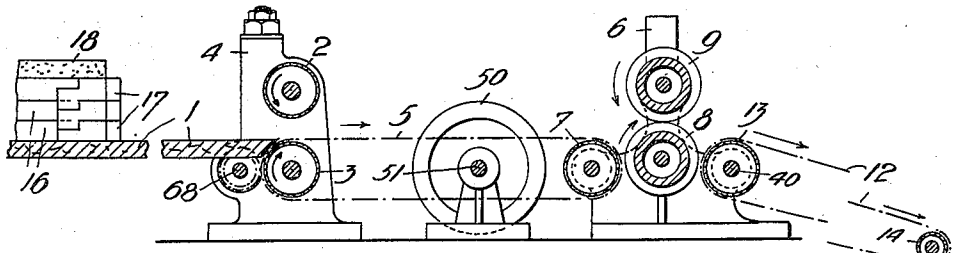


Fig. 2.

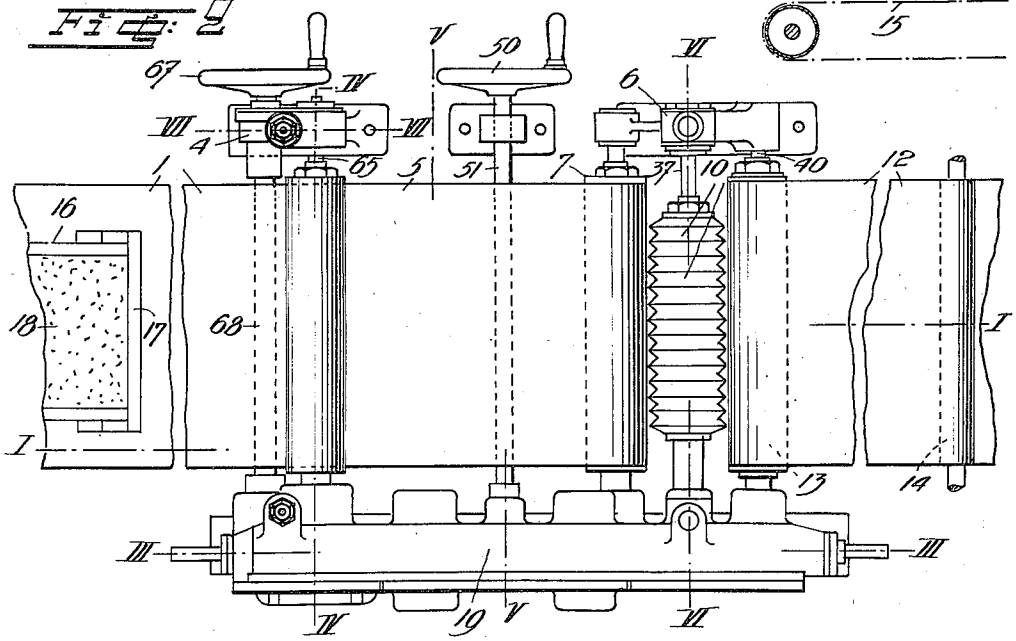
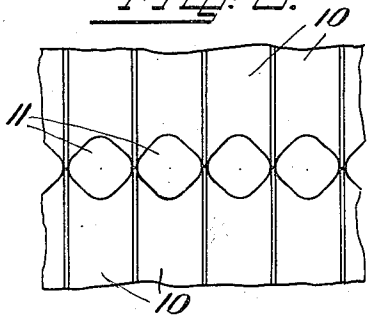


Fig. 3.



Inventor
Anton Erik Andelin
By
Pennie Davis Marvin & Edmonds

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Fig. 3.

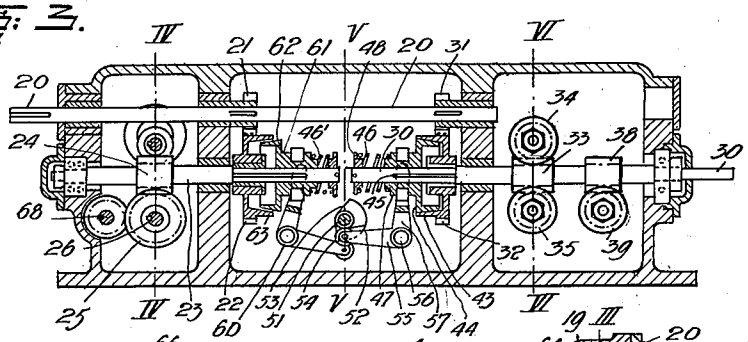


Fig. 4.

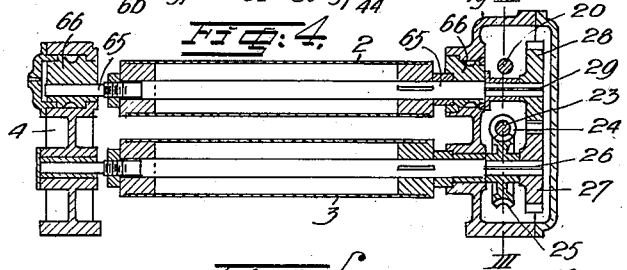


Fig. 6.

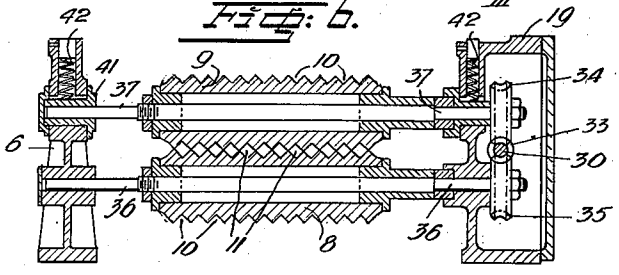


Fig. 5.

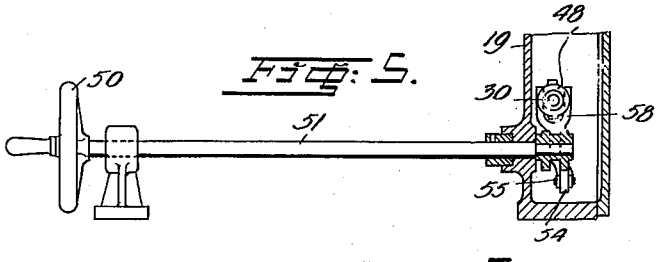
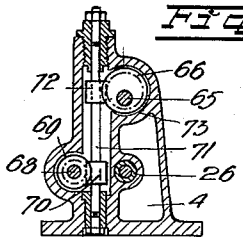


Fig. 7.



Inventor
Anton Erik Andelin
By
Rennie Davis Marvin & Edmonds
attorneys

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UNITED STATES PATENT OFFICE

ANTON ERIK ANDELIN, OF BROMARF, BJORKNAS, FINLAND, ASSIGNOR TO FINSKA FORCIT-DYNAMIT AKTIEBOLAGET, OF HANGO, FINLAND, A CORPORATION OF FINLAND

METHOD AND APPARATUS FOR FORMING PLASTIC EXPLOSIVES INTO STRINGS

Application filed December 1, 1928, Serial No. 323,085, and in Sweden October 31, 1927.

When forming plastic explosives into strings, for instance in the manufacture of dynamite cartridges, it has hitherto been usual to press out the plastic explosive through nozzles having a cross section suitable for the purpose.

According to the present invention the plastic explosive is formed into strings by passing it between rollers which around their surfaces are provided with grooves, the form of which is so chosen as to give the strings formed when the plastic explosive passes between the rollers, the desired cross section.

In order to clearly explain the invention there is diagrammatically shown in the accompanying drawings by way of example, a form of construction of an apparatus suitable for the purpose.

Figure 1 shows a vertical section of the apparatus.

Figure 2 shows the apparatus seen in plan from above.

Figure 3 shows a vertical section on line III—III in Figures 2 and 4.

Figure 4 shows a vertical section on line IV—IV in Figures 2 and 3.

Figure 5 shows a vertical section on line V—V in Figures 2 and 3.

Figure 6 shows a vertical section on line VI—VI in Figures 2 and 3.

Figure 7 shows a vertical section on line VII—VII in Figure 2.

Figure 8 shows on a larger scale a part of the grooves in the rollers shown in Figure 6.

1 is a table or board on which the plastic explosive to be formed into strings is fed to two rollers 2 and 3 arranged one above the other which rollers are rotatably mounted in frames 4, 19 between which rollers the explosive is pressed out into cake-like form or such like of suitable thickness determined by the distance between the rollers, which distance can be controlled by means, which will be described hereafter. The cake of the explosive formed in this way is fed by an endless cloth or transmission belt 5, running over said roller 3 and a roller 7 rotatably arranged in frames 6, 19 to the form rollers 8, 9, which are rotatably arranged in said frame. As will be better seen in Figures 2, 6, 8 these rollers are provided with grooves 10, running around their surface, which grooves in both rollers are positioned opposite one another so as to form complete openings 11 of suitable form and size. When the explosive is fed from the conveyor 5 to said form rollers which are rotated by devices suitable for the purpose, the explosive will be formed into a number of parallel strings corresponding to the number of the grooves which strings are received by the endless conveyor cloth or belt 12, running over rotatably arranged rollers 13, 14, and delivered onto another conveyor 15 for subsequent treatment, for instance in the case of dynamite, for cutting into suitable lengths of cartridges and packing or embaling in paraffined paper. The plastic explosive is supplied to the working board 1 suitably by means of a receptacle 16, the walls of which are made up of a number of frames 17 arranged one above the other, which frames, as will be seen from the drawings (see Figure 1) are so formed that the frames sidewise are kept in a determined position in relation to each other but otherwise loose from each other so that one frame at a time can be lifted and removed when required, leaving free a layer 18 of suitable thickness of the plastic explosive so that it may be cut along the upper edge of the topmost frame of the remaining frames (or frame) by means of a wire or other suitable cutting device so that in such a way a cake of the plastic explosive will be loosened from the mass in the receptacle which cake then is placed on the board close to the rotating rollers 2, 3 and is caught by the rollers and pressed out as described above when passing between the rollers to a homogeneous layer or cake of even thickness, which layer, as stated above, by means of the conveyor 5 is delivered to the forming rollers 8, 9.

For driving and adjusting the different members or parts the following devices are provided. In a frame 19 is a driving shaft 20 rotatably mounted which can be connected to a motor (not shown) suitable for the purpose. On said shaft two toothed wheels 21, 31 with their bushings are secured. The

wheel 21 is in engagement with a toothed wheel 22, arranged on shaft 23 rotatably mounted lengthwise in the frame which shaft carries a screw wheel 24, which gears with a corresponding toothed wheel 25 fastened on a shaft 26 mounted in the frame on which shaft the lower roller 3 also is secured (see Figures 3 and 4). On the outer end of the shaft 26 is a toothed wheel 27 arranged in engagement with a corresponding toothed wheel 28 on the shaft 29 for the upper roller 2. From this it will thus be seen that the engagement of the toothed wheels 27, 28 with each other will cause the rollers 2, 3 to rotate synchronously. The forming rollers 8, 9 also are driven synchronously by means of the following devices. On a longitudinal rotatably mounted shaft 30 a toothed wheel 32 is arranged which gears with the toothed wheel 31 on the driving shaft 20 in a similar manner to that described above with regard to the wheels 21, 22. The shaft 30 can thus be set in rotation by means of the driving shaft 20. On the shaft 30 is arranged a screw wheel 33, which is in engagement with corresponding wheels 34, 35 on one end of the shafts 36, 37 respectively, which carries the forming rollers 8, 9.

From this it will thus be seen that the last mentioned rollers on rotation of the shaft 30 will rotate synchronously with each other.

On the last mentioned shaft is also arranged a screw wheel 38 which is in engagement with a wheel 39 arranged on the shaft 40, carrying the roller 13 on which the conveyor belt 14 is running so that this is made to rotate simultaneously with the shafts 8, 9 at a speed corresponding to their peripheral speed. Bushings 41, in which the shaft pins 37 for the upper forming roller 9 are mounted, are arranged so as to provide a certain play in vertical direction but are kept normally in their lower position by springs 42 but can be raised against the direction of the pressure of the springs in case any solid object or the like is unintentionally present in the mass to be formed. The toothed wheels 32, 22 are loosely arranged on their shafts 30, 23, but can be coupled in driving connection with said shafts by coupling devices suitable for the purpose, when the couplings are brought into driving position.

According to the form of construction illustrated by way of example in Figure 3, friction couplings are used which are both of similar construction. The wheel 32 is formed into a sleeve 43. A flanged disc or sleeve 44 corresponding to the inner conical surface of the sleeve 43 is mounted on the shaft 30 in such a way that it may be moved in the axial direction of the shaft but takes part in the rotation of the shaft by means of a projection or the like entering a longitudinal groove 45 in the shaft. By the action of a helical spring 46 arranged on the shaft 30 between the nave 47 of the sleeve 44 and a disc 48 fastened to the end of the shaft the sleeve 44 is normally pressed against the sleeve 43 in such a way that these parts together form a friction coupling whereby the shaft 30 thus will be brought to rotate with the shaft 20 thereby causing the shafts 8, 9, 13 also to rotate.

As will be seen from the drawings (Figure 3), a similar coupling device is arranged on the shaft 23 whereby said shaft can be brought into driving connection with the driving shaft 20 by the intermediation of the wheel 22. On the drawings (Figure 3) the coupling members on the shaft 30 are shown in driving connection with each other and the coupling members on the shaft 23 are shown out of connection with each other in which latter case the rollers 2, 3 thus do not rotate. By the intermediary of a crank wheel 50, arranged on one end of the shaft 51 one or both of said couplings can as desired be connected or disconnected. For this purpose the end of the shaft 51 which is mounted in the frame 19 is provided with two cam discs or projections 52, 53 the first mentioned of which is arranged in such a way that upon rotation of the shaft 51 it can be brought to act upon a cylinder 54 mounted on one end of an angular lever 55, which is pivoted on a shaft pin 56. The other arm 57 of said lever is formed into a U-shaped member or clamp 58 being in connection with a corresponding groove in the nave or hub 47 of the coupling member 44. From this it will thus be seen that by the turning or rotation of the shaft 51 the lever 55 by means of its arm 58 can be brought to move the coupling member 44 against the effect of tension of the spring 46 to the left (Figure 3) out of connection with the coupling member or sleeve 43, whereby thus the shaft 30 will be disconnected and the rollers driven by said shaft will stop. The shaft 23 can at will be connected or disconnected to the driving shaft 20 by means of an angle lever rotatable around the shaft pin 60 one end of which lever being acted upon by the cam disc 53 in the same manner as described above and the other end of said lever being in connection with the nave 61 of the sleeve 62 in a manner analogous with that described above, said sleeve being movable axially but not rotatably, which sleeve together with the sleeve 63 on the wheel 22 forms a friction coupling. By means of a spring 46′ on the shaft 23 arranged in an analogous manner to the spring 46 on the shaft 30 the coupling members 22, 62 are automatically brought into connection with each other upon turning the shaft 51 in position to enable such a connection being made.

For adjusting the distance between the smooth rollers 2, 3 so as to be able, at least within certain ranges, to regulate as desired the thickness of the layer of the ex-

plosive supplied to the forming rollers the following devices are provided.

The parts 65 of the shaft of the upper roller 2 are eccentrically journalled in a cylindrical bushing 66, which are again journalled in corresponding frames 4 respectively, 19. By turning the hand-wheel 67, which is arranged on one end of the transversal shaft 68, said bushings 66 can be brought to rotate in such a way that the trunnions 65 can be raised or lowered as desired to some extent depending on the eccentrical mounting.

For this purpose the shaft 68 (see Figure 7) is provided with screw wheels 69, gearing with corresponding driving wheel 70, mounted on a vertical rotatable shaft 71, which furthermore is provided with a screw wheel 72, in engagement with a corresponding wheel 73, which is connected to the bushing 66. Upon turning the hand-wheel 67 and the shaft 68 respectively in either direction the bushing 66 will rotate in its bearing which will have for consequence that the trunnion 65 of the roller 2 eccentrically mounted in the bushing will be raised or lowered. By the use of a screw or helical wheel for the gearing the adjustment of the bushing 65, 66 is automatically secured, so that the bushing cannot rotate by the effect of pressure on the roller 2 but only by rotation of the wheel 67. Figure 7 shows said gearing device in a section on line VII—VII in Figure 2. A similar device is provided also at the other end of the roller, i. e. in the frame 19 although not shown on the drawings.

Generally it is desired that the strings should have a circular cross-section. For this purpose, however, the grooves in the forming rollers should not have a semi-circular form, i. e. such a form that two opposite grooves together form a complete circular opening, but in order to gain this purpose said grooves must have approximately such a form as shown in Figure 8, namely such that the opening practically forms a quadrate, the corners of which are somewhat rounded and having their diagonals positioned in a radial respectively axial direction of the rollers.

In the forming process here intended the pressure within the string of the plastic material upon passing through the roller openings will namely be such that the plastic mass after having passed the roller openings takes the form of strings of practically circular cross section.

From the above will be seen that the plastic material which is fed through the forming rollers is formed to a number of parallel strings, which are received on the conveyor belt 12 rotating at a speed corresponding to the speed of feeding from the forming rollers. According to the present invention there is the advantage that the material by means of a forming process is formed into a number of parallel strings, fed at the same speed and thus will be of uniform quality which involves great practical advantages over methods hitherto used, when the strings of the plastic material were formed by the extrusion of the material through nozzles. According to the present method and device greater safety is gained against risk of explosion in comparison with what has been the case in hitherto known methods and devices for the purpose in question.

Without further explanation it can be seen from the drawings (see for instance Figures 3, 4 and 6) that the gearing devices, etc., are enclosed in casings whereby the explosive is prevented from entering into these gearing or transmission devices and thus explosion is obviated.

It is also evident that details of the construction of apparatus here illustrated by way of example may be modified without departing from the idea underlying the invention. Thus for instance the coupling devices, by means of which the rollers are coupled into or out of driving connection with the driving shaft 20 and the devices for adjusting said coupling devices can be carried out in many different ways. This is the case also with the devices, by means of which the roller 2 is raised or lowered.

Having thus described my invention I declare that what I claim is:—

1. Apparatus for preparing plastic explosive material in string form for use in the manufacture of dynamite cartridges and the like, which comprises a pair of pressing rollers adapted to press a quantity of plastic material into sheet form, a pair of cooperating grooved rollers, means for feeding said material from said pressing rollers to said grooved rollers, said last named rollers being adapted to form the material into a plurality of continuous strings separated from one another, and means for conveying said formed strings away from said grooved rollers, said apparatus including a drive shaft, and clutch members for releasably connecting said drive shaft to the pressing rollers and the grooved rollers.

2. Apparatus for preparing plastic explosive material in string form for use in the manufacture of dynamite cartridges and the like, which comprises a pair of pressing rollers adapted to press a quantity of plastic material into sheet form, a pair of cooperating grooved rollers, means for feeding said material from said pressing rollers to said grooved rollers, said last named rollers being adapted to form the material into a plurality of continuous strings separated from one another, and means for conveying said formed strings away from said grooved rollers, said apparatus including an operating shaft for each pair of rollers, a clutch member for each shaft rotatably mounted

thereon, a drive shaft, gearing connecting each of said clutch members to said drive shaft, a second clutch member for each operating shaft, said second named clutch members being axially movable on said shafts but restrained against rotational movement independent thereof, spring means for urging said first and second named clutch members into engagement, a control lever, and means connected to said lever and to said second named clutch members for separately or collectively disengaging said clutch members upon operation of said control lever.

3. Apparatus for preparing plastic explosive material in string form for use in the manufacture of dynamite cartridges and the like, which comprises a pair of pressing rollers adapted to press a quantity of plastic material into sheet form, a pair of cooperating grooved rollers, means for feeding said material from said pressing rollers to said grooved rollers, said last named rollers being adapted to form the material into a plurality of continuous strings separated from one another, and means for conveying said formed strings away from said grooved rollers, said apparatus including an operating shaft for each pair of rollers, a clutch member for each shaft rotatably mounted thereon, a drive shaft, gearing connecting each of said clutch members to said drive shaft, a second clutch member for each operating shaft, said second named clutch members being axially movable on said shafts but restrained against rotational movement independent thereof, spring means for urging said first and second named clutch members into engagement, a control lever, cam members on said control lever, and arms connected to said second named clutch members and engaging said cam members, whereby said clutch members may be separately or collectively disengaged against the action of said spring means upon operation of said control lever.

4. Apparatus for preparing plastic explosive material in string form for use in the manufacture of dynamite cartridges and the like, which comprises a pair of pressing rollers adapted to press a quantity of plastic material into sheet form, a pair of cooperating grooved rollers, means for feeding said material from said pressing rollers to said grooved rollers, said last named rollers being adapted to form the material into a plurality of continuous strings separated from one another, and means for conveying said formed strings away from said grooved rollers, said apparatus including a rotatable eccentric bearing for one of the pressing rollers, a control shaft, and gearing connecting said shaft and said bearing, whereby said so mounted pressing roller may be raised or lowered upon rotation of said shaft.

In testimony whereof I affix my signature.

ANTON ERIK ANDELIN.