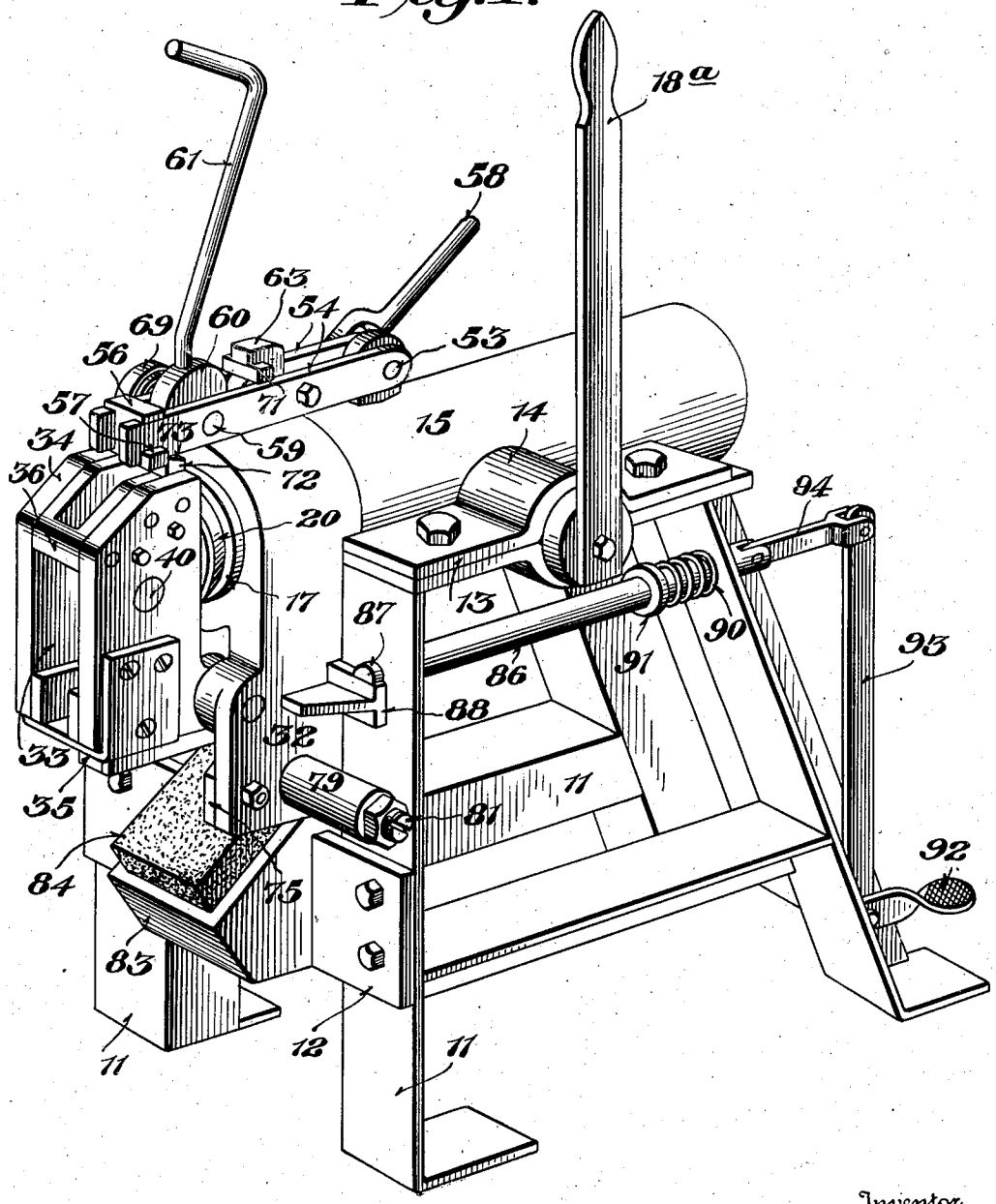
May 3, 1938. W. J. PLEWS 2,116,212

APPARATUS FOR THE EXPLOSIVE TREATMENT OF MATERIALS

Filed Dec. 17, 1934 4 Sheets-Sheet 1

Fig. 1.



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APPARATUS FOR THE EXPLOSIVE TREATMENT OF MATERIALS

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Fig. 2.

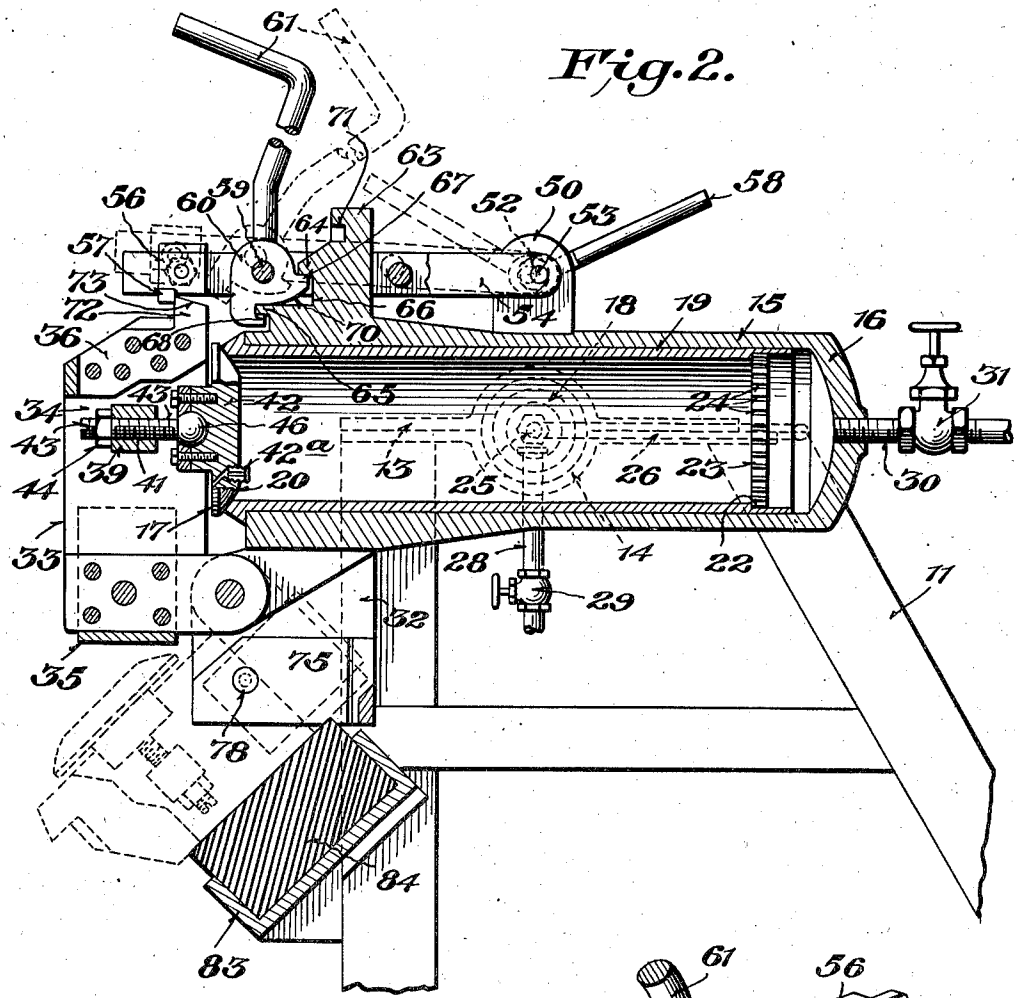
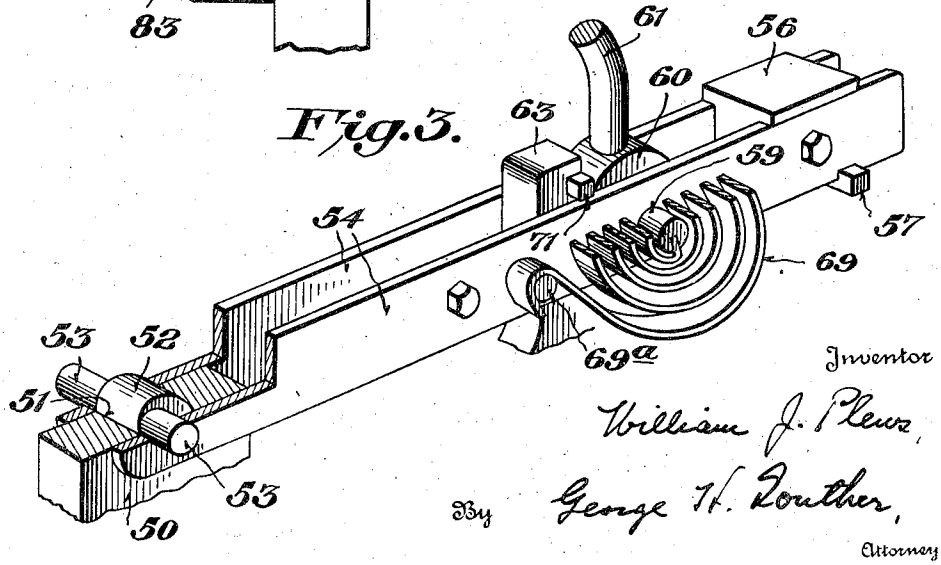


Fig. 3.



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APPARATUS FOR THE EXPLOSIVE TREATMENT OF MATERIALS

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Fig. 5.

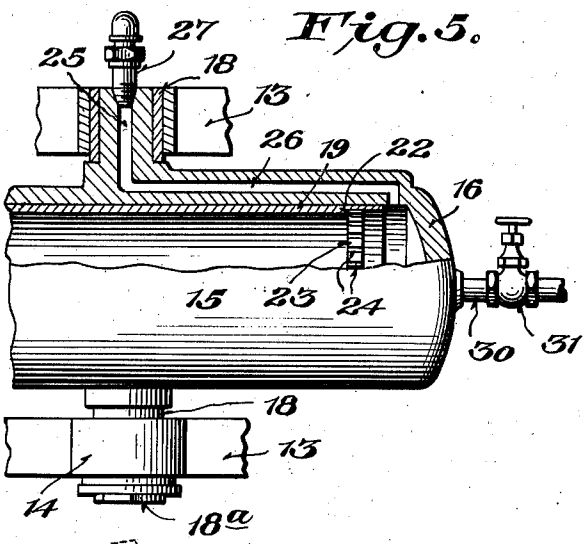


Fig. 6.

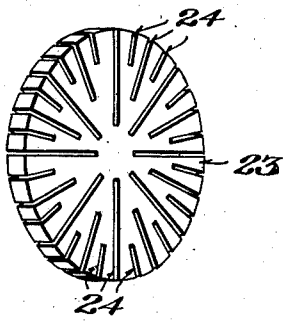
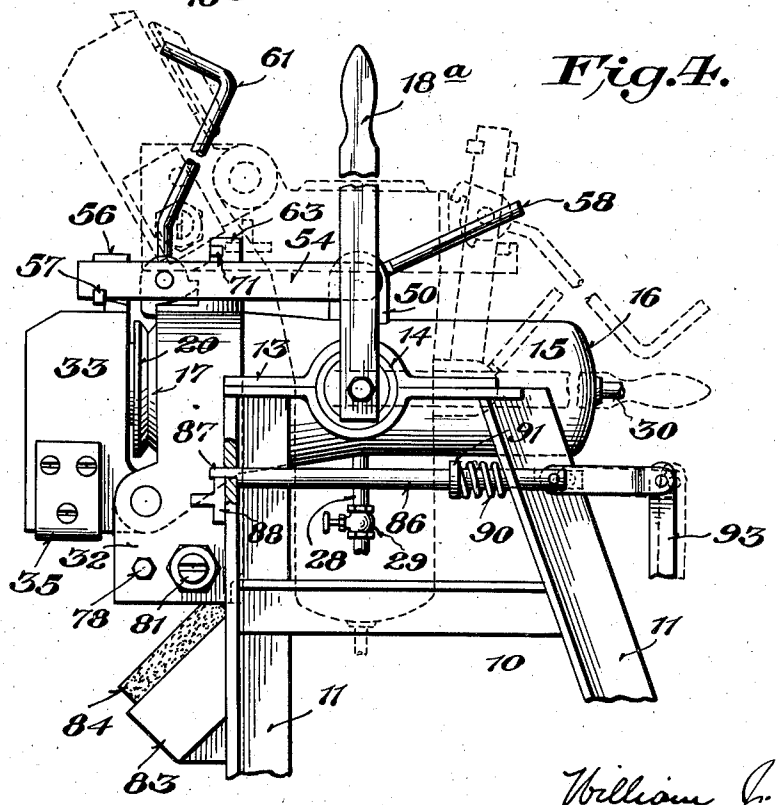


Fig. 4.



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APPARATUS FOR THE EXPLOSIVE TREATMENT OF MATERIALS

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Fig. 7.

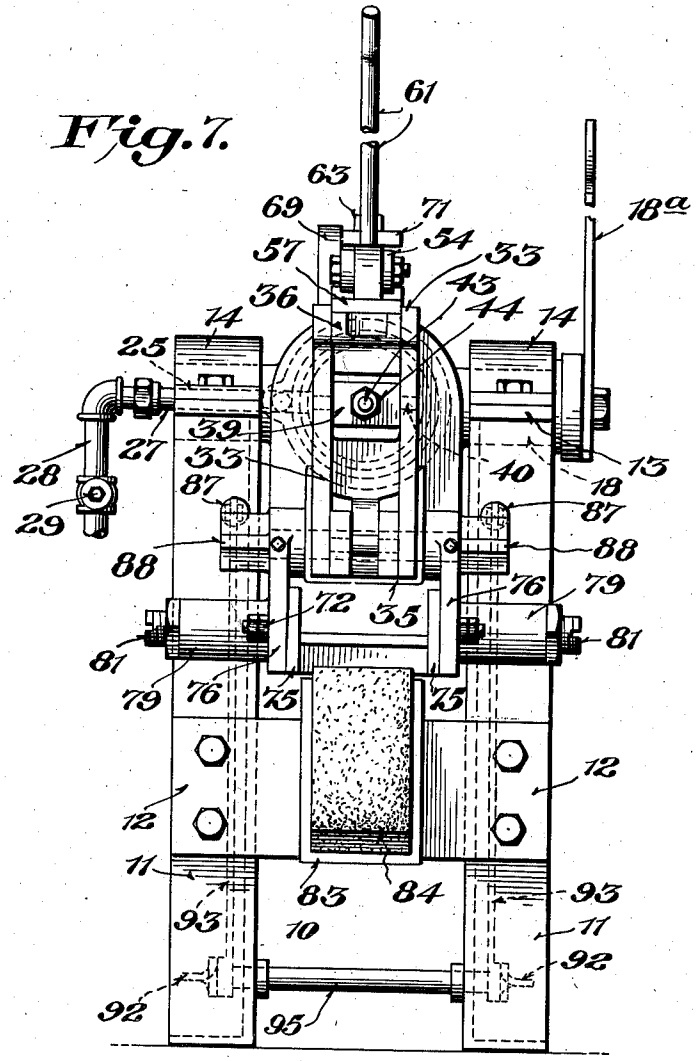
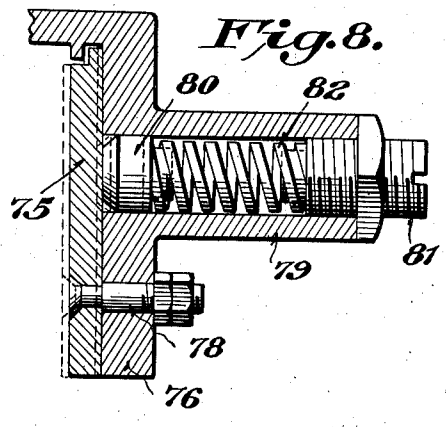


Fig. 8.



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Patented May 3, 1938 2,116,212

UNITED STATES PATENT OFFICE

2,116,212

APPARATUS FOR THE EXPLOSIVE TREATMENT OF MATERIALS

William J. Plews, Niagara Falls, N. Y., assignor to Plews Processes, Inc., a corporation of New York

Application December 17, 1934, Serial No. 757,965

5 Claims. (Cl. 99—238)

This invention relates to an apparatus for the treatment of materials such as cereal grains and other materials of an organic or inorganic nature for the purpose of exploding, expanding, disintegrating, dehydrating, or otherwise modifying or changing the chemical and/or physical properties of the same.

More specifically the invention consists in the provision of a pressure chamber in which the material to be treated is placed and which is so constructed that the fluid pressure therein may be suddenly released, resulting in the violent discharge of the material into the atmosphere. The effect on the material of the explosive action incident to the sudden release of pressure depends upon the nature of the material treated, the nature, temperature and pressure of the fluid within the chamber, and the length of time which the material is permitted to remain in the chamber under said conditions of temperature and pressure before the pressure is released.

Various types of apparatus for carrying out the so-called "explosion process" have been heretofore proposed. Examples of such apparatus are disclosed in United States Patent No. 1,442,304, issued January 16, 1923, to Arthur R. Spencer and William J. Plews, and United States Patent No. 1,455,975, issued to the same inventors May 22, 1923. Such devices have certain inherent disadvantages which I have overcome in the present invention.

I have found that in order to obtain the best results from the explosion process, certain fundamental conditions must be observed. For example, in the treatment of certain materials, it is essential, in order to obtain uniformity of particle size and condition, that the material within the chamber be expelled therefrom substantially instantaneously upon release of the pressure in the chamber. To accomplish this result it is necessary that provision be made for increasing the normal speed of travel of that portion of the mass which is remote from the chamber opening. Also, for efficient operation, it is necessary that the entire mass be discharged from the chamber. Any portion remaining in the chamber after release of pressure will usually be found to be in the untreated, partially treated, or in some cases, scorched condition, depending upon the nature of the material being treated.

Again, it is essential in the treatment of cereals, particularly oat groats, where the fluid medium is usually at a relatively high pressure and in the super-heated condition, to admit the fluid to the chamber in such a manner as to avoid local scorching, which frequently results in contamination of the flavor of the entire chamber contents.

From a practical standpoint, the device must be so constructed as to withstand continuous wide fluctuations in pressure and temperature, as well as the stresses incident to the sudden opening movement of the chamber cover or valve and the parts associated therewith. The cover must be so constructed and arranged that, upon being released, it will be moved away from its seat and out of range of the opening of said chamber within a minimum period of time to permit full enjoyment of the advantages of substantially instantaneous pressure reduction and eliminate the possibility of the material being damaged by being discharged against said cover and associated parts.

An object of the present invention is to provide a device for subjecting various kinds of material to the explosion process having all of the advantages enumerated above.

A further object of the invention is to provide a device of the type referred to having a novel type of pressure chamber.

A further object of the invention is to provide a device of the type referred to having novel closure, latching and releasing mechanism.

A further object of the invention is to provide a device of the type referred to having novel means for absorbing the energy imparted to the pressure chamber closure and associated parts by the pressure of the fluid medium within the chamber when said closure is released.

Other objects, features and advantages will appear as the description proceeds.

I will describe my device in connection with the exploding and dehydrating of oat groats, but I wish it distinctly understood that the device may be employed for the treatment of various other substances including other cereal grains.

In the accompanying sheets of drawings wherein I have illustrated the preferred embodiment of my invention—

Figure 1 is a perspective view of said device.

Figure 2 is a side elevational view thereof in section.

Figure 3 is a perspective view, partly in section, showing certain details of the latching mechanism.

Figure 4 is a side elevational view of the device.

Figure 5 is a fragmentary plan view of the pressure chamber partly in section, to illustrate the manner of ingress of fluid medium to the pressure chamber.

Figure 6 is a perspective view of the diffusion member.

Figure 7 is an elevational view of the device, and

Figure 8 is a fragmentary sectional view of one of the friction plates.

Referring to the drawings, reference numeral 10 designates generally a carriage or cradle on which my device is mounted and which consists of a pair of standards 11 adapted to be firmly

bolted or otherwise secured to a floor or other foundation. Said standards are connected to each other by means of a tie-plate 12. To provide a convenient means for pivotally mounting the pressure chamber, the top portion of each standard 11 is in the form of a pair of plates 13, having central adjacent semi-circular portions defining bearings 14.

The pressure chamber as shown in detail in Figs. 2 and 5, consists of a relatively heavy cylindrical member 15, having a closed end 16 and an open end 17. Member 15 is preferably made of cast steel and cast integrally therewith is a pair of trunnions 18 adapted to be positioned within the bearings 14 to pivotally support the pressure chamber for rotational movement in a vertical plane. The chamber is rotated on said trunnions by manually manipulating lever 18a. Positioned within said member 15 and concentric therewith is a tubular lining member 19 preferably made of non-oxidizing material such as stainless steel, Monel metal, or the like. One end of member 19 is spaced a short distance from the closed end 16 of member 15, and the other end projects through the open end of said member. The projecting portion is somewhat enlarged and is spherically ground to provide a valve seat 20. The wall of member 15 is increased in thickness at the open end for the purpose of strengthening the same. The inner end of tube 19 is counterbored to provide a shoulder 22 against which is positioned a disc or diffusion plate 23, having over substantially its entire area a plurality of apertures 24, which as shown, are in the form of slots. The diffusion member is in effect a transverse partition which divides the pressure chamber into two communicating chambers, the forward one of which serves as a treating chamber and the other as a fluid-receiving chamber.

Communication is afforded to the interior of the pressure chamber through passage-way 25 formed axially of one of the trunnions 18, and passage-way 26 formed in the wall of member 15. One end of passageway 26 communicates with passageway 25 and the other end terminates adjacent the closed end 16 of the chamber. Passageway 25 is in communication with a source of supply of preheated fluid under pressure through nipple 27 and conduit 28. Nipple 27, which is stationary, is shown as having a screw-threaded end extending into passageway 25 and engaging screw-threads formed in the wall thereof to permit of relative angular movement between said nipple and trunnion 18 as the pressure chamber is rotated about said trunnion, but any suitable type of swivel connection may be employed. The admission of fluid to the pressure chamber is controlled by manually operated valve 29. The closed end 16 of the chamber is provided with an outlet 30 controlled by a valve 31.

The means for effecting closure of the open end of the pressure chamber will now be described in detail. Journalled in a pair of spaced plates 32 formed integrally with member 15 is a valve yoke 33, which consists of a pair of vertical plates 34 joined at their lower ends by straps 35 and at their top portions by member 36. Extending between plates 34 and journalled therein is a bar 39 having reduced end portions 40, and having a transverse threaded aperture 41 adapted to be brought into alignment with the longitudinal axis of the pressure chamber when the yoke is in the valve-closing position. The open end 17 of the pressure chamber is closed by a spherically ground valve or closure member 42 carried by a threaded valve spindle 43, which is threaded through aperture 41 and held in position by means of lock nut 44. Valve 42 is connected to spindle 43 by means of a ball and socket joint 46. Valve 42 is provided with a leak-port 42a.

The means for forcing the valve into tight engagement with the valve seat and for releasing the valve are as follows: mounted on the top of member 15 and preferably cast integrally therewith, is a vertical lug 50, having an aperture 51 in which is positioned a shaft 52. The ends of shaft 52 are reduced to provide a pair of aligned cranks 53, which are eccentrically arranged with respect to said shaft. A rod 54 is mounted on each crank 53. Said rods extend in substantially parallel relationship and at their free ends support a detent block 56 having a detent 57 formed in its under surface. A lever or handle 58 is mounted on one of said cranks in such a manner as to rotate therewith. Intermediate their ends rods 54 are joined by a shaft or pin 59 on which is mounted a cam 60 which is adapted to be rotated by cam handle 61. Adjacent its open end, member 15 is provided with a vertical portion 63 provided with teeth 64 and 65 and an intermediate flat surface 66. Cam 60 is provided with a pair of teeth 67 and 68 which are adapted to engage with teeth 64 and 65 respectively when the handle 61 is rotated in a counter-clockwise direction (looking at Figs. 1, 2 and 4) to positively lock rods 54 and detent 57 in their lowermost position, illustrated in Fig. 1. A spiral spring 69, having one end secured to the shaft 59 and the other end hooked over a pin 69a carried by one of the rods 54, tends to hold the cam in this position. The cam surface, indicated by the numeral 70, is so designed that upon rotation of the handle 61 in the clockwise direction, it will coact with surface 66 to elevate the rods 54 and detent 57 to their upper, or closure-releasing position, illustrated in dotted lines in Fig. 2. A stop member 71 is provided in the upper portion of member 63, to limit the upward movement of rods 54. Looking at Fig. 2, it will be noted that detent 57, when in its lower position, is in the path of travel of projecting portion 72 of member 36. The upper surface of portion 72 is inclined as indicated at 73, to permit the detent to ride over said surface when the valve is being closed.

The operation of my device will now be readily understood. The pressure chamber is rotated on trunnions 18 by means of lever 18a until it assumes the vertical or loading position illustrated by dotted lines in Fig. 4. In this position valve 42 is swung free from the chamber opening. Oat groats are poured into the chamber through its open end until the treating zone is substantially filled. It will be noted that disc 23 prevents the material from entering the fluid-receiving zone adjacent the closed end of the chamber. Valve yoke 33 is rotated on its pivot to bring valve 42 into the closed position. Cam handle 61 is rotated in the counter-clockwise direction, causing teeth 67 and 68 to engage teeth 64 and 65 to positively hold rods 54 and detent 57 in the downward position. Shaft 52 is then rotated in the clock-wise direction by means of lever 58, causing rods 54 to be moved to the right (looking at Fig. 2). This movement of rods 54 will cause detent 57 to be brought into engagement with projection 72. As further pressure is applied to the lever 58, valve 42 obviously will be brought into tight engagement with valve seat 20. The ball and socket connection permits limited uni-

versal movement of the valve. Due to the fact that the valve is spherically ground, it will seat in any position within the limits of said movement. Because of the swivel mounting of supporting bar 39, pressure will be uniformly applied to the valve, irrespective of the position it assumes. If the valve should become worn, it can be adjusted by loosening lock-nut 44 and turning spindle 43. Valve 31 may be opened at this point to drain off any condensate which may be present in the chamber, or, if the chamber is cool, to permit the fluid to blow through outlet 30 to raise the temperature of the chamber and the chamber wall. After valve 31 has been closed, valve 29 is opened to admit fluid under pressure to the chamber. I have found that steam at about 200 pounds pressure and from 50 to 200 degrees of superheat is a satisfactory medium for the treatment of oats. The fluid enters the fluid-receiving zone of the chamber from passageway 26 and is broken up into a series of fine streams by diffusion member 23. As the fluid progresses toward the forward end of the chamber, it forces the air contained therein through leak-port 42*a* to the atmosphere. It is essential that all of the air be removed from the chamber to prevent the formation of air pockets in the zone occupied by the oat groats.

The chamber is then rotated to the horizontal or discharge position shown in Figures 2 and 4. After the material has remained for the necessary period of time, in the case of oat groats for from one and a half to two minutes, valve 29 is closed and handle 61 is rotated in the clock-wise direction, (looking at Fig. 2) causing teeth 67 and 68 to become free from engagement with teeth 64 and 65, and causing rods 54 to be elevated by the action of cam surface 70 on surface 66. As soon as detent 57 has been raised to the position where it is clear of projection 72, valve 42 and yoke 33 will be violently swung to the open position by the pressure of the fluid within the chamber, and the material therein will be forcibly and substantially instantaneously discharged therefrom.

An important function of diffusion member 23 should here be noted. During the period the oat groats remain in the chamber, their pores become thoroughly impregnated with superheated steam. When the pressure is suddenly released, the steam escapes from the pores with sufficient vigor to cause disruption of the cell walls and enlargement or exploding of the groat. This action is probably enhanced by the flashing into steam of a large portion of the natural moisture content of the groat. Obviously, the less suddenly the pressure is released, the less vigorously the steam will tend to escape from the pores of the groat, and the less the size of the groat will be increased. As the groats remote from the open end of the chamber must travel the entire length of the treating chamber before they reach the atmosphere, they would normally be subjected to less sudden pressure reduction than those adjacent the open end of the chamber. I have found, however, that when diffusion member 23 is used, the steam occupying the fluid-receiving zone of the chamber functions, on sudden release of pressure, as an auxiliary supply of steam to maintain the pressure within the chamber relatively high until the entire mass of groats has been discharged therefrom. Also, as pointed out above, as said auxiliary steam rushes toward the open end of the chamber, it carries with it any groats which may not have been originally discharged. In other words, the steam occupying the steam space, acts, upon release of pressure within the chamber, as a secondary supply of steam which is fed to the treating chamber simultaneously with the reduction in pressure to accomplish the results set forth above.

The energy imparted to the valve and yoke by the pressure of the fluid medium may be absorbed in any suitable manner, but I have found the novel means shown in the illustrations to be very convenient and effective. The valve is permitted to swing freely until it is out of alignment with the chamber to effect substantially instantaneous reduction of pressure and to avoid damage to the contents of the chamber. As the valve mechanism rotates in the downward direction, its movement is accelerated by the force of the gravity. As soon as the valve mechanism is out of range of the chamber, the vertical ends of the strap 35, which is shown as U-shaped, come into frictional engagement with a pair of friction plates 75, carried by lugs 76 depending from casting 15. The bearing force exerted by plates 75 on strap 35 and consequently the amount of energy dissipated through frictional engagement of said plates with said strap is regulated by adjustment of a pair of springs, one of which acts on each plate. In Fig. 8 I have shown one such spring. It will be noted that plate 75 is loosely supported for limited movement by pin 78. A hollow boss or lug 79 extends from member 76 and within said boss is a thrust member 80 bearing directly on plate 75. Threaded through the open end of said boss is an adjusting screw 81, and positioned between said screw and said thrust member is a helical spring 82. Spring 82 tends to hold plate 75 in the dotted line position shown in Fig. 8. Obviously, adjustment of screw 81 will vary the tension of spring 82 and will definitely affect the magnitude of the energy dissipated through frictional engagement of the strap with plates 75, as the valve yoke passes between said plates during the opening movement. The residual energy is absorbed by a resilient member, preferably a solid block of rubber which is positioned in the path of travel of the valve yoke. As shown, a pocket 83 is formed in the tie-plate 12 and a solid block of resilient material 84 is placed therein at such an angle that its upper surface is parallel to the contacting surface of the valve yoke at the instant of contact. Block 84 serves as a cushion stop member to yieldingly limit the downward movement of the valve mechanism. Springs 82 may be so adjusted that the impact of the valve mechanism on block 84 will be relatively light and the valve mechanism will come to rest thereon. Or, if desired, the adjustment of springs 82 may be varied so as to permit an impact of sufficient magnitude to cause the return of the valve mechanism, due to the resiliency of block 84, to a position between plates 75 where it will be held by said plates in convenient position for subsequent manual closing.

It may be desirable to employ means for locking the pressure chamber in the horizontal position to prevent its being accidentally rotated on its trunnions by reaction incidental to sudden pressure release. I have shown one means for so doing which consists of a pair of rods 86, one of which is mounted in each standard 11, as shown in Figs. 1 and 7. The forward ends 87 of the rods are reduced in size to fit through apertures formed in the forward legs of standards 11, and are provided with flat under surfaces adapted, when the gun is in the horizontal position, to

rest upon the upper surfaces of plates 88, one of which extends from each side of casting 15, thus locking the chamber in the horizontal position. The rods are urged in the forward or locking position by springs 90 acting on collars 91, there being one spring and one collar mounted on each rod. The rods are withdrawn from the locking position by depressing either one of a pair of foot pedals 92, forming one arm of bell crank levers 93 connected to the rods through links 94. Both pedals are mounted on shaft 95 for simultaneous rotational movement. Thus depression of either pedal will release both rods and permit the chamber to be rotated to the vertical position for loading.

In the above I have described one form of my invention. Many modifications will occur to those skilled in the art. For example, valve seat 20 might be formed on a protruding end of member 15, rather than on member 19. Also, it may be found that in the treatment of certain materials it is not desirable to evacuate the air from the chamber. In such cases a solid plug may be substituted for the apertured member 42*a*. Further, the specific type of closure means may be varied. A new and novel process which may be carried on by the use of the apparatus herein disclosed and claimed is disclosed in my copending application Serial No. 757,964, filed December 17, 1934, and entitled "Method for treatment of materials." It is to be understood, however, that the apparatus of the instant disclosure may be adapted for carrying on processes other than that disclosed and claimed in my aforesaid pending patent application. It is my intent that this patent shall cover all such modifications as come within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for the exploding of starch-containing materials by the utilization of high fluid pressure and high temperature comprising a pressure chamber having an open end and a closed end, means for closing the open end of said chamber, means for admitting a gaseous fluid under high pressure to said chamber adjacent its closed end, and a perforated partition subtending substantially the whole area of said chamber and being interposed between said fluid admission port and the open end of said chamber for dividing the fluid admitted to said chamber into a plurality of fine streams, said partition dividing said pressure chamber into a large treating sub-chamber to hold the material to be treated and a reserve sub-chamber of substantial volume to hold the gaseous fluid whereby the expansion of said fluid contained in the reserve sub-chamber, on opening of said closing means, assists in the expulsion of the said materials from the treating sub-chamber.

2. Apparatus for the exploding of cereal grains comprising a high pressure chamber having an open end and a closed end, means for admitting fluid under pressure to said chamber adjacent its closed end, a valve yoke rotatably supported by said chamber adjacent its open end, a valve carried by said yoke adapted to close the open end of said chamber, means adapted to engage a portion of said valve yoke to lock the valve in closed position, means for forcing said valve into tight engagement with the open end of said chamber, means for releasing said valve from its closed position to permit sudden reduction of pressure within said chamber, and a perforated partition within said chamber and subtending its area for dividing the fluid pressure medium into a plurality of fine streams, said partition dividing said pressure chamber into a large treating sub-chamber to hold the material to be treated and a reserve sub-chamber of substantial volume to hold the gaseous fluid whereby the expansion of said fluid contained in the reserve sub-chamber, on opening of said closing means, assists in the expulsion of the said materials from the treating sub-chamber.

3. Apparatus for the treatment of materials comprising a carriage provided with trunnion bearings, a pressure chamber mounted in said bearings for rotational movement in a vertical plane, closure means pivotally mounted on said chamber for closing same, means for holding said closure means in the closed position, means for releasing said holding means to permit said closure means to be moved away from said chamber, and means for absorbing the energy of said closure means, said last named means comprising a pair of stationary spring-pressed friction plates adapted to frictionally engage a portion of said closure mechanism during its opening movement to dissipate some of the energy of said mechanism, and a resilient buffer positioned in the path of travel of said closure mechanism to adsorb the residual energy thereof.

4. Apparatus for the treatment of grains by the explosion process comprising a high pressure chamber, closure means for said chamber, means for admitting gaseous fluid under high pressure to said chamber, and a perforated partition subtending substantially the whole area of said chamber and being disposed within said chamber for dividing said chamber into a material-treating chamber and a gaseous fluid-receiving chamber of substantial volume whereby upon release of said closure means, expansion of the gaseous fluid pressure medium occupying said fluid-receiving chamber will assist in the expulsion of the material undergoing treatment from said material-treating chamber.

5. Apparatus for the treatment of cereal grains by the explosion process which comprises a tubular member having an open end and a closed end, a partition perforated over substantially its entire area and subtending substantially the whole transverse cross-sectional area of the tubular member, said partition dividing said tubular member into a relatively large main treating chamber that is adjacent said open end and an auxiliary chamber of substantial volume that is adjacent said closed end of the tubular member, the grains to be treated being received in said main treating chamber, closure means for tightly closing the said open end of the main treating chamber after the cereal grains have been disposed therein, means for admitting a preheated fluid under pressure to said auxiliary chamber whereby said perforated partition diffuses said preheated fluid into a plurality of fine streams whereby each cereal grain is substantially simultaneously and uniformly subjected to the influence of said preheated fluid medium, and means for releasing rapidly said closure means whereby substantially all of the cereal grains will be forcibly and substantially instantaneously discharged from said treating chamber.

WILLIAM J. PLEWS.