On Her Majesty's Service

Notes from Treatise on Service Explosives 1900

~~Card 2 Notes from Wardell Handbook of Gunpowder 1888~~

WASC-1536
WAI-0397
WAHN-0082

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Treatise on Service Explosives, HMSO. b/w photographs of illustrations. /1-/28

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1895 Trubill.

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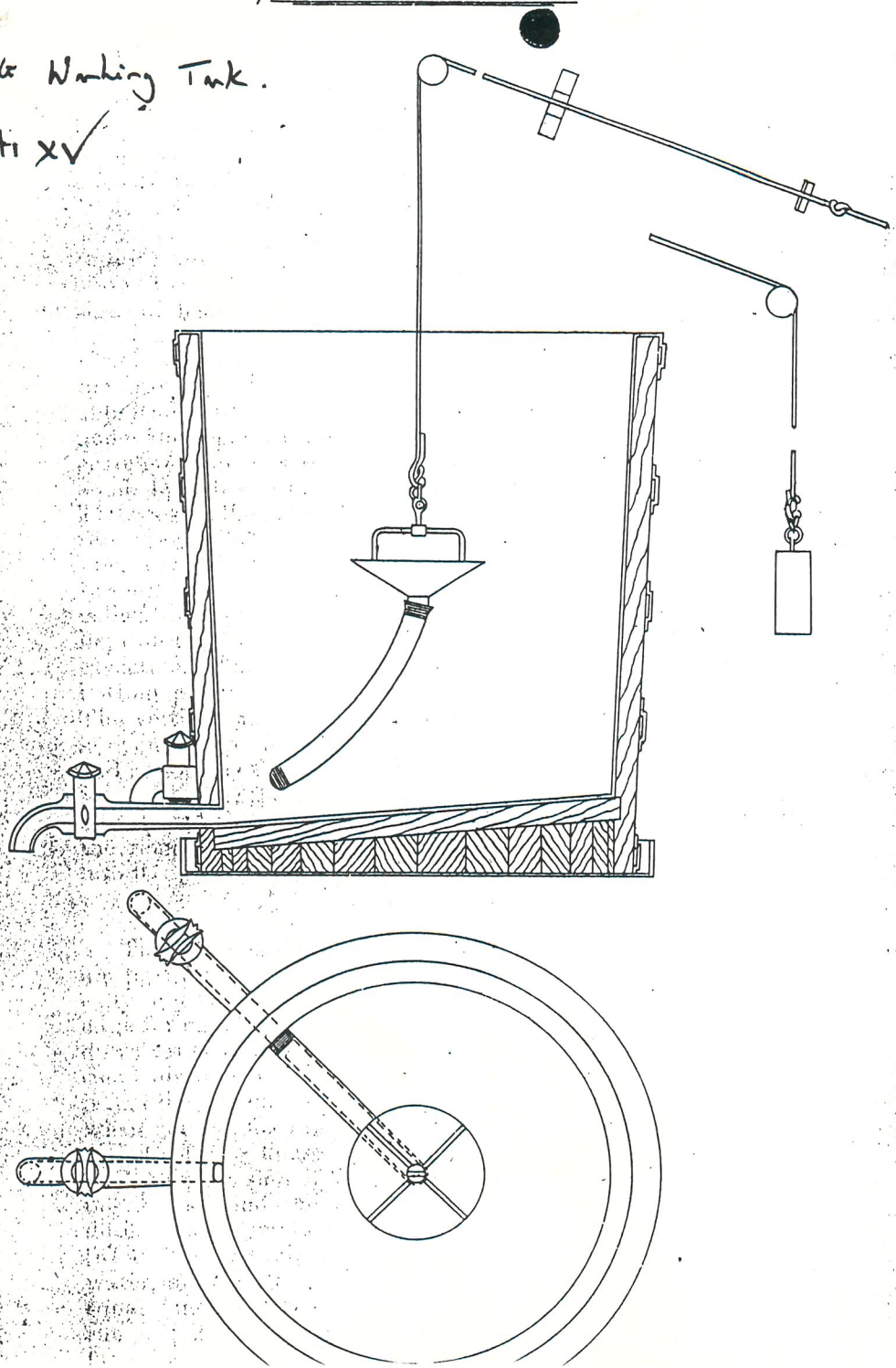
Plate XV



allowed to settle to the bottom, and the washing water run off through the upper cock to the wash water gutter. The air is then turned on again, fresh cold water run in, then the remainder of the nitro-glycerine from the separator, and the whole washed again for two or three minutes, when the air is turned off, the nitro-glycerine allowed to settle, and the wash water run off as before. This is repeated twice more, making four washings in all; at the fourth washing however, two buckets of warm soda water are added. When the washing water has been drawn off after the fourth washing, the nitro-glycerine is ready to go to the washing house.

(D) *Washing.*

The carbonate of soda solution used for washing the nitro-glycerine in the "washing house" is prepared in a tank in the nitrating house. The temperature of the solution is 50° C. (122° F.), and the strength 10° Twaddell.

The washing house is connected with the nitrating house by means of a lead gutter, through which the nitro-glycerine and soda waters flow. In the washing house are two lead-lined vats (Plate XV) side by side, with either of which the gutter communicates by means of a moveable indiarubber bend; this enables two charges to be washed at one time. The washing tanks are supported over a large oblong drowning tank, kept nearly full of water. Cold water from the main, or warm water from a tank alongside, can be run through india-rubber branches into either tank over the edge. Air pipes supplying air at a pressure of about 50 lb. on the square inch are laid round the bottom of each tank. The bottom of the tank slopes down to the nitro-glycerine draw-off cock in front. On one side, and near the bottom, is a smaller cock connected with the gutter leading to the wash water settling house; inside the tank an india-rubber pipe connects the wash-water cock with the "skimmer," through which the wash water is skimmed off the surface of the nitro-glycerine as the latter sinks to the bottom of the tank. This skimmer (Plate XV) is a circular brass dish with a hole in the centre to which a hollow lead elbow is fitted; over the other end of this elbow, the india-rubber tube attached to the wash water cock, is secured. The skimmer is suspended in the tank by means of a rope passing over a pulley and led outside the building where a counter-weight is attached to it. Previous to running the nitro-glycerine from the pre-wash tank to the washing tank, a quantity of soda water is sent down through the nitro-glycerine gutter into the washing tank, and the air in the latter turned on. The nitro-glycerine is next run down into the washing tank, and then more soda water. The temperature in the washing tank is now brought to 30° C. (86° F.) by the addition of hot or cold water as required, the total quantity of soda water and plain water amounting altogether to about 30 gallons. On the completion of this first washing, the air is turned off,

from the commencement to the completion of the test must not be less than 18 minutes. A proportion of the charges are also tested for volatile matter, which must not exceed 0·5 per cent., estimated by loss of weight on being placed in a desiccator over dry calcium chloride for 16 hours; and for alkalinity, which, calculated as sodium carbonate in the nitro-glycerine, is not to exceed 0·01 per cent.

Nitro-glycerine Manufacture at Waltham Abbey. Newer Process.

Considerable improvements have been made during the past few years in the nitro-glycerine manufacture at Waltham Abbey by the introduction of the Nathan, Thomson and Rintoul process.

In this the nitrating vessel is of the usual construction excepting that it has an inlet pipe for acid at the bottom and a glass separation cylinder with a lateral overflow pipe at the top. The other essential parts are a pre-washing tank, a washing tank and a final filtering tank.

Method of operation.—The charge of nitrating acid is run from a high level gauge tank into the nitrating vessel, where it is cooled and agitated while the glycerine is run in. When the nitration is complete and the temperature has fallen slightly, the agitation is stopped. The separation of the nitro-glycerine is allowed to proceed in the same vessel, and waste acid from a previous charge is caused to flow gently in from a high level waste tank through the inlet pipe at the bottom of the nitrator. The inflowing waste acid forms a layer at the bottom of the apparatus, and gradually raises the whole charge till the level of the clear nitro-glycerine appears in the separation cylinder and flows over into the pre-washing tank where it is drowned in water. The rate of inflow of the waste acid is regulated so as to be equal to the rate of separation of the nitro-glycerine. This is easily done by keeping the upper surface of the acid layer at a constant level in the separation cylinder and just below the outlet. When the bulk of the nitro-glycerine has separated a sharp line of demarkation appears in the separation cylinder.

The subsequent manufacture is carried out in the usual manner. The above system of manufacture is fully described and specified in patent No. 15,983, 1901.

Now as to the treatment of the residual acids left in the nitrator after the bulk of the nitro-glycerine has been displaced.

The contents of the nitrator are allowed to stand until a short time before the apparatus is required for the next charge. This allows the recovery of as much of the nitro-glycerine as possible. A small quantity of the clear nitro-glycerine free waste acids, lying at the bottom of the apparatus, is run off. The level of the acids is thus sufficiently lowered to allow of

their being air-stirred without splashing over. The acids are then strongly agitated and a small quantity of water, equal to 2 per cent. by weight of the acids formed is slowly added. The agitation of the mixture is continued until the temperature has begun to fall when the air current is stopped and sufficient waste acid is run in from the high level tank to raise the surface to a level with the separation cylinder. After remaining at rest for a short time to ensure that no nitro-glycerine remains undecomposed (unseparated) the acids are run off for storage or denitration.

A sufficient quantity is raised to the high level waste acid tank for use as displacing acid for a subsequent charge.

The apparatus is then in readiness for the next nitration. This method of treating acids is described in patent No. 3,020, 1903.

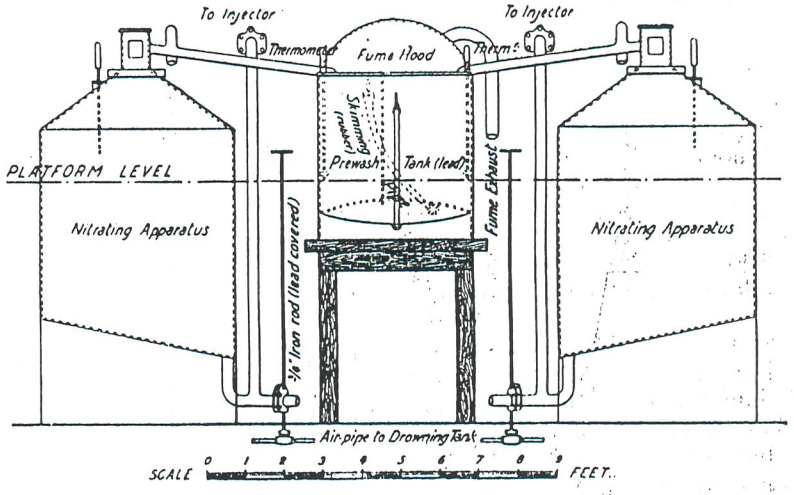


Fig. 1*a*.

Fig. 1*a* shows the general arrangement of a nitrating plant built in duplicate, and fig. 2*a* shows the various falls required and the economy effected in the necessary heights of the buildings.

The primary object of the new treatment is to obviate the necessity of passing nitro-glycerine through any form of cock, and so decrease the danger of manufacture.

Removing the nitro-glycerine from contact with the acids as soon as it separates, also increases the safety, as do the cooling coils in the separation and "after-separation" stage, the latter rendering it possible to check at once any undue rise of temperature. Less transference of both acids and nitro-glycerine is necessary.

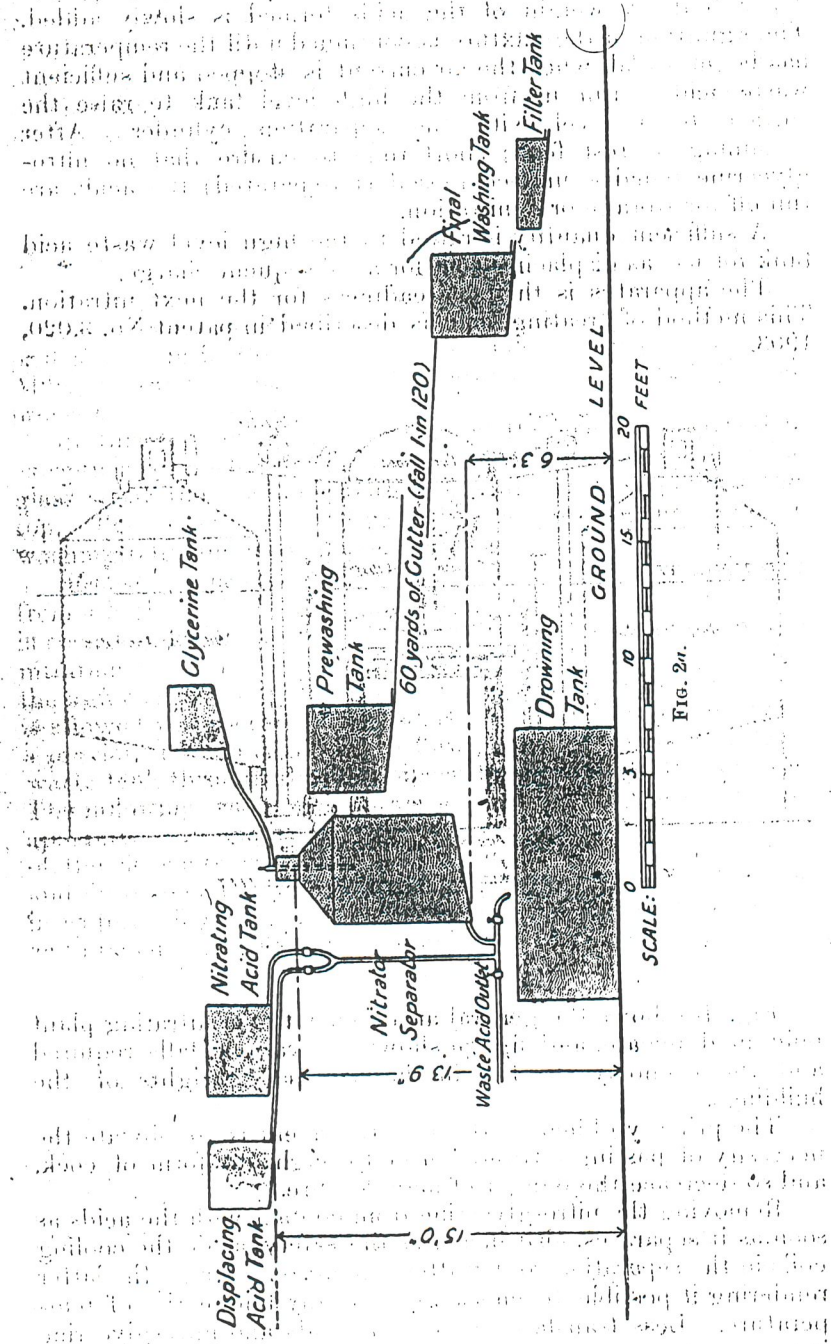


FIG. 21.

The essential explosive in all forms of dynamite is nitro-glycerine. The first dynamite was invented by A. Nobel immediately after he had found that nitro-glycerine could be detonated by a mercury fulminate charge. Nitro-glycerine in the liquid form is for reasons stated (*ante* p. 77 and *seq.*) quite impossible as a practical explosive, but when absorbed into a porous inert material it may be carried and stored with comparative safety, and much more perfectly detonated than in the liquid state. This was Nobel's discovery. The porous inert material most generally employed is "Kieselguhr," an infusorial deposit of a smooth and non-gritty nature. This after cleaning and drying can absorb about three times its weight of nitro-glycerine without appreciable exudation. This forms the original dynamite. Many modifications have been proposed. In some nitrates and other oxygen supplying substance are added, and in others the "Kieselguhr" is more or less replaced by salts such as sodium carbonate, barium sulphate, ammonium salts, charcoal, oxide of iron, &c.

The ingredients sanctioned are—

Sodium carbonate, Barium sulphate, Mica, Talc, Ochre.	In all 8 parts (or less) by weight, in substitution for an equal amount by weight of kieselguhr.

An amount of ammonium carbonate not exceeding 1½ parts by weight in every 100 parts by weight of the finished dynamite, is also allowed to be, and is generally added.

The kieselguhr is prepared by calcining, to drive off water and organic matter, and more or less of the accompanying sand is sifted away. It generally contains a little iron, which accounts for the more or less red tinge observable in ordinary dynamite. Nitro-glycerine is poured on to the prepared kieselguhr and the two thoroughly kneaded together into a plastic mass, which is then, in a special machine, pressed up into cylindrical cartridges of various diameters, to suit various sizes of bore holes for blasting, each cylinder being wrapped in parchment paper. Five pounds of cartridges make a packet, and 10 packets go to a box, which thus contains 50 lb. of dynamite. When ignited unconfined in small quantities, it burns away fiercely with a reddish flame; if the amount is sufficiently large, however, it ends by exploding. The usual method of exploding it is by means of a fulminate of mercury detonator. Contact with water quickly disintegrates it, separating out the liquid nitro-glycerine, and hence great care is required when using it in wet places; in this particular it compares unfavourably with blasting gelatine and gelatine dynamite. The exuded nitro-glycerine may find its way into cracks in the rock, and lie there for an indefinite time until called into fatal activity by a blow from a pick or a drill. Another great danger in the use of dynamite arises from its freezing at a comparatively high temperature (about 40° F.), and it remains

frozen even at 50° F.; in its frozen state it is useless as a blasting agent, and has to be thawed or "tempered." This operation requires great care, and the instructions issued with every packet should be closely and carefully attended to. The safest plan is to place it in a tin inside another tin containing hot water, on the principle of a glue pot, but the outer tin *must not* be placed on a fire or stove, and the inner tin must be watertight. Special "warming pans" on this principle are sold, jacketed with felt and canvas; this not only prevents the pan being placed on the fire, but keeps in the heat.

It cannot be too strongly impressed, that if dynamite or other nitro-glycerine preparations are gradually warmed up to a temperature approaching their igniting point they become extremely sensitive to the least shock or blow, and once that point is reached, they do not simply burn, but explode with great violence.

Blasting gelatine is a combination of nitro-glycerine and soluble cellulose nitrate. It is made by dissolving, with the aid of kneading and heat, finely divided soluble cellulose nitrates in nitro-glycerine. The product is a gelatinous mass about the colour of new honey, and varying in consistency, from a tough leathery material, to a soft substance like jelly. Blasting gelatine No. 1, which is that practically in use, contains from 93 to 95 per cent. of nitro-glycerine, and is made up into cartridges like dynamite. Speaking broadly, the thinner the gelatine the more sensitive it is to detonation; but, on the other hand, a thin gelatine is more liable to liquefaction, and possibly also to exudation, and thus to cause danger in storage and transport. Specially strong detonators are required to detonate it, or ordinary detonators with a portion of dynamite or gunpowder. Blasting gelatine, unlike dynamite and nitro-glycerine, is much more, instead of much less liable when frozen, to be exploded by a blow such as that given by a rifle bullet. It is, on the whole, less liable to freeze than dynamite. Blasting gelatine has the great advantage over dynamite of being practically unaffected by water. It is stored, therefore, under water, in suitable tanks in the magazine, and is packed in tins containing 45 lb., as received from the makers. It is more powerful than dynamite, not only as containing a higher percentage of nitro-glycerine, but also since the explosive nitrated cellulose instead of with a porous inert kieselguhr. It is also, from its physical condition, safer and rather safer to use.

Gelatine Dynamite, and *Gelignite*, are two modifications of blasting gelatine which are now largely manufactured. They are cheaper, but not such powerful explosives.

Gelatine dynamite, of which there are two varieties, differing only slightly in composition, contains about 30 per cent. of explosives, while gelignite only contains about 60 per cent. The varieties principally in use contain nitro-glycerine, nitrated

The liability of nitro-glycerine to freeze is a source of danger in the employment of dynamites of almost any kind, not because the nitro-glycerine is more sensitive in the frozen or solid state than when liquid. In fact, it has been shown by a number of observers that it is less sensitive in that condition, but the danger lies in the melting or "thawing" process.

Very early indeed in the history of nitro-glycerine (1866) attempts were made to reduce the freezing point by the addition of nitro-compounds of benzenic derivatives (nitro-benzene, nitro-totuene, &c).

The employment of mono and dinitro-glycerine in admixture with nitro-glycerine proper has been proposed. These nitrates are, however, hygroscopic and even soluble in water, and so objectionable.

The employment or poly-glycerine nitrates has also been suggested. Poly-glycerine or di-glycerine is made by heating glycerine for some time to about 290° C. in a flask with long neck. Water is formed and driven off, and two or more molecules of glycerine unite or condense, probably thus:—

$$2\{C_3H_5(OH)_3\} - H_2O = C_3H_5(OH)_2OC_3H_5(OH)_2$$

The di-glycerine (or poly-glycerine) formed is of very high boiling-point, and, although a very thick and viscous liquid at ordinary temperatures, does not seem to freeze. On nitration with the mixed acids in the ordinary way, a tetra-nitrate,

$$C_6H_{10}O(NO_3)_4,$$

is formed. This nitrate is stated to be less sensitive, and, at the same time, nearly equally as powerful as nitro-glycerine in explosive power. It does not freeze, and is insoluble in water. Recent experiments seem to indicate that nitrated mono-chlorhydrin is nearly as powerful as nitro-glycerine, and has the advantage of remaining liquid even at −25° C.

Mono-chlorhydrin, $C_3H_5(OH)_2Cl$, results from the action of hydrogen chloride on glycerine. It is easily nitrated by the mixed acids, and the dinitro-chlorhydrine,

$$CH_2Cl.CHNO_3CH_2NO_3,$$

is less soluble in acids or water than nitro-glycerine, its manufacture and purification are easy. Its specific gravity = 1·54 at 15° C.; on heating to about 180° C., red vapours appear, and at 190° C. it boils without exploding. It is very volatile under diminished pressure, distilling at about 120° under 15 mm. pressure.

It is comparatively safe against percussion or friction, but can be easily detonated by a fulminate detonator, and thus gives results differing but little from ordinary nitro-glycerine.

An addition of 20 per cent. of this dinitro-chlorhydrine to dynamite is said to prevent freezing in ordinary winter temperatures. This substance gelatinises nitrated celluloses.

Aceto nitro-glycerine is said to be a slight improvement on the ordinary nitro-glycerine in the matter of non-liability to freezing, and at the same time produce almost the same effect on explosion. It can be made by converting the glycerine into the mono acetate by the action of glacial acetic acid and subsequent treatment with the mixed acids in the ordinary way.

Its composition is represented by the formula $C_3H_5(NO_3)_2C_2H_3O_2$.

Explosives of this type are often compared by exploding a weighed amount inside a lead cylinder. The increase in capacity, or widening out of the bore of the cylinder, is then ascertained and compared with a standard explosive.

CHAPTER IX.

HISTORY, PROPERTIES, ETC., OF SMOKELESS POWDERS AND CORDITE. MANUFACTURE OF CORDITE.

ALTHOUGH smokeless, or semi-smokeless explosives have for some time been in use for sporting purposes, it is only within comparatively recent years that serious attention has been paid to the production of a smokeless powder for military purposes.

Immediately after the discovery of guncotton attempts were made, notably in Austria, to suit it for this purpose, but the extreme difficulty of controlling with certainty and uniformity its rate of combustion in guns and small arms, prevented its adoption.

France, about the year 1885, was the first country to adopt a smokeless powder for the ammunition for use with the Lebel magazine rifle. It was known as "Vieille" powder, or "Poudre B," and was simply a mixture of soluble and insoluble cellulose nitrates, somewhat hardened by digestion with ether and alcohol. Since that date several preparations, giving little or no smoke, consisting essentially of guncottons, or nitrated celluloses, or of mixtures of them with other substances, specially treated to render them slower burning, have been proposed to take the place of black powder. The general nature of treatment, for which many patents have been taken out, consists in dissolving or gelatinizing the guncotton by the use of liquids, such as acetic ether and acetone, by which process the fibrous character of the original substance is more or less destroyed, and a horny material produced, the rate of combustion of which is slower than that of the substance in its fibrous condition, the reduction in the rate of combustion being entirely due to the physical condition of the resulting product. Heating compressed blocks or granules of these substances with camphor, instead of treating them with liquid solvents, also has the effect of hardening their surfaces, and of reducing the rate of combustion, and has been applied with some success to the production of semi-smokeless powders.

The solvents above mentioned (except camphor) do not enter into the composition of the finished material; the gelatinous mass obtained by their action is in this condition rolled out into sheets, or pressed through suitable dies into

REELING GEAR FOR RIFLE CORDITE.

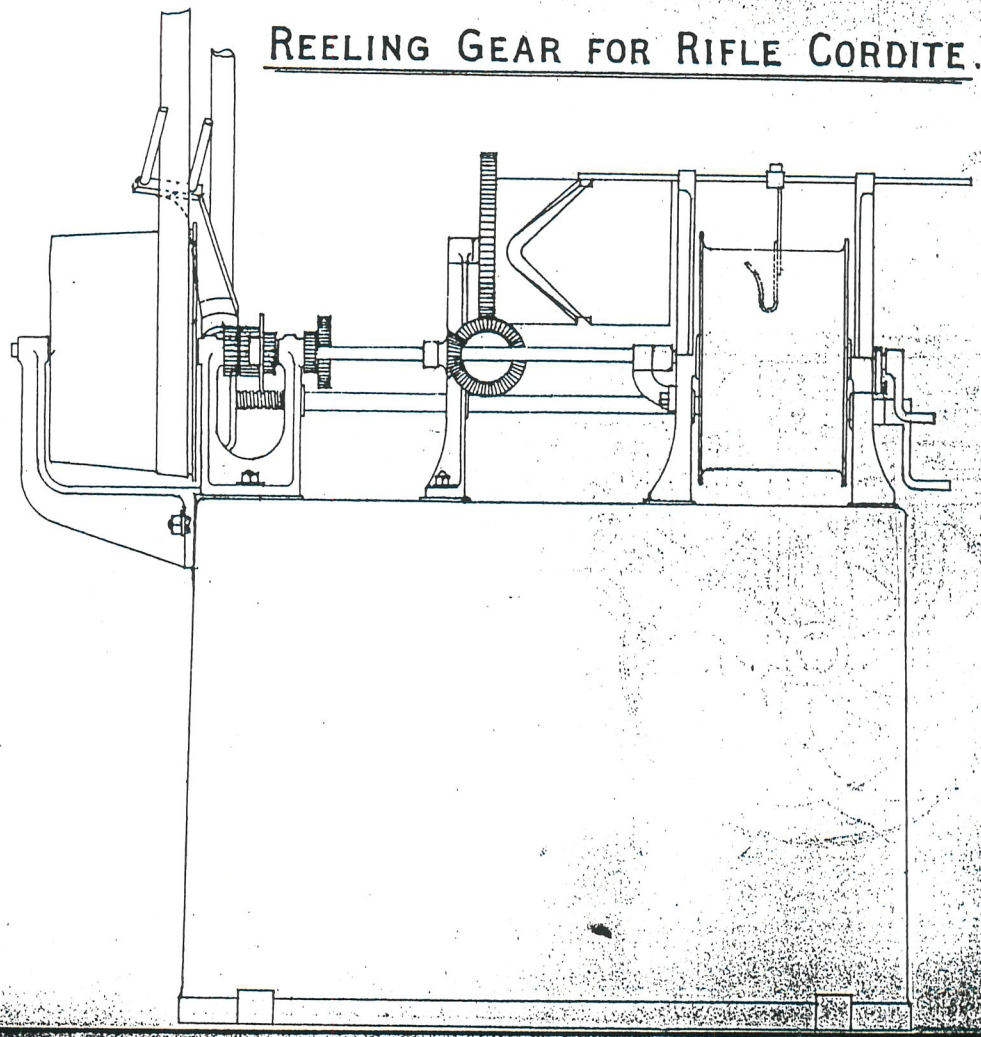


PLATE XX

PLATE XLV

PRESS FOR RIFLE CORDITE.

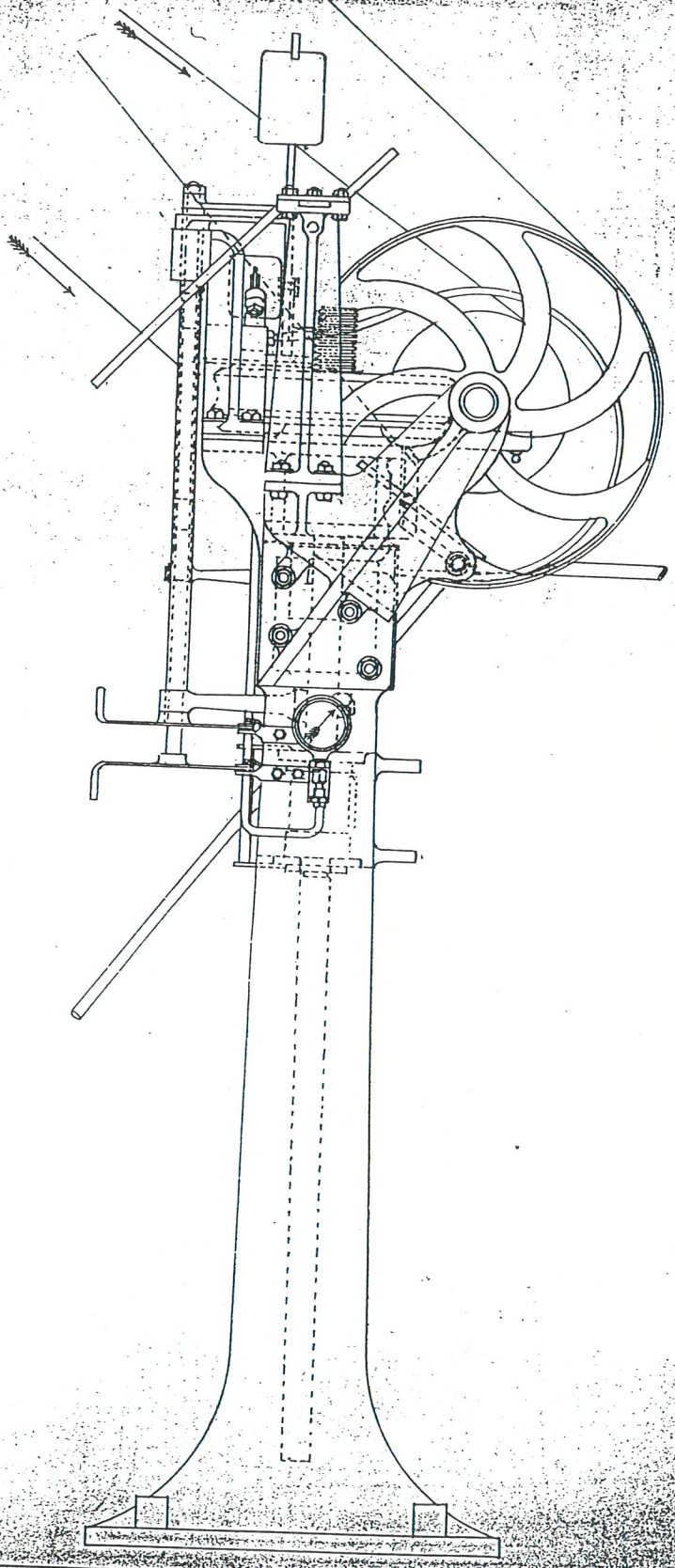


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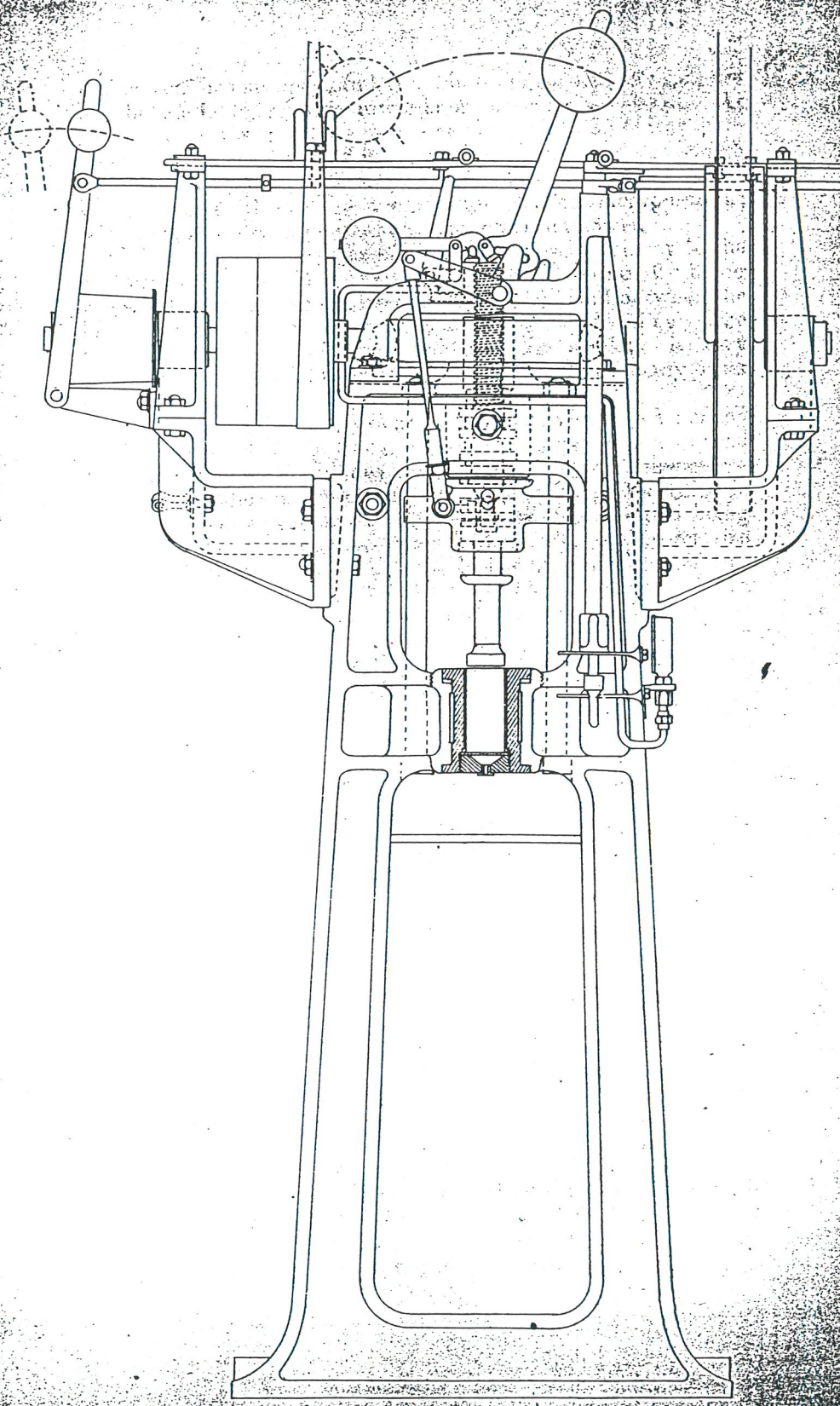
PLATE XVII

PRESS FOR RIFLE CORDITE.



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INCORPORATING MACHINE FOR CORDITE.

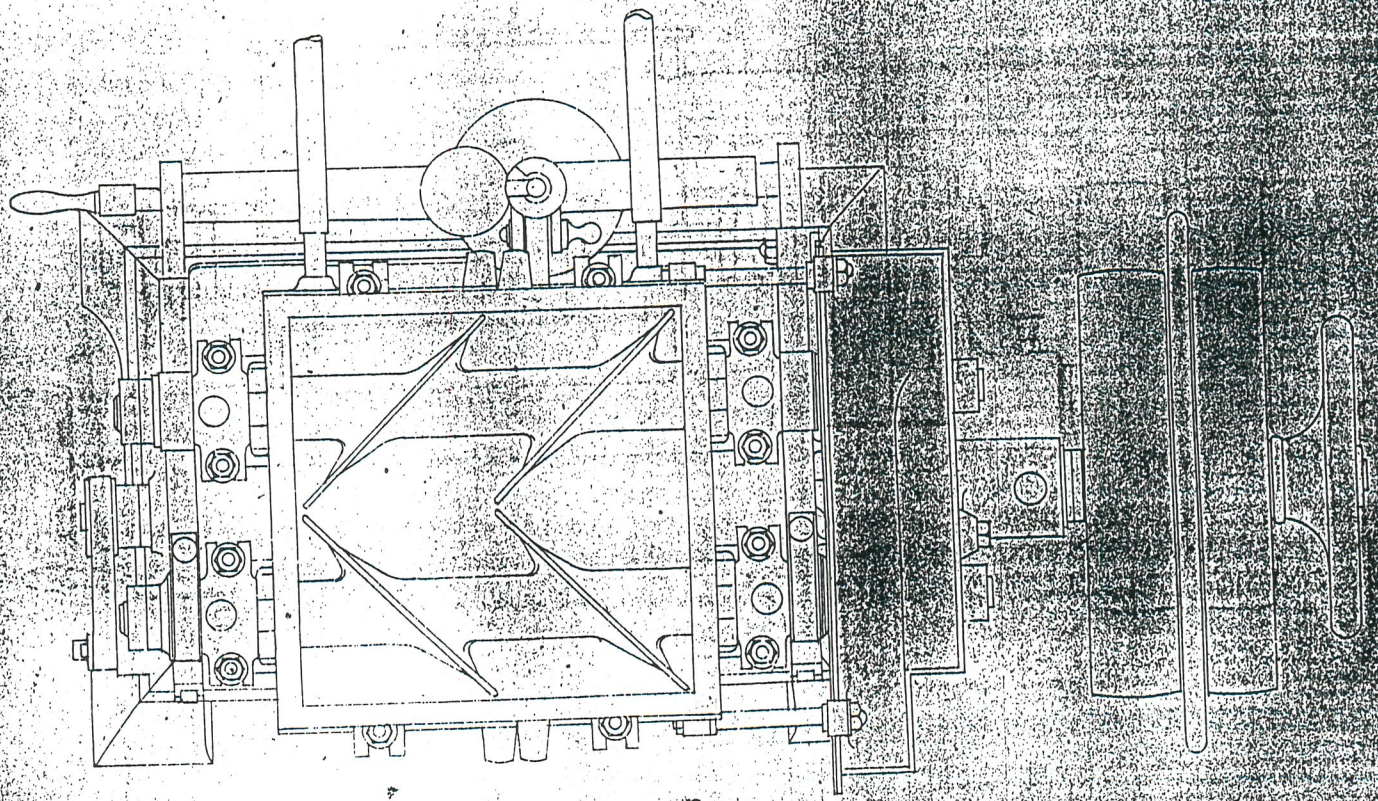


PLATE XVII.

INCORPORATING MACHINE FOR CORDITE.

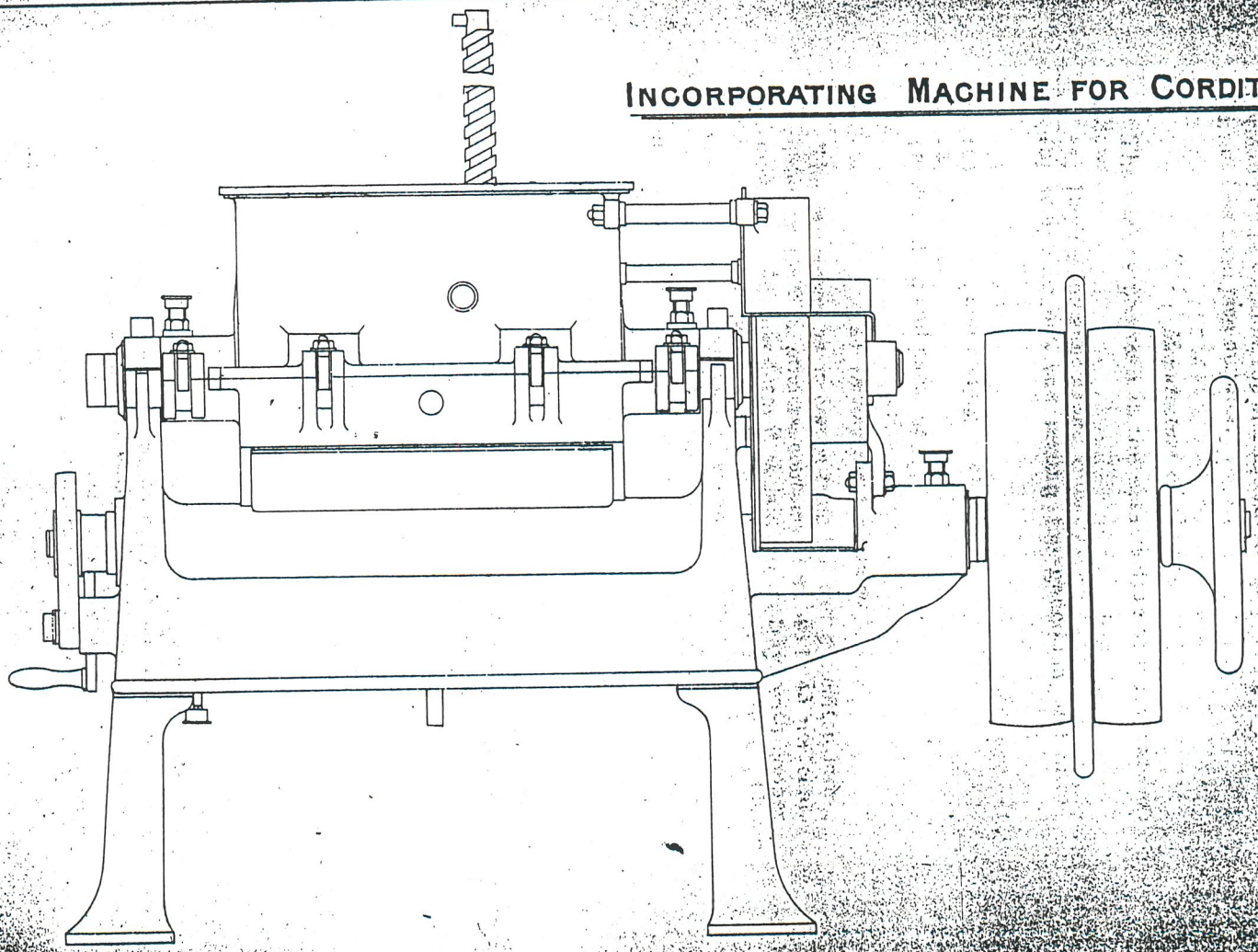
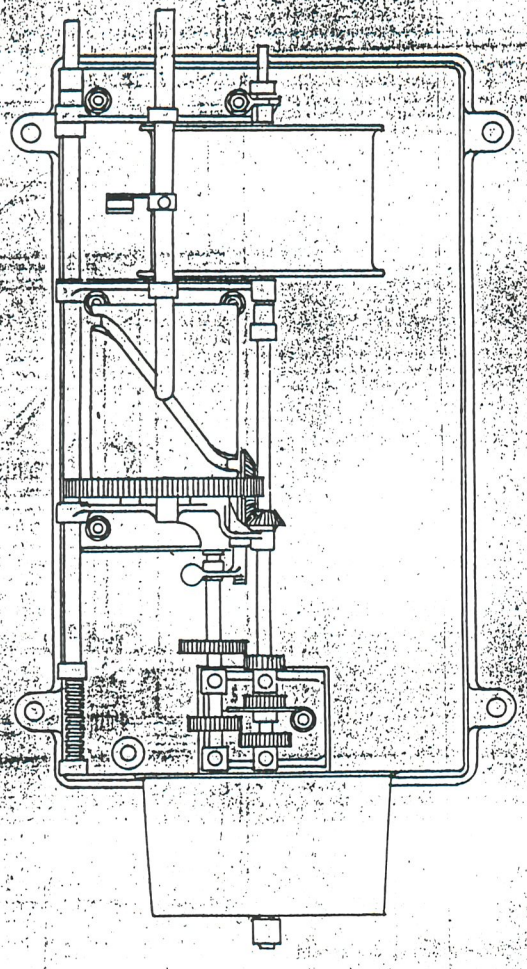


PLATE XXX



REELING GEAR FOR RIFLE CORDITE.

(D) *Pressing and Reeling or Cutting.*

There are three natures of presses in use at Waltham Abbey for pressing ~~or "squirting"~~ cordite, viz.,—screw, screw and hydraulic combined, and hydraulic. The screw presses are used for the manufacture of small-arm cordite, and are combined with an automatic reeling arrangement for winding the cordite onto reels as it issues from the die; the screw and hydraulic combined, and the hydraulic presses, are for producing the large natures of cordite, and they are provided with cutting gear for cutting the cordite to the required lengths, as it is pressed. The general construction of the screw press for small-arm cordite, is shown ~~on Plates XVIII and XIX.~~ The plunger, the upper portion of which is screwed, passes up through the centre of a worm wheel ~~which forms the nut, the worm wheel itself being~~ worked by a worm on a horizontal shaft to which the driving pulleys are attached. By means of automatic striking gear, the motion of the worm is reversed when the plunger comes to the bottom of its stroke, the speed of the return stroke being increased. On the completion of the up-stroke, the automatic striking gear again comes into play and stops the machine altogether.

The reeling gear is shown ~~on Plates XX and XXI.~~ The reel, the body of which is of ~~perforated zinc~~ sheet, with skeleton brass ends, is mounted in front of the press on a horizontal spindle with a cone pulley fixed to one end, and is driven by another cone pulley on the worm shaft; this latter pulley is made to revolve by means of a friction cone worked by a lever on the right side of the machine. The object of the cone pulleys is to enable the speed of the reel to be adjusted to suit the rate at which the cordite is issuing from the die. The cordite is traversed automatically from side to side of the reel as it is wound upon it. The press cylinders are closed at the bottom by a plug, provided with handles for screwing it in and out, in the centre of which is the die. Resting on the plug is a steel plate with a number of holes in it. This plate supports a fine wire gauze disc, which acts as a sieve to prevent small particles of wood or of other foreign substances from getting into and blocking up the die. The cylinder is shown in section on Plate XVIII.

The press cylinders are filled by ~~means of a small hydraulic "ramming machine," working at a low pressure, and having a quick up and down stroke, the motion being controlled by a hand lever actuating the valves. The pressure is only sufficient to consolidate the material in the press cylinder.~~ The full cylinder is placed in the press under the plunger, and the machine started and worked as above described. On completion of the up-stroke, the empty cylinder is removed from the press and another full one inserted. Each cylinder contains a little over one pound of cordite dough, ~~which~~ is pressed out into a length of about 2,000 feet and wound on the reel. A

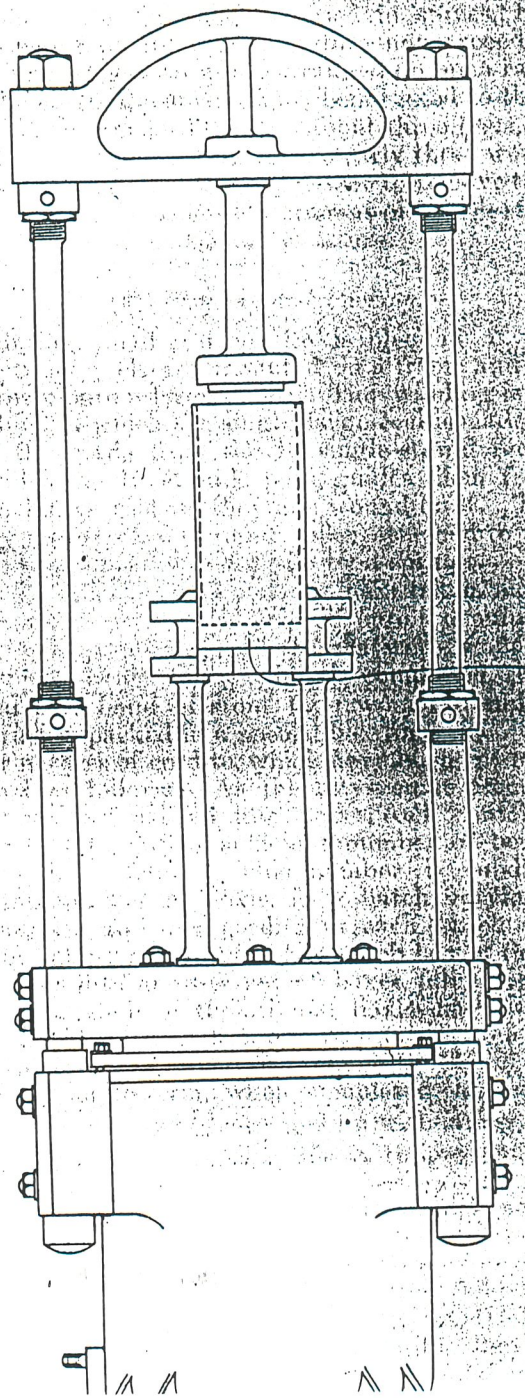
The screw and hydraulic presses for the large natures of cordite are, as far as the actual pressing is concerned, on practically the same principle as the screw press just described. The press cylinders however, are an integral part of the machine, and are not removed for filling, the filling being done from a hopper attached to the cylinder, which latter is deep enough to contain the whole charge in an uncompressed condition.

In one pattern of press, the plunger screw is attached to, and revolves in a ram working in a small hydraulic cylinder. When the press cylinder is charged, the valve leading to the hydraulic cylinder is opened, and the pressure, acting on the ram and plunger, forces it down, and it compresses the material into the actual press cylinder, ~~performing in this way the same function as the hydraulic ramming machine in the case of the cylinder of the small press.~~ The screw gear is then started and the material pressed out through the die. The arrangement of perforated plate and wire gauze strainer is the same as in the small press cylinder. The number of dies in the plug, that is the number of cords that can be pressed at one time, depends on the diameter of the press cylinder, and on the size of the cordite which is being pressed.

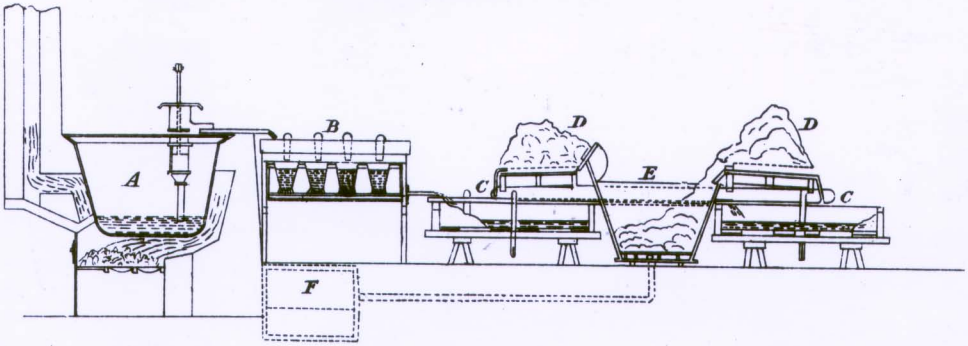
The smaller sizes of cordite, that is, sizes 5, 7·5, and 10, are reeled by hand on reels of similar materials to those used for small arm cordite, as they issue from the die. As soon as a pressing is completed, the reels are taken to a cutting machine, consisting of two horizontal steel blades, mounted on a stand opposite one another, and in the same plane. The reel is supported in the stand so that the cordite lies at right angles to, and between the two blades, which are then brought together until they touch the reel, and in so doing they of course cut through the cordite and divide it into a number of strands of equal, or nearly equal length, this length being regulated by the diameter of the reel. The cordite is then laid out flat on shallow wooden trays, the bottoms of which are formed of narrow battens with open spaces between them.

The larger natures of cordite, viz., size 15, and above, are led as they issue from the die, onto an endless leather band travelling at the same rate as the issuing cordite. This band has steel blades on its surface, fixed at right angles to the direction of its motion. The band passes under a roller, which is adjusted so as to press the cordite on to the knives, and in this way it is cut to length, the length being regulated by the distance apart of the blades on the belt. As they are cut, the strands are picked off the belt by hand, and arranged on trays, as described above in the case of the smaller natures.

The hydraulic press, a general outline of which is shown on Plate XXII, is on the usual principle of such presses. The plunger is fixed and the cylinder is supported on a table which is secured to the ram. As the ram ascends, the cordite is pressed out, and reeled or cut on the endless band, driven by

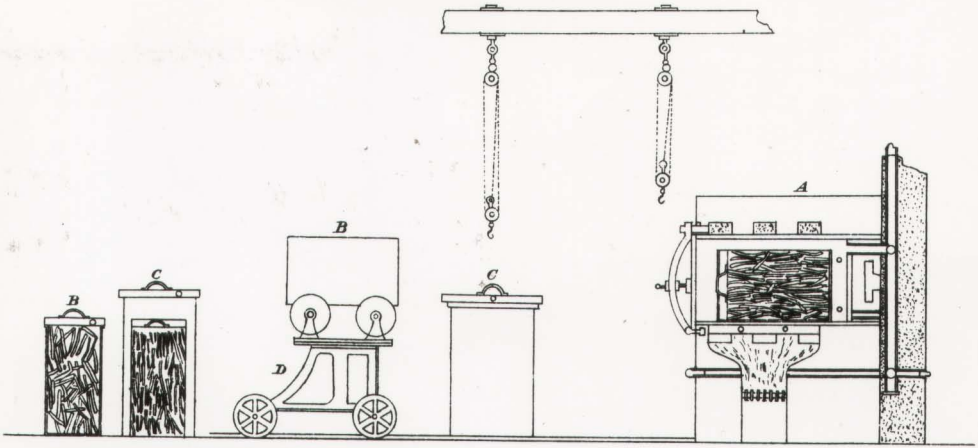


Apparatus for Refining Saltpetre.



A. *Refining Copper*
B. *Filtering Stand*
C. *Coolers or Crystallizing Pans*
D. *Drainers.*
E. *Washing Vat.*
F. *Liquour Tank.*

Apparatus for Burning Charcoal.



A. Retort, showing pipes for conducting gases to the furnace.
B. Slip, for holding wood. C. Cooler. D. Carriage for Slip.

SULPHUR REFININC APPARATUS.

Fig.1.

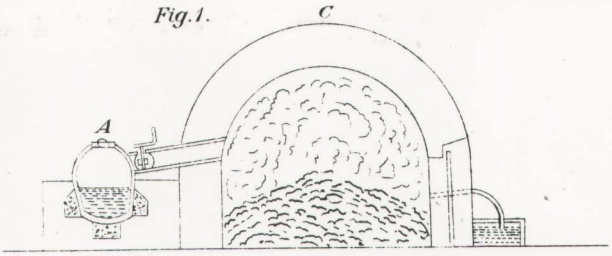
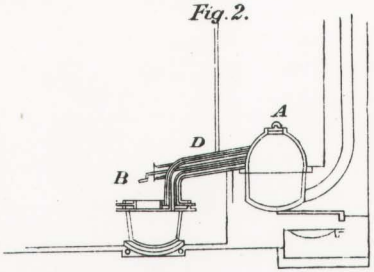
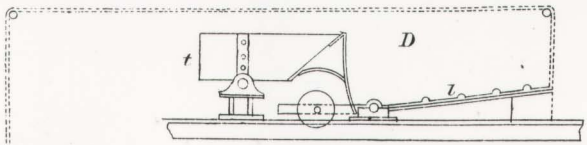


Fig.2.

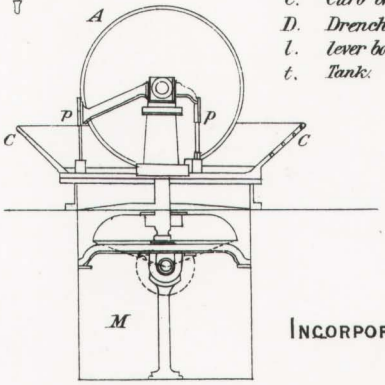


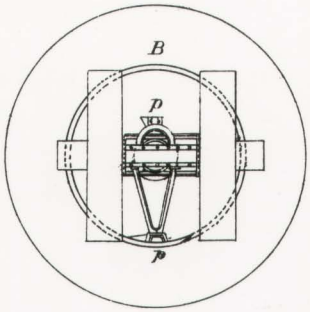
A. Melting Pot.
B. Receiving Pot.
C. Subliming Chamber.
D. Cold Water Jacket

The Subliming Chamber & Receiving Pot are placed at right angles to one another in the refinery.



A. Sectional Elevation, showing one runner and ploughs (p.p)
B. Plan of runners and bed.
C. Curb of bed. M. Underground Tank for Machinery.
D. Drenching apparatus.
l. lever board or shutter.
t. Tank.

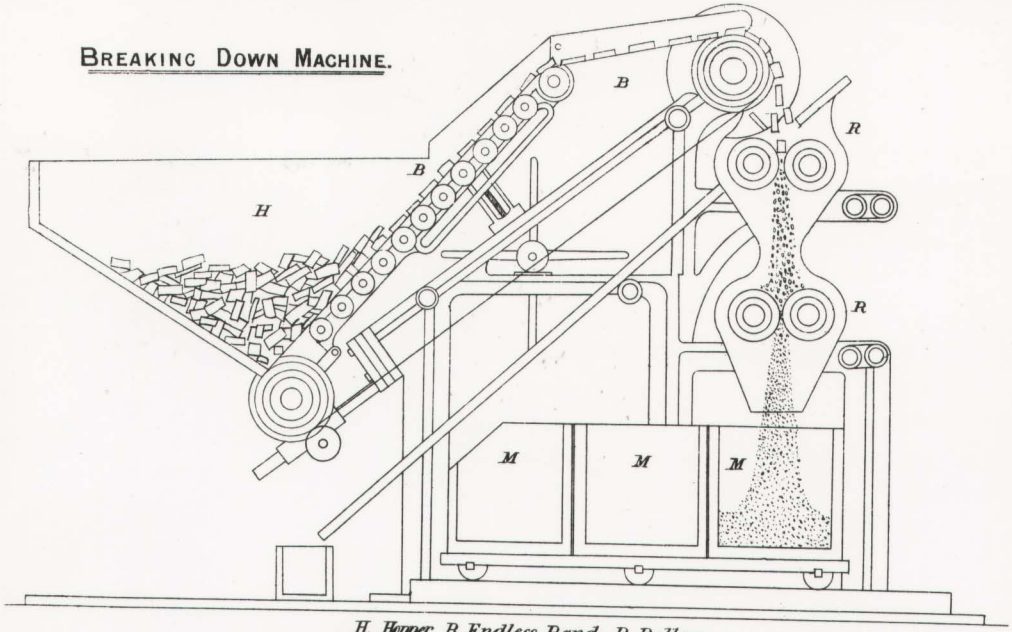




INCORPORATING MILL.

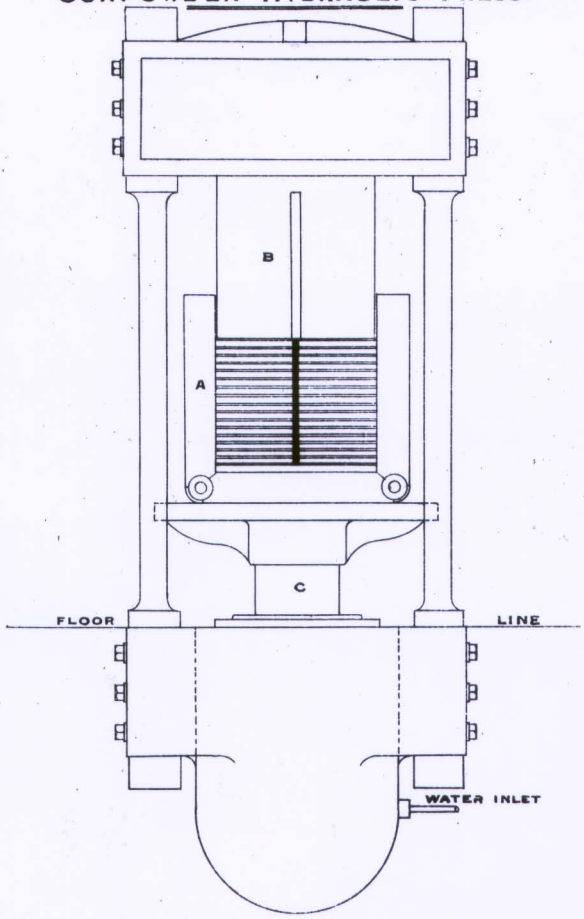
N. B. In the Mill the Shutter is placed directly over the bed.

BREAKING DOWN MACHINE.



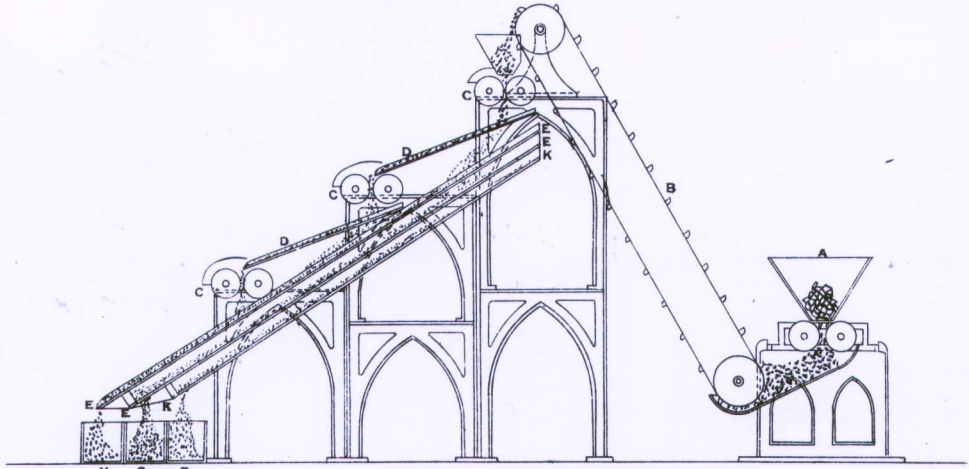
H. Hopper. B. Endless Band. R. Rollers,
M. Boxes to receive meal.

GUNPOWDER HYDRAULIC PRESS.



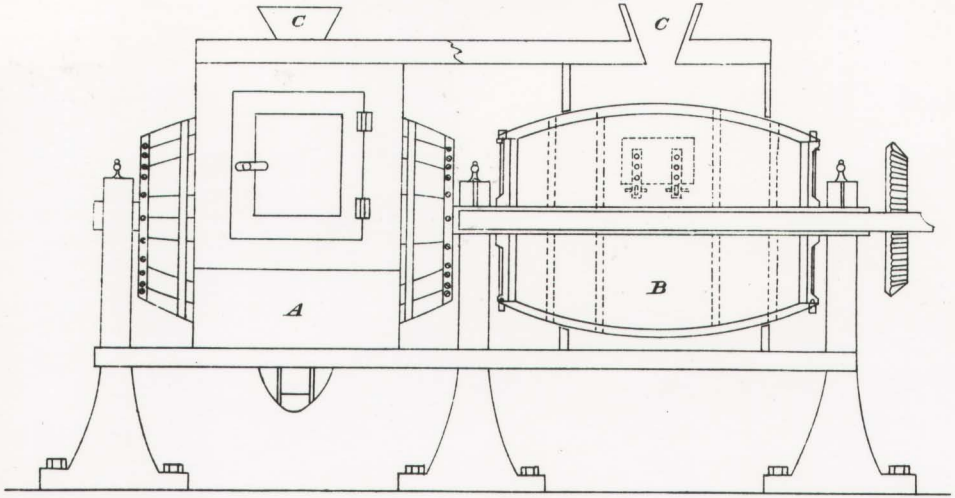
A. PRESS BOX. B. PRESS BLOCK. C. HYDRAULIC RAM.

Granulating Machine.



A. Hopper for Receiving the Cake.
D. Endless Band.
C.C.C. Three Pairs of Rollers.
D.D. Short Screens.
E.E. Long Screens.
F. Box for Dust
G. Box for Grain.
H. Box for Chucks.
K. Bottom Board.

GLAZING BARRELS.

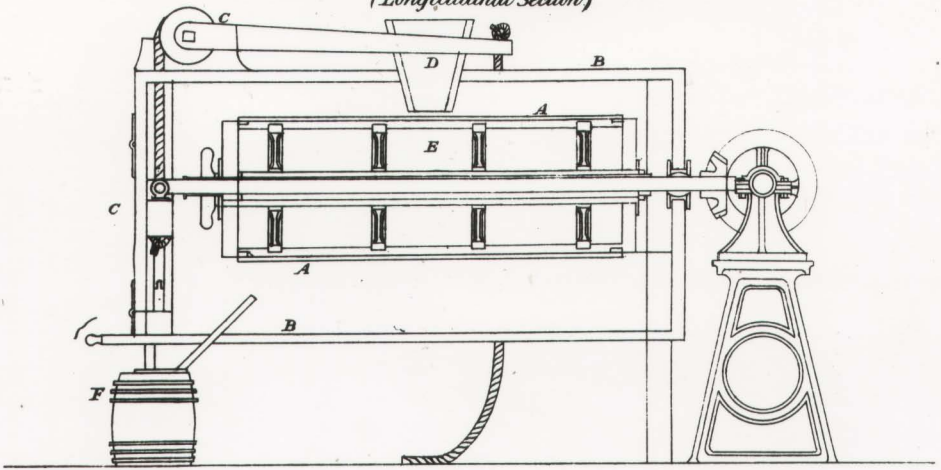


A. Elevation, showing door of case.
C. Hoppers for loading.

B. Section through barrel.
(showing opening in dotted lines)

HORIZONTAL FINISHING REEL.

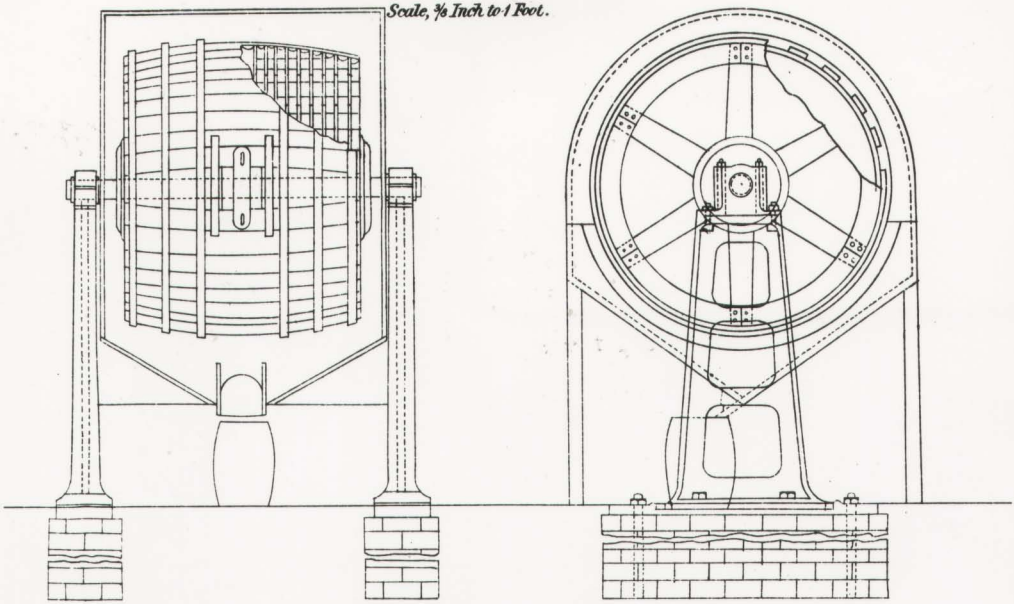
(Longitudinal Section)



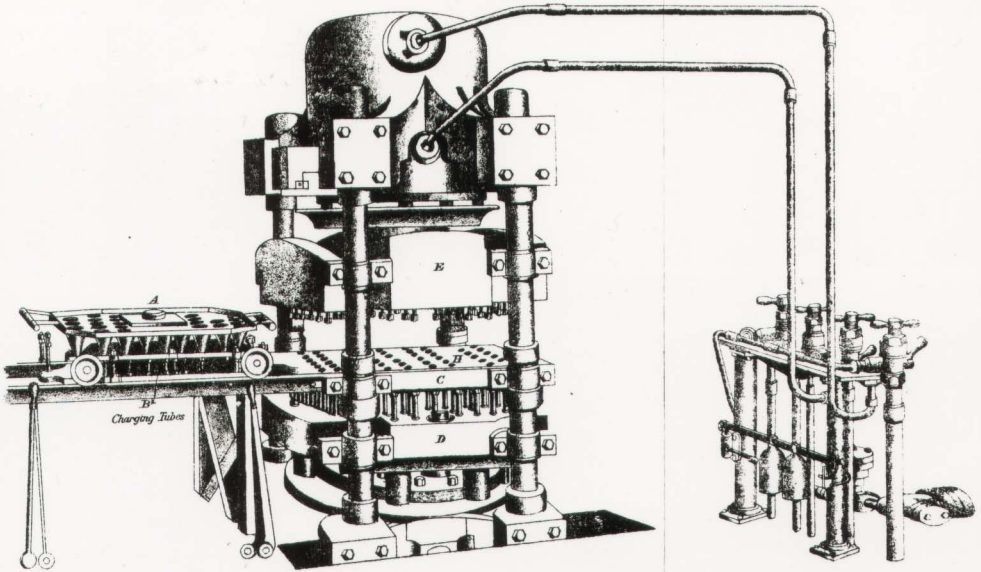
A. Cylindrical reel.
B. Reel Case.
C. Apparatus for lowering one end for unloading.
D. Hopper for Loading.
E. Opening in reel for loading.
F. Barrel for unloading into.

WOODEN SKELETON FINISHING REEL.

Scale, ¾ Inch to 1 Foot.

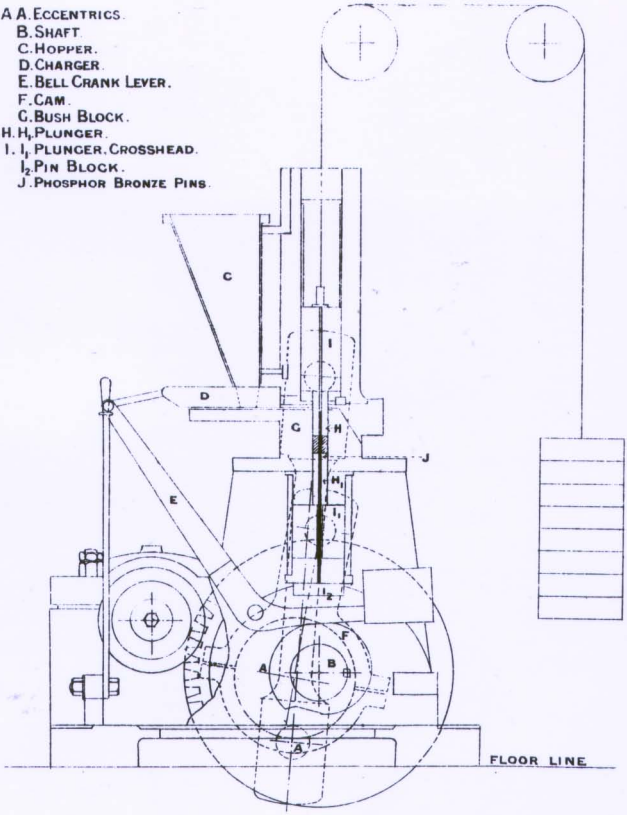


Prismatic Powder Machine.

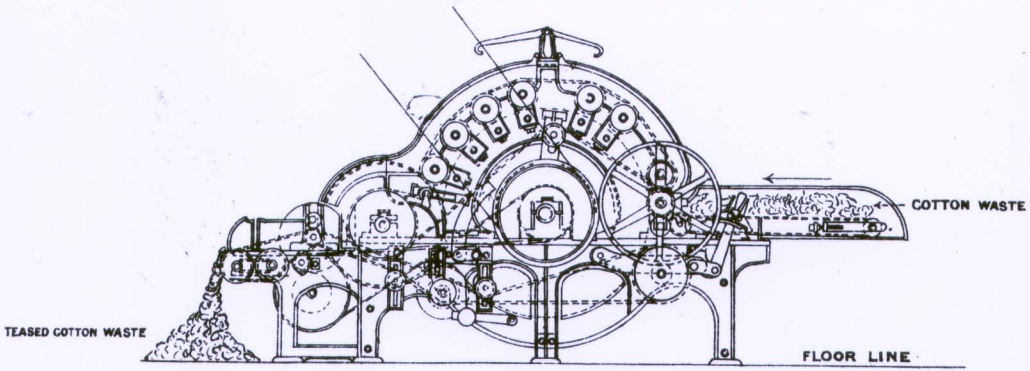


CAM MACHINE.

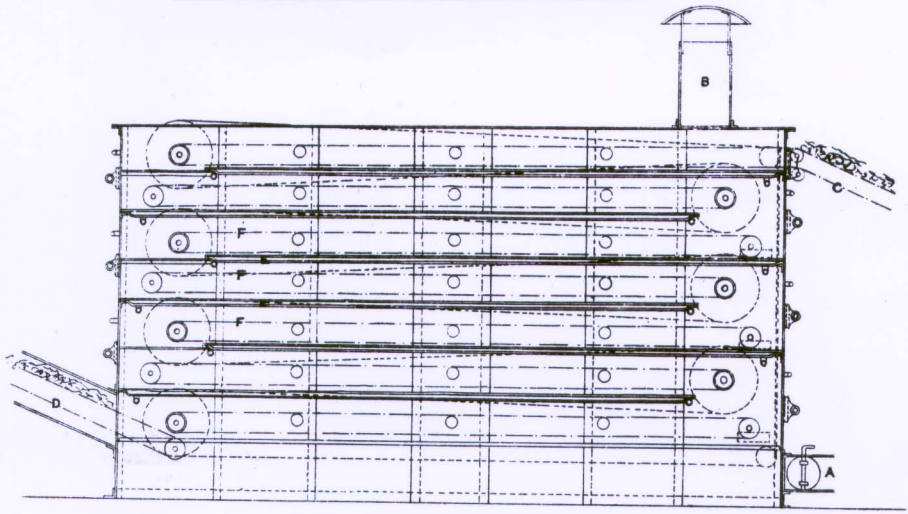
A A. ECCENTRICS.
B. SHAFT.
C. HOPPER.
D. CHARGER.
E. BELL CRANK LEVER.
F. CAM.
G. BUSH BLOCK.
H. H_1 PLUNGER.
I. I_1 PLUNGER. CROSSHEAD.
I_2 PIN BLOCK.
J. PHOSPHOR BRONZE PINS.



COTTON WASTE TEASING MACHINE.

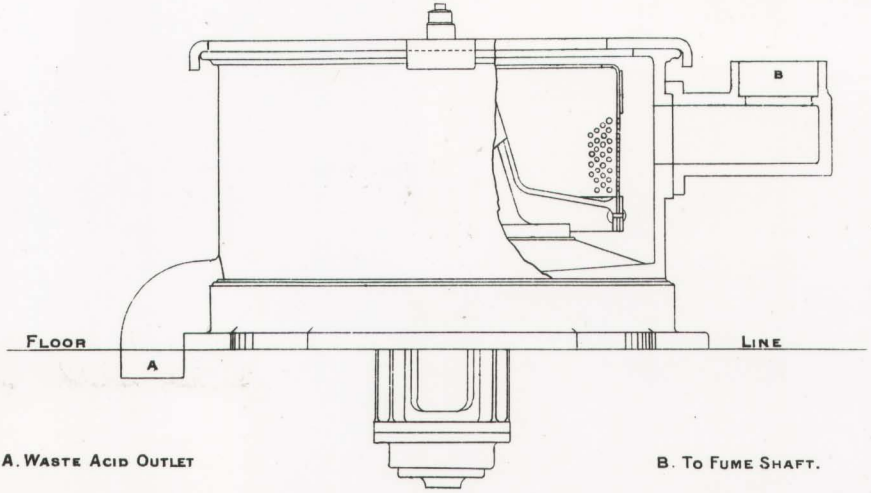


COTTON WASTE DRYING MACHINE.



A. Hot Air Inlet.
B. Hot Air Outlet.
C. Cotton Elevating Band, Inlet.
D. Cotton Elevating Band, Outlet.
E. Steam Trays.
F. Endless Bands.

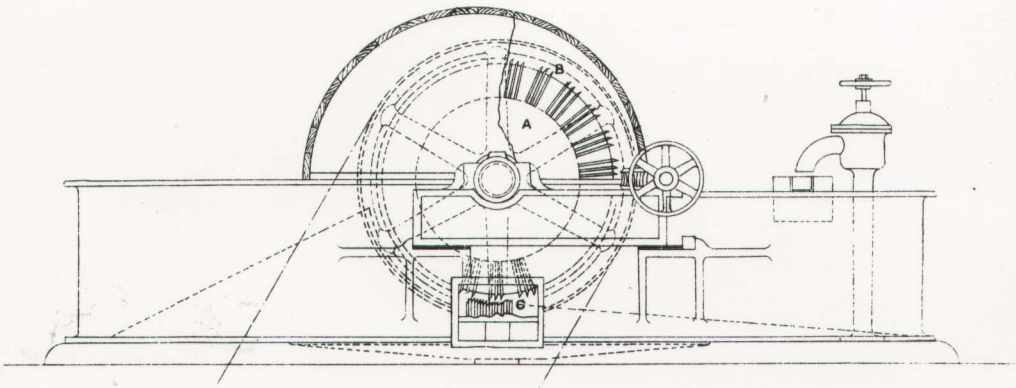
CENTRIFUGAL ACID EXTRACTOR.



A. WASTE ACID OUTLET

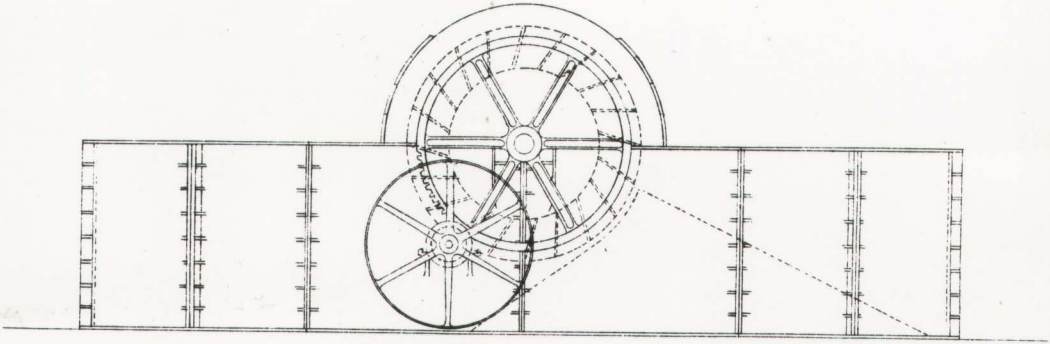
B. TO FUME SHAFT.

BEATING ENGINE.

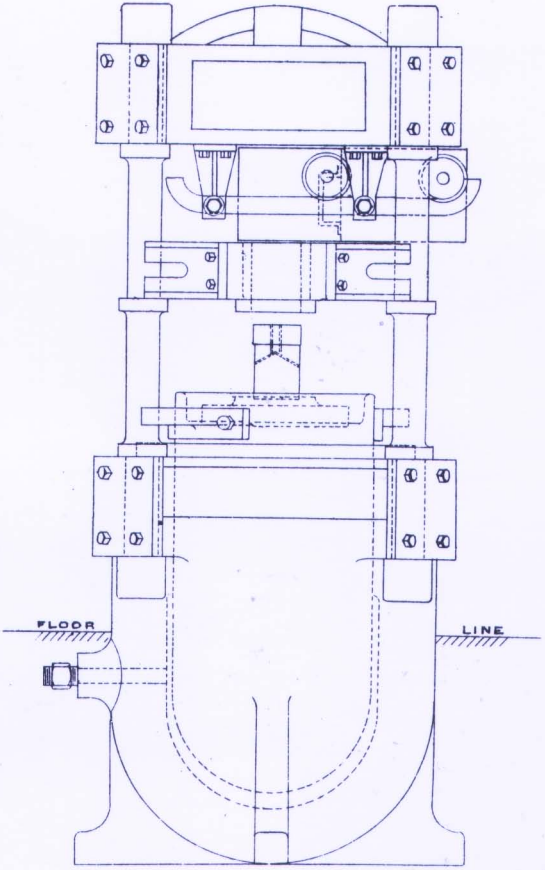


ROLLER A. KNIVES B. BEDPLATE C.

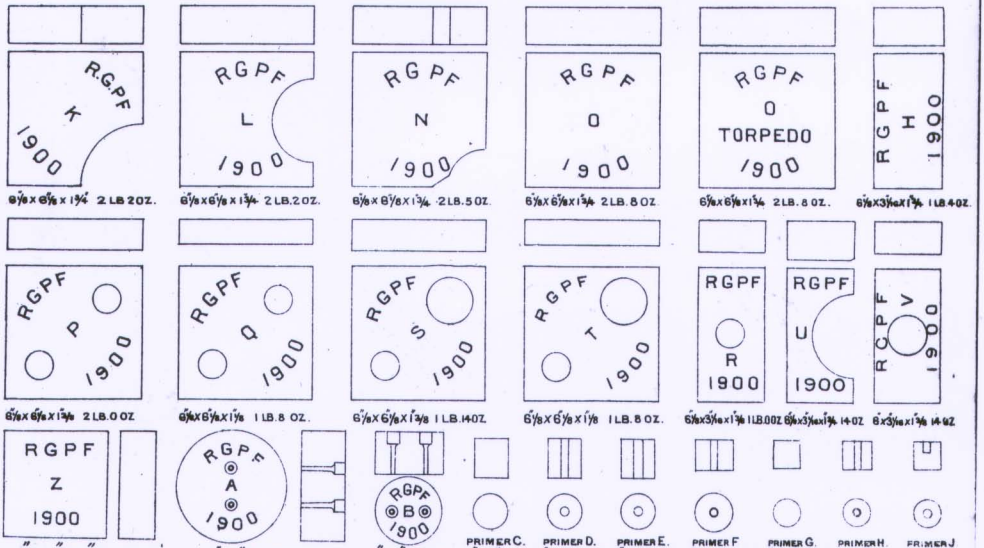
POACHER.



GUNCOTTON HYDRAULIC PRESS.



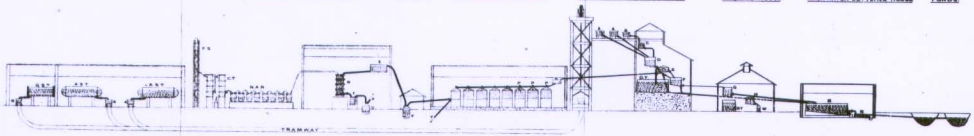
SERVICE GUNCOTTON SLABS AND PRIMERS.



NITRO-GLYCERINE FACTORY.

NOTE. ACID WATER AND GLYCERINE
NITRO-GLYCERINE

GLYCERINE AND ACID SHED | TOWERS AND ACID SEPARATING HOUSE | EGG HOUSE | AFTER SEPARATING HOUSE | LIFT AND NITRATING HOUSE | WASHING HOUSE | WASH WATER SETTLING HOUSE | PONDS.



B. GLYCERINE BOGIE
G.S.T. GLYCERINE STORE TANK
A. ACID BOGIES
A.S.T. ACID STORE TANKS

N.A.R. NITRIC ACID RECEIVERS
C.T. CONDENSING TOWERS
F.S. FUME SHAFT

R. ACID TOWERS
S. SETTLING TANK
T. SYPHON TANK AND COIL
U. SULPHURIC ACID EGG
X. TO CONCENTRATION PLANT

V. ACID EGG

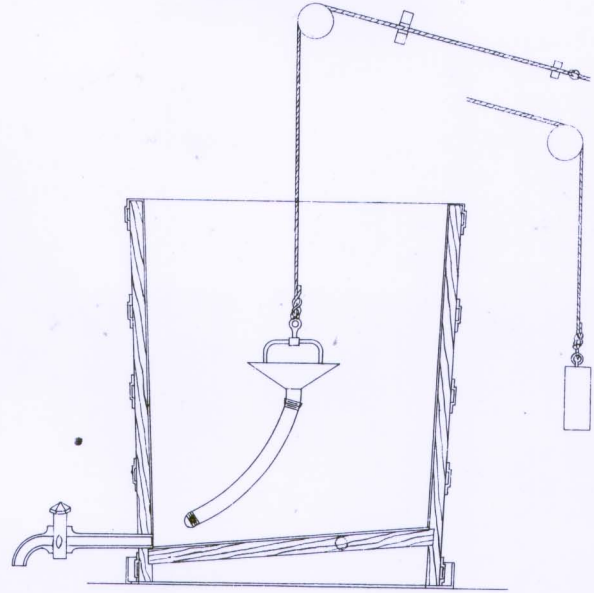
O. ACID TANK
P. SEPARATING BOTTLES
Y. DRAIN TO RIVER

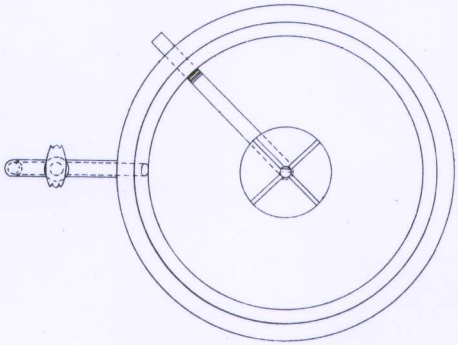
A. ACID BOGIES
B. GLYCERINE BOGIE
C. GLYCERINE TANK
D. NITRATING APPARATUS
E. SEPARATING TANK
F. PREMASH TANK
DT. DROWNING TANK

G. WASHING TANK
H. FILTER TANK
DT. DROWNING TANK
W. SCALES

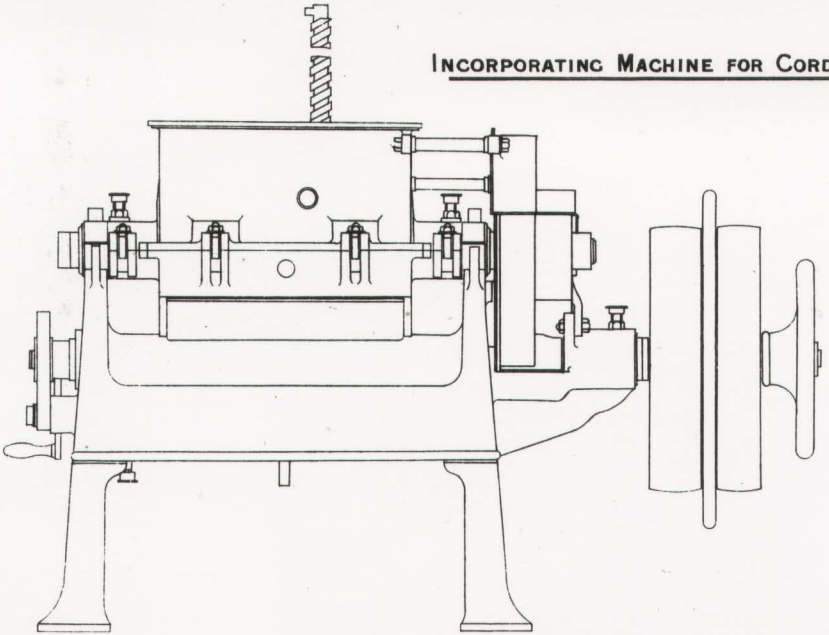
M. WASH WATER SETTLING TANK
N. LABYRINTH

N/G WASHING TANK.

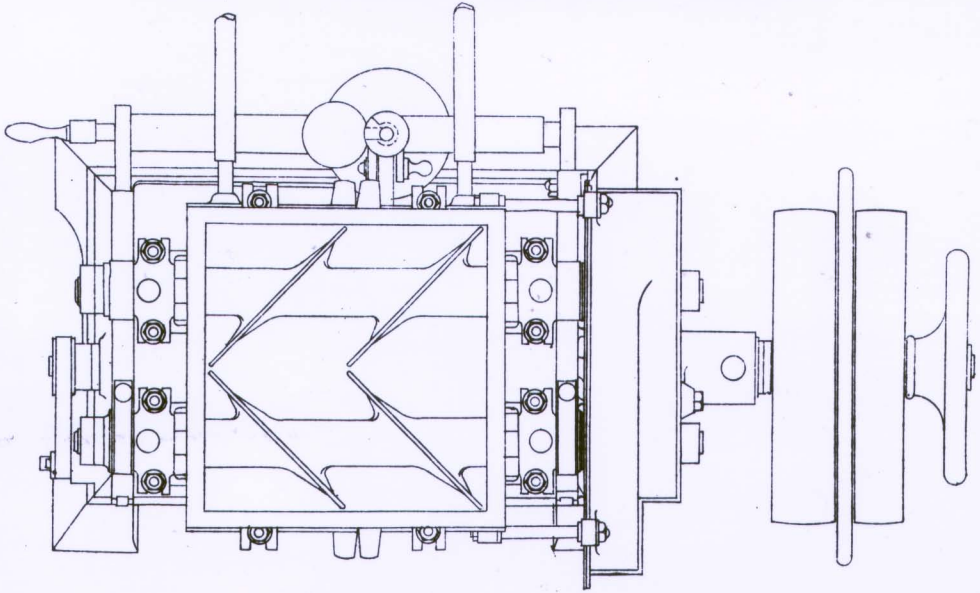




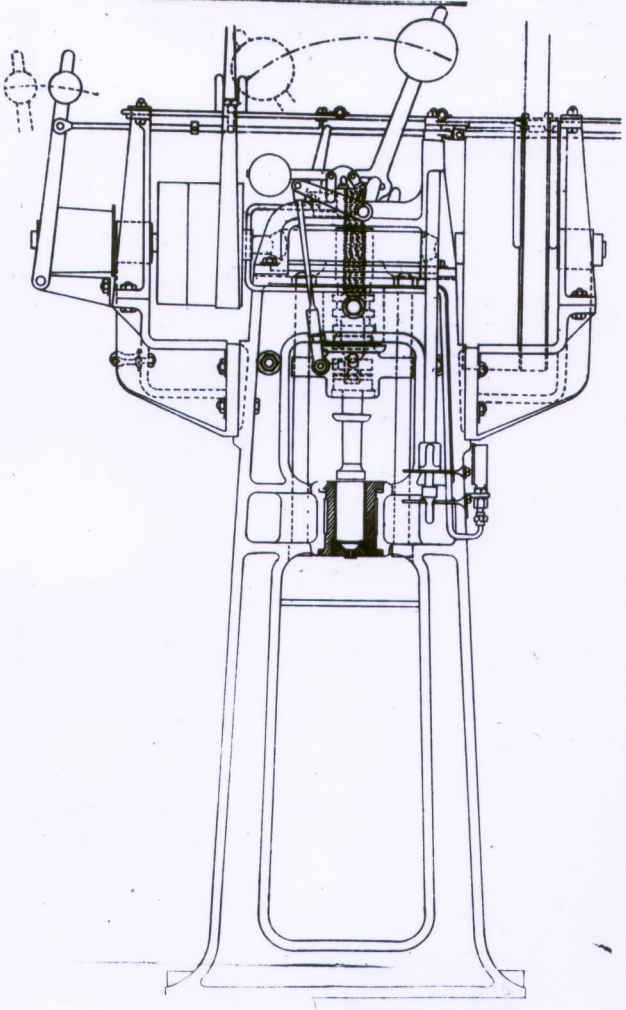
INCORPORATING MACHINE FOR CORDITE.



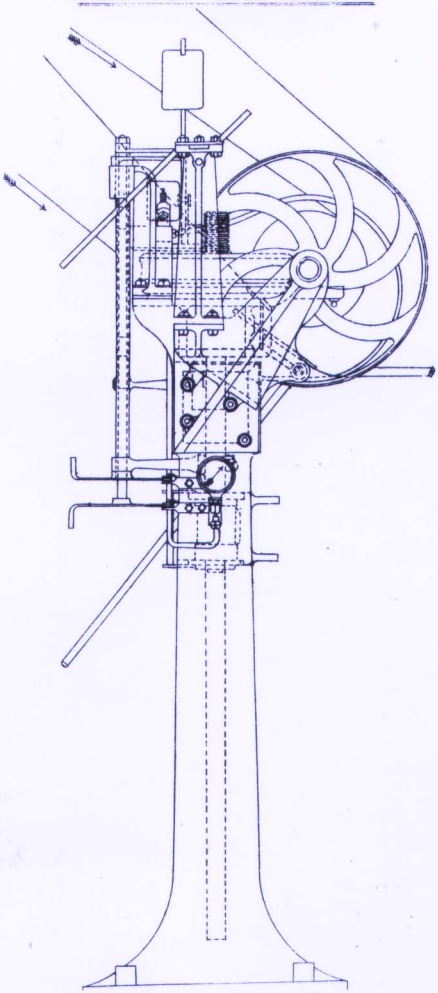
Incorporating Machine for Cordite.



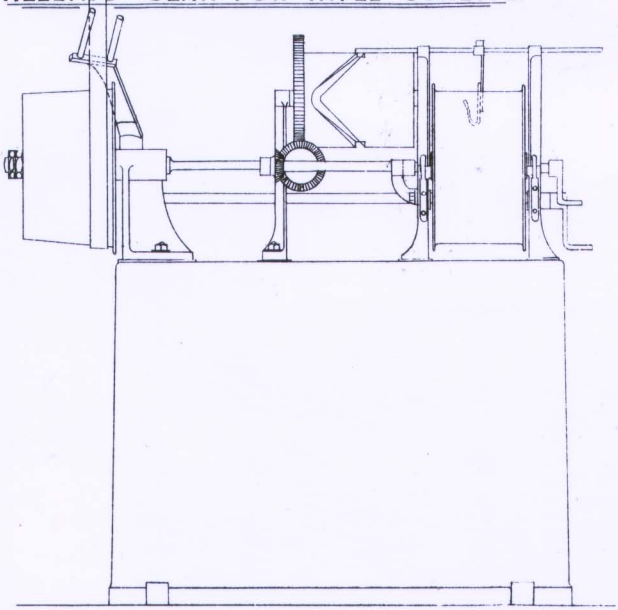
PRESS FOR RIFLE CORDITE.



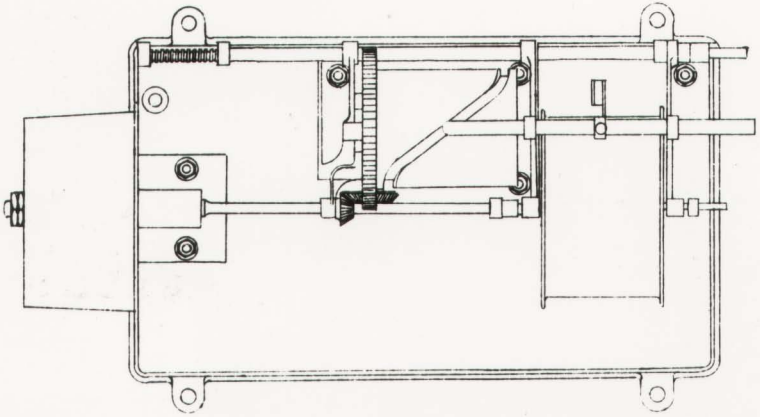
PRESS FOR RIFLE CORDITE.



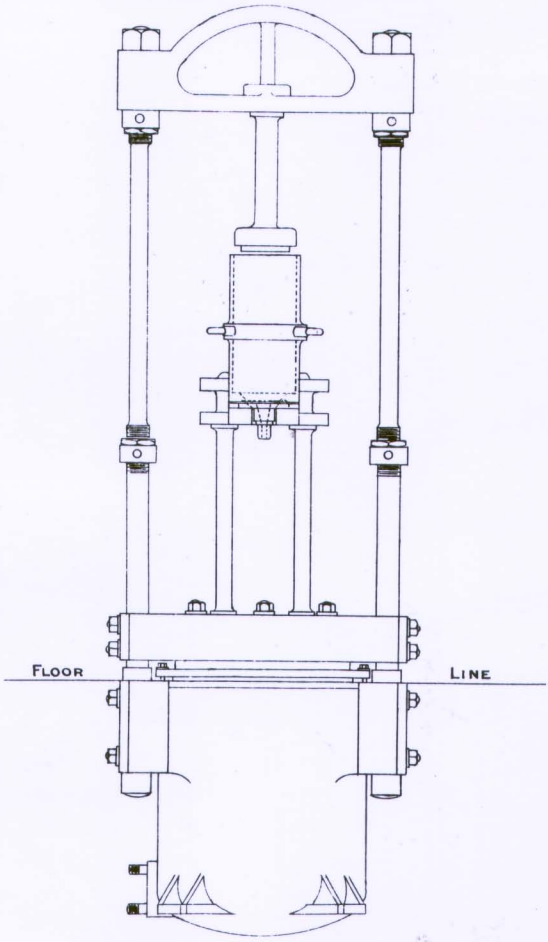
REELING GEAR FOR RIFLE CORDITE.



REELING GEAR FOR RIFLE CORDITE.



CORDITE HYDRAULIC PRESS.



PRO Supply 5/809

Treatise on Service Explosives. HMSO. 1900

LIST OF PLATES.