No. 860,607. PATENTED JULY 16, 1907.

F. I. DU PONT.

MACHINE FOR CHARGING CARTRIDGE SHELLS.

APPLICATION FILED JULY 12, 1905.

5 SHEETS—SHEET 1.

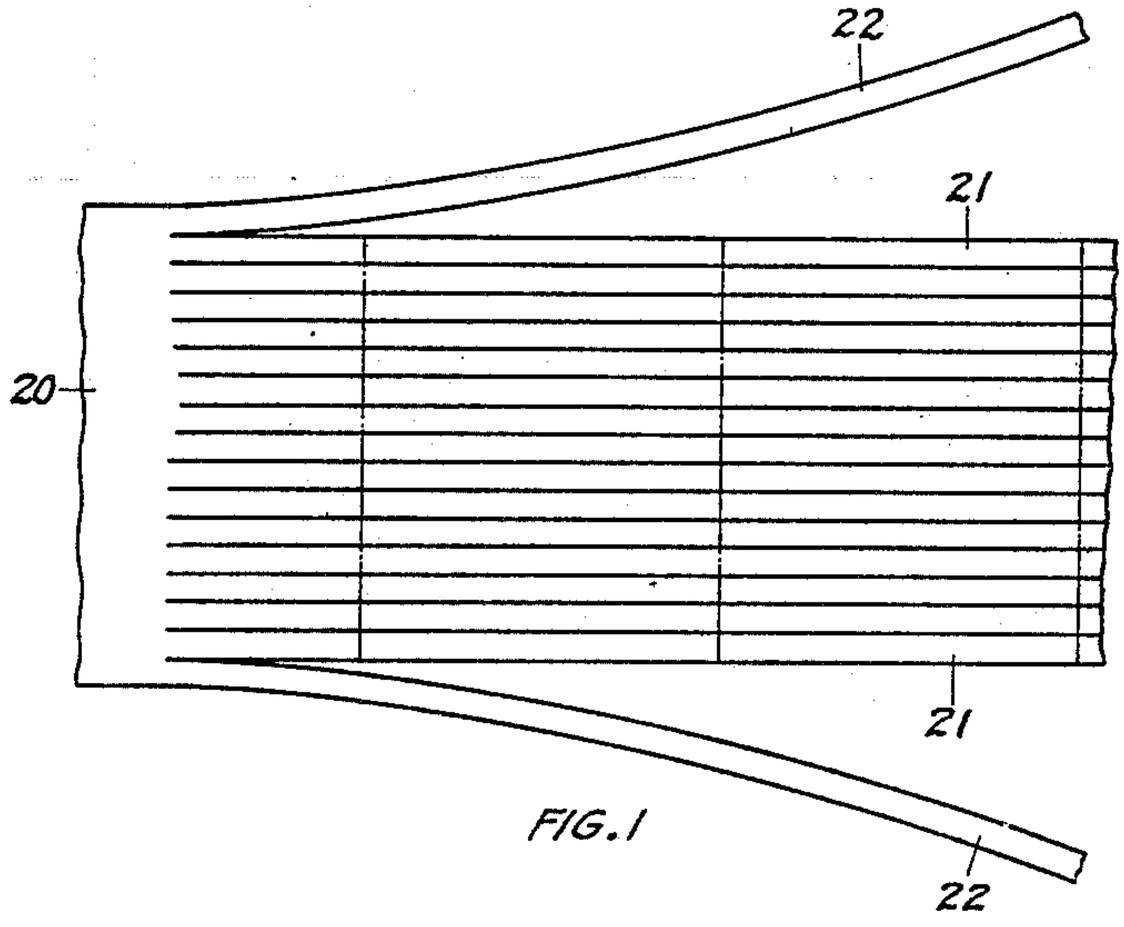

FIG. 1

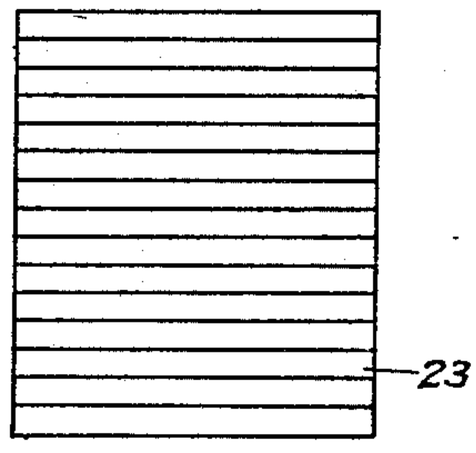

FIG. 2

FIG. 3

FIG. 4

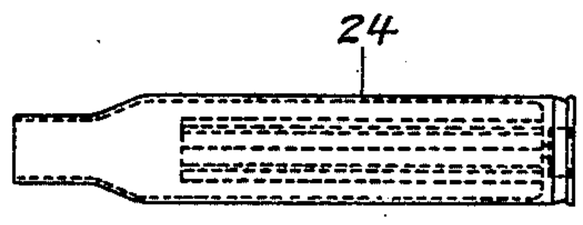

FIG. 5

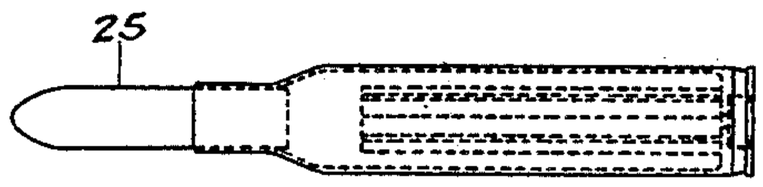

FIG. 6

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5 SHEETS—SHEET 2.

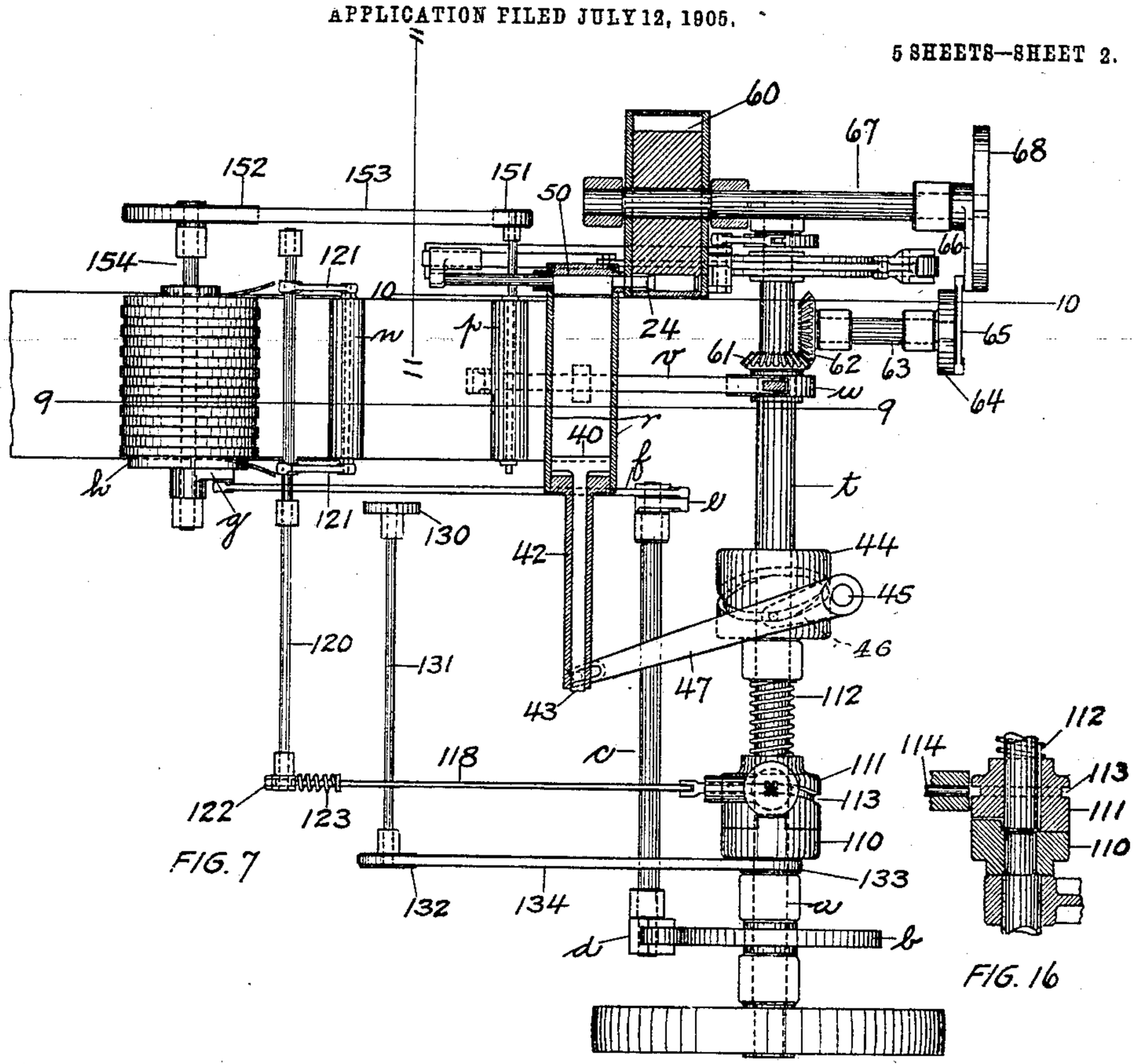

FIG. 7

FIG. 16

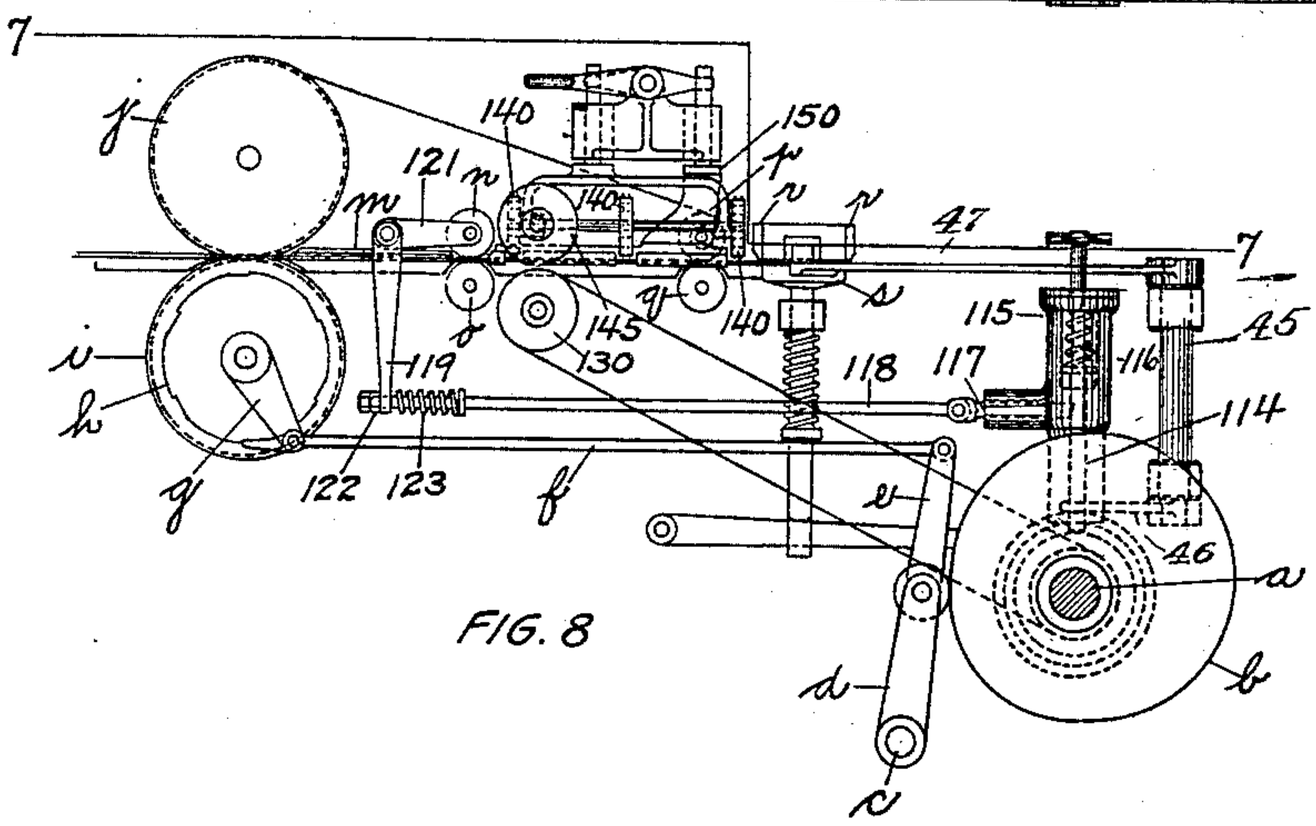

FIG. 8

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5 SHEETS—SHEET 3.

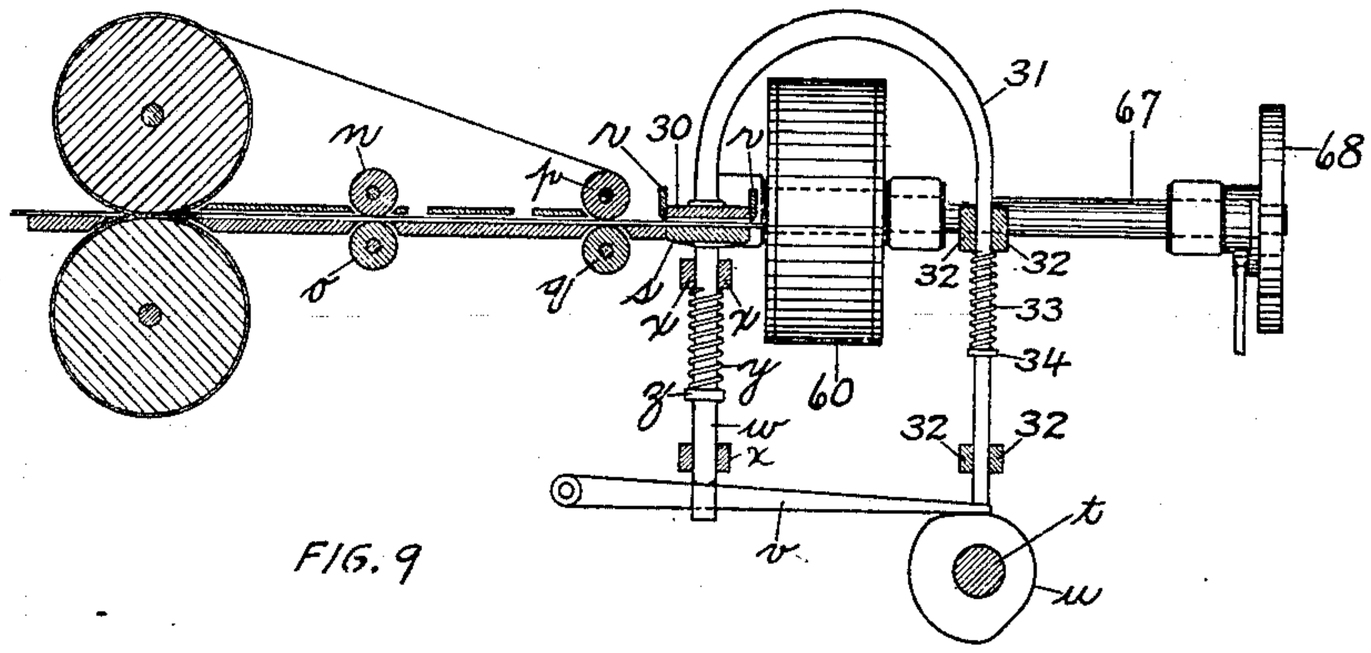

FIG. 9

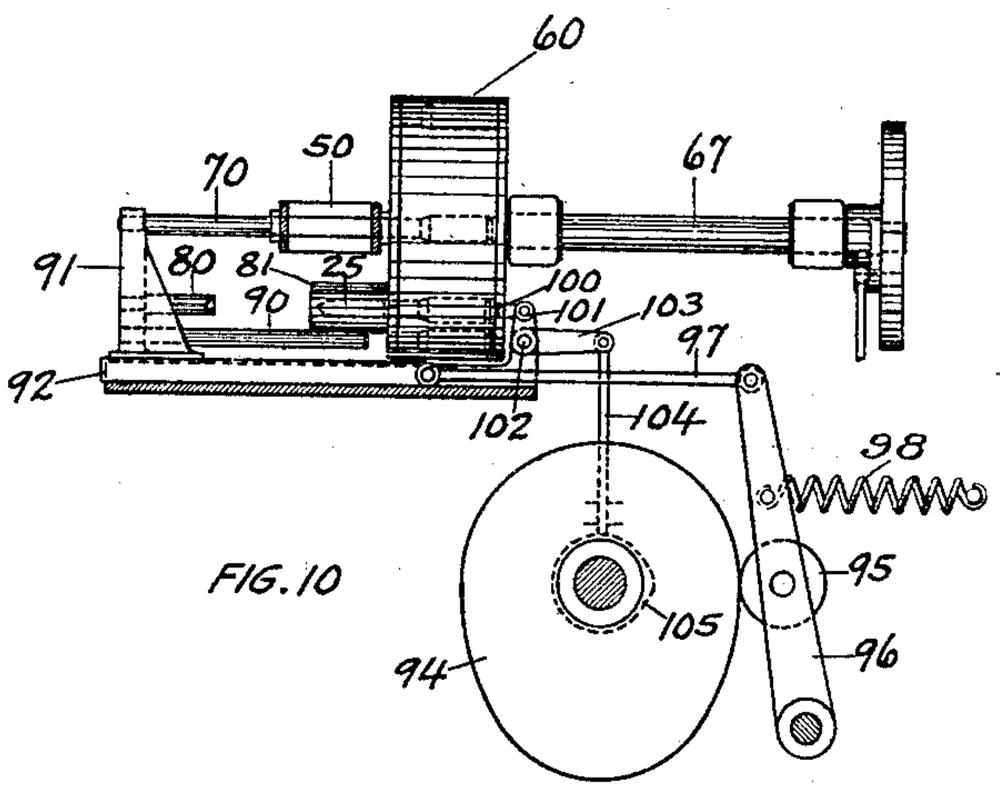

FIG. 10

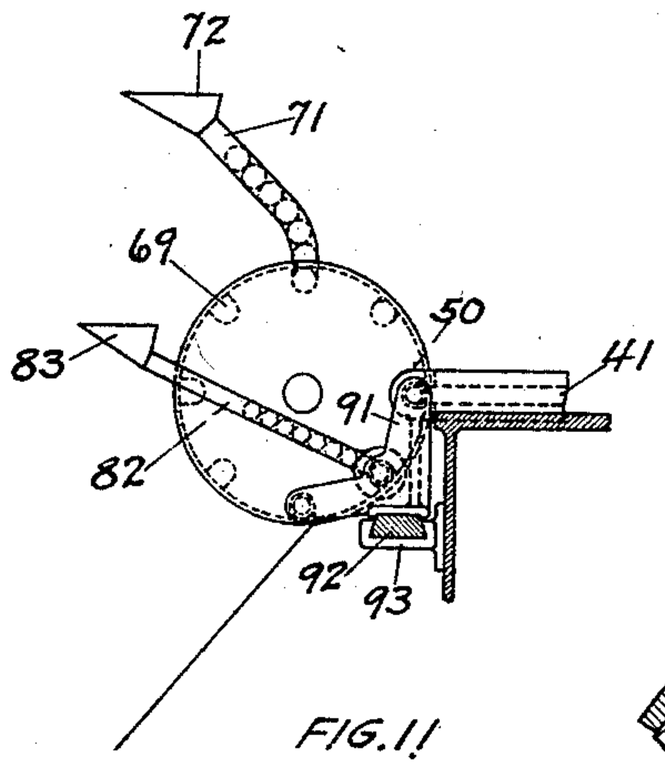

FIG. 11

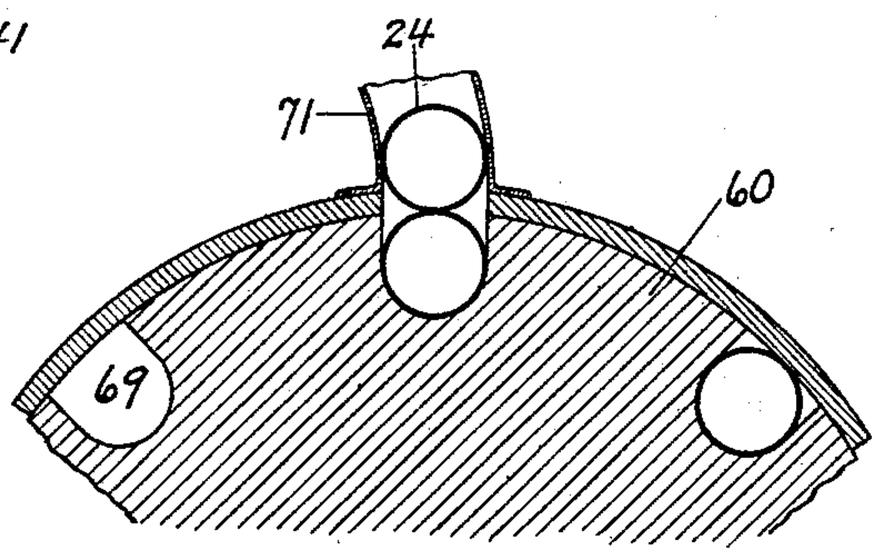

FIG. 12

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5 SHEETS—SHEET 4.

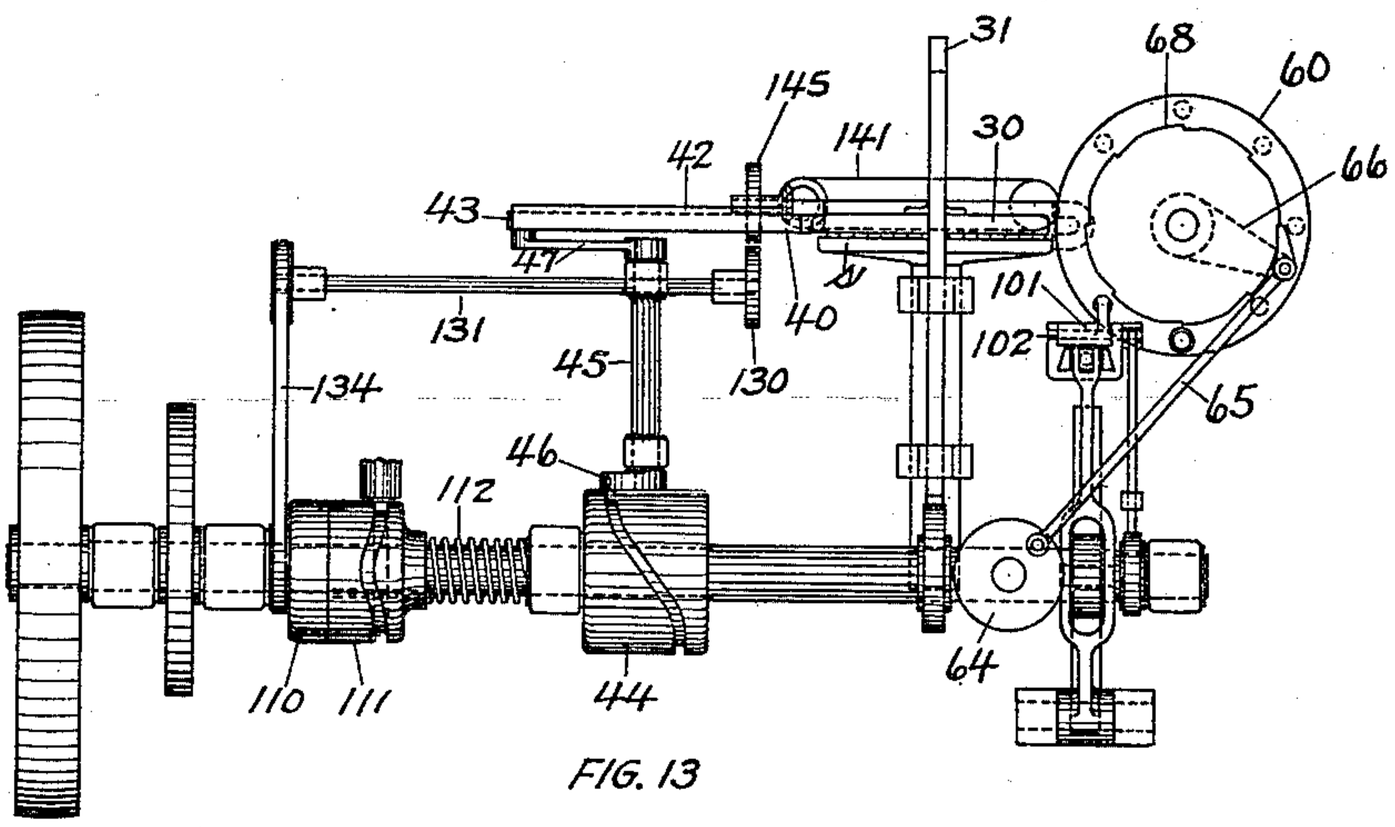

FIG. 13

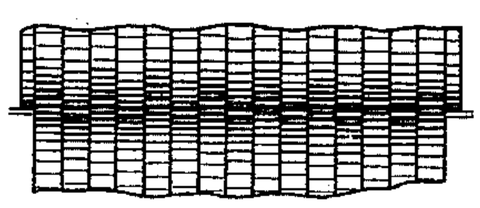

FIG. 17

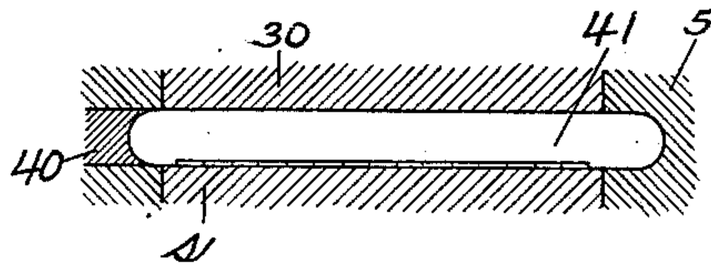

FIG. 18

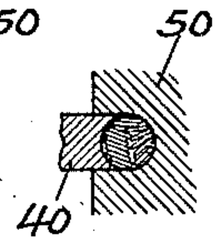

FIG. 19

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5 SHEETS—SHEET 5.

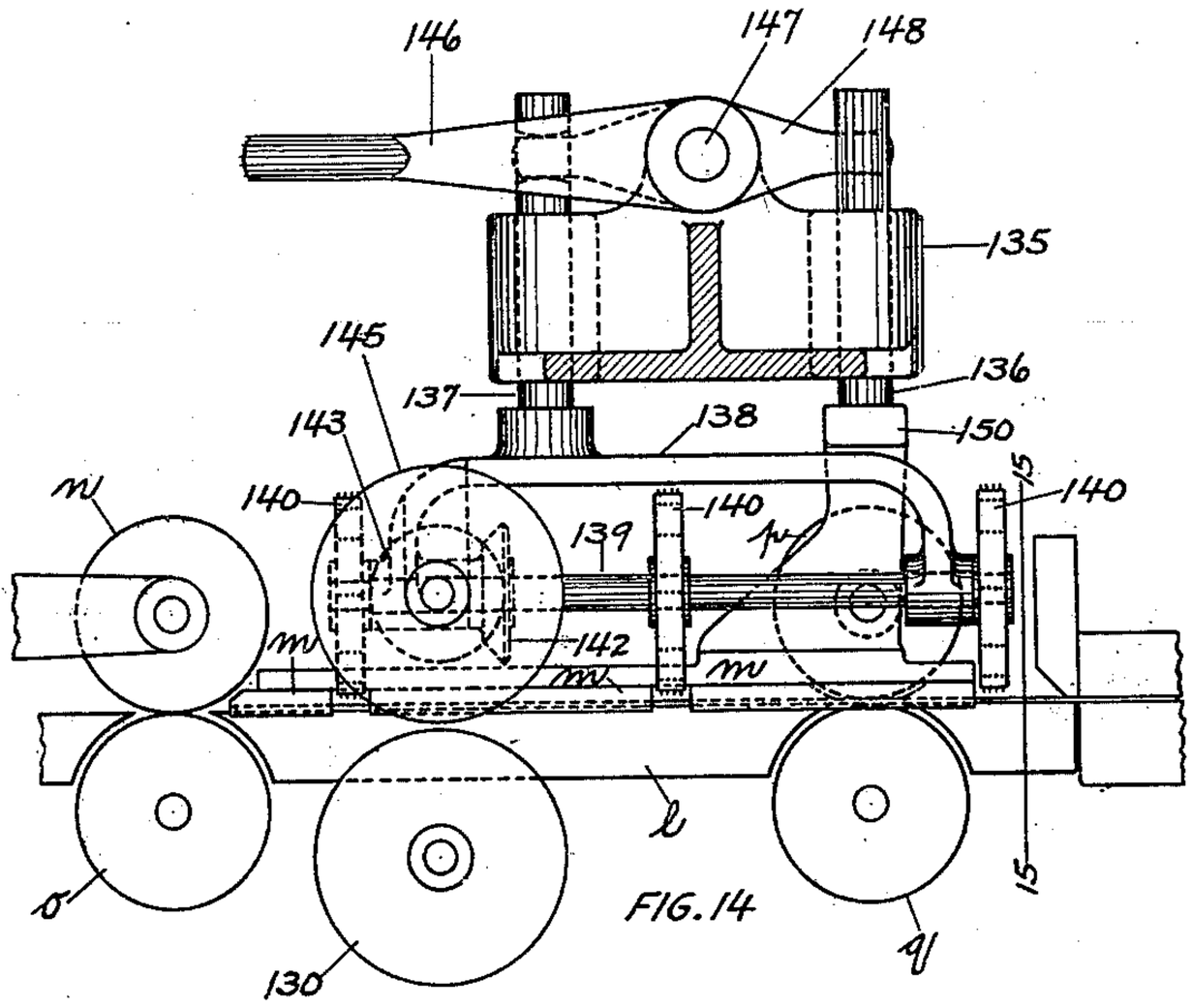

FIG. 14

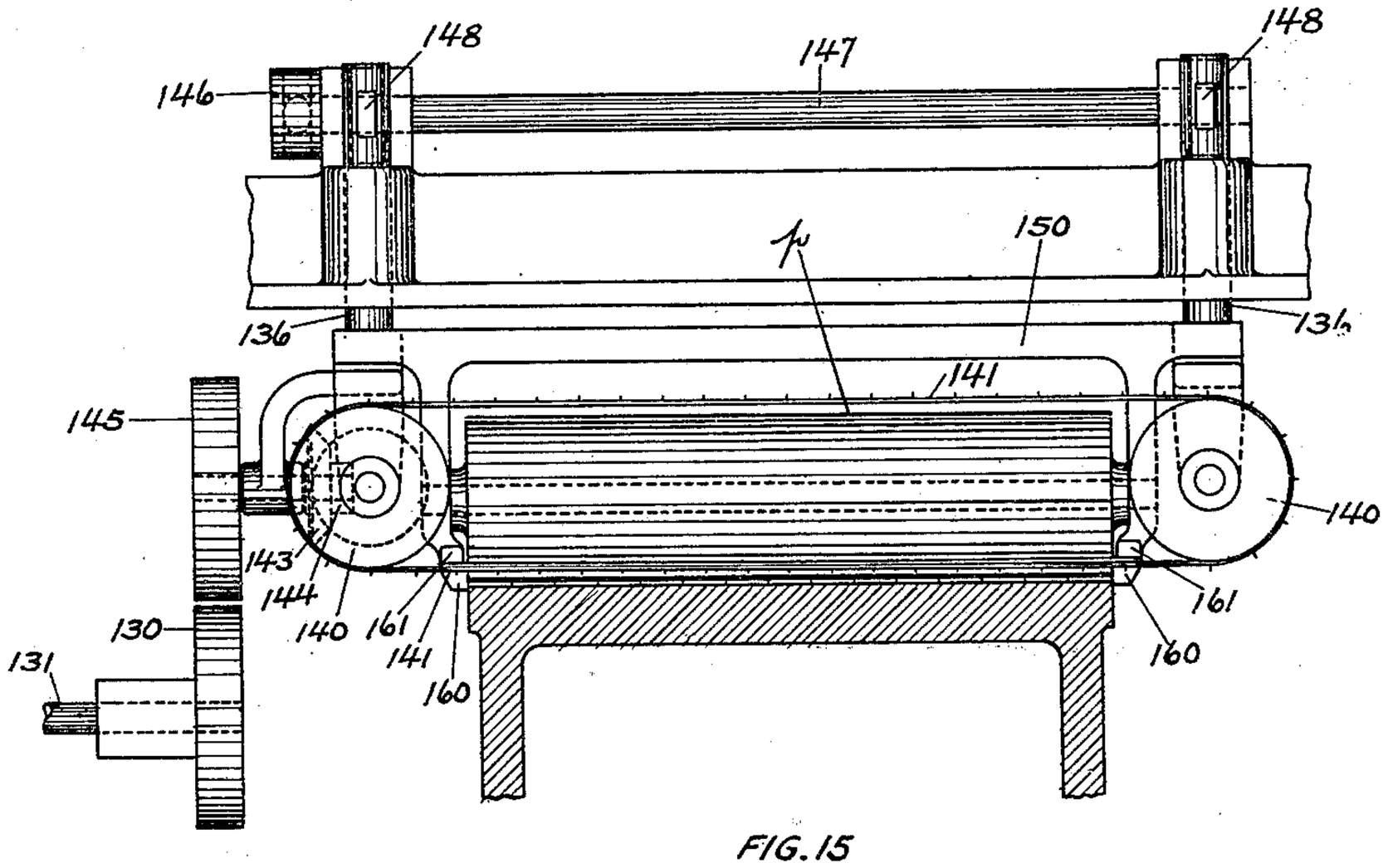

FIG. 15

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UNITED STATES PATENT OFFICE.

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MACHINE FOR CHARGING CARTRIDGE-SHELLS.

No. 860,607. Specification of Letters Patent. Patented July 16, 1907.

Application filed July 12, 1905. Serial No. 269,306.

To all whom it may concern:

Be it known that I, FRANCIS I. DU PONT, a citizen of the United States, residing at Wilmington, county of Newcastle, and State of Delaware, have invented a new and useful Improvement in Machines for Charging Cartridge-Shells, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

The object of my invention is to load cartridge cases with charges of sheets or strips of smokeless powder so as to produce substantially absolute uniformity in explosive power between one cartridge and another. In large pieces this has been heretofore attempted by forming the powder into sheets, cutting the sheets into strips, and inserting a definite weight of strips into the shell. Notwithstanding the fact that this method insures the insertion into each shell of a definite weight of powder, and consequent uniformity in this respect between cartridge and cartridge there is more or less variation in the explosive force of the different cartridges. The reason for this variation I have found is due to the following conditions: The sheets from which the strips are cut vary in thickness and different parts of the same sheet vary in thickness. Consequently, comparing cartridge with cartridge, a definite weight of strips therein does not insure uniformity in the total superficial area of the strips. If the thickness of the smokeless powder strips is sufficiently great for the burning of these to continue throughout the whole travel of the projectile from the chamber to the muzzle of the piece, it is on the superficial area of the strips, and not on the weight of the power contained in the strips, that the explosive power of the cartridge depends. To particularize, a cartridge charged with relatively thick strips of a definite total weight will present a smaller superficial area of powder than a cartridge charged with relatively thin strips of the same total weight, and hence will be of inferior explosive force.

It will be understood that if it were feasible to form the sheets of explosive powder of uniform and unvarying thickness, the objection to the method of charging by weight would be overcome; but as it is practically impossible to do so, I have attained the object of uniformity of explosive force between one cartridge and another by charging into each shell a sheet of explosive powder of definite superficial area. I preferably carry out the method by first taking a sheet or roll of explosive powder of any dimensions, cutting the sheet to definite width and at the same time cutting it longitudinally into strips, then cutting the strips transversely to form sets of strips of definite length, then bunching the strips so formed, and then inserting the bunched strips into the shell. By this process, I attain substantially absolute uniformity of explosive force between one cartridge and another, notwithstanding variations in weight of powder resulting from variations in the thickness of the original sheet or roll.

It is true that in calculating the absolute total surface area of the strips, the area of the edges, as well as of the sides, should, strictly speaking, be considered; and that, therefore, even with my process, there will be a certain variation in the superficial area of the strips in the different shells. Owing however, to the fact that the strips are very thin, the ratio of the surface area of the edges to that of the sides is so minute that any variation in surface area arising from variation in thickness of the strips is practically negligible.

The process can be carried out by hand, and in my application No. 277,312, filed September 7, 1905 (being a division of the present application) I have claimed said process as well as the cartridge formed thereby. The economic use of the process, however, demands mechanism that will carry out the process expeditiously, and as far as possible automatically. I have accordingly devised a machine for so carrying out the process, which forms the subject of the present application. In order, however, that the primary functions of the machine may be understood before entering upon a description thereof, I shall first describe the process and the cartridge formed thereby.

Figure 1 is a plan view of the sheet cut into strips. Fig. 2 is a plan view of the sheet of Fig. 1 cut to length. Fig. 3 is an end view of the strips bunched preparatory to insertion in a shell. Fig. 4 is a side view of Fig. 3. Fig. 5 is a side view of the shell charged with the bunched strips. Fig. 6 is a side view of the shell of Fig. 5 loaded with a bullet. Fig. 7 is a sectional view of the machine on the line 7—7 of Fig. 8, with the cleaning mechanism removed. Fig. 8 is a side view of Fig. 7 with the cleaning mechanism in place, but with the driving pulley removed. Fig. 9 is a longitudinal section on the line 9—9 of Fig. 7, with the driving mechanism for the pawl lever and plunger slide removed. Fig. 10 is a longitudinal section on the line 10—10 of Fig. 7. Fig. 11 is a transverse section on the line 11—11 of Fig. 7, looking toward the right, with the feeding rolls removed. Fig. 12 is an enlarged transverse section of a part of the cartridge cylinder shown in Fig. 11. Fig. 13 is an end view of the machine looking toward the left of Fig. 7. Fig. 14 is an enlarged side view of the cleaning mechanism. Fig. 15 is section on the line 15—15 of Fig. 14. Fig. 16 is a transverse sectional

view of the driving clutch and associated parts. Fig. 17 is an enlarged view looking between the cutting rolls. Fig. 18 is an enlarged sectional view through the cap, bunching slide and bunching die. Fig. 19 is an enlarged view of the bunching die, with the strips bunched in place by the bunching plunger.

I shall first describe the preferred way of carrying out the process, which may be understood by reference to Figs. 1 to 6 inclusive.

I first take a sheet or roll 20 of explosive material and cut or shear it lengthwise into strips 21, which are preferably of equal width, as shown in Fig. 1. The original sheet may be precisely the width of the combined width of the strips 21, but in carrying out my process by machinery, it is more feasible to have the original sheet of greater width and cut or shear off the excess 22 on each side thereof. The strips so formed are then cut transversely to a definite length, as shown in Fig. 2, forming a plurality of sets of strips 23, each set composed of a definite and unvarying number of strips each of a definite and unvarying length and width. The strips of a single set, or the strips of a definite and unvarying plurality of sets of strips, are then bunched together, as shown in Figs. 3 and 4, and inserted into a shell 24, as shown in Fig. 5. In Fig. 6 is shown a completed cartridge with bullet 25 inserted.

It will be understood, from the foregoing description, that shells charged by the process will each contain a definite number of strips of equal length and breadth, and therefore that all the shells will necessarily contain powder charges presenting substantially equal superficial areas and will therefore be of equal explosive power, notwithstanding variations in weight of powder.

I will now describe the apparatus shown in the remaining figures for mechanically and automatically carrying out the described process and which forms the subject of the present application.

a is the main driving shaft, on which is the cam *b*.

c is a rock shaft turning in bearings on the frame of the machine, which frame is omitted in the drawings for the purpose of clearness. On one end of the rock-shaft *c* is an arm *d*, whose free end carries a roller that is engaged by the cam *b*. On the other end of the rock shaft *c* is an arm *e*, which is connected by a link *f* with a pawl lever *g* on the shaft of the lower cutting or shearing roll *i* turning in bearings on the machine frame. *h* is a ratchet wheel secured to the end of the roll *i*. *j* is the upper cutting or shearing roll, which also turns in bearings on the machine frame.

As the main driving shaft rotates, the cutting roll *i* is ratcheted a fraction of a revolution at each rotation of the driving shaft, drawing the sheet 20 of explosive material forward between the rolls and cutting it into strips 21 as illustrated in Fig. 1. The original sheet is preferably wider than, and must be at least as wide as, the cutting rolls. The excess 22 on each side of the cutting rolls is sheared off and then thrown aside by means of the lips 160 of the stationary guide *m* hereinafter described.

The construction of the rolls themselves will be best understood by reference to Fig. 17, which is a front view of the abutting portions of the two rolls, looking between them, from which it can be seen that the cutting periphery of each roll consists of alternately raised and depressed annular sections engaging respectively corresponding alternately depressed and raised annular sections on the other roll, so that the raised section of one roll overlap the raised sections of the other roll.

I is a table extending forward of the cutting roll and *m* are guide plates overlying the table. Between the table and guides the strips are carried forward to the bunching slide 40, to be hereinafter described. The table and guides are cut away, forward of the feeding mechanism, to receive the feed rolls *n*, *o*, and forward of the rolls *n*, *o*, the guides are cut away to receive the cleaning belts and the feed rolls *p*, *q*. The feed roll *q* turns in bearings in the main frame. The bearings for the feed roll *p* are on the frame 150, hereinafter more fully described. On the shaft of roll *p* is a pulley 151, which is driven from a pulley 152, on the cutter roll shaft 154 through the medium of a belt or chain 153. These feed rolls and cleaning belts will be hereinafter referred to.

Just beyond the forward end of the table *l* are the stationary knives *r*, *r*, which are adjusted apart a distance equal to the length to which it is desired the strips shall be cut. Beneath the knives *r r* is the vertically movable platform *s*, which is elevated at the proper time, causing the strips to engage the stationary knives and by them be cut to length.

To raise the platform *s* the following mechanism is provided. *t* is a shaft clutched to the main driving shaft *a* as hereinafter described. *u* is a cam on shaft *t*. *v* is a lever pivoted at one end to the machine frame and at the other end engaging the cam *u*. *w* is a rod secured at its upper end to the platform *s* and at its lower end having an orifice through which the lever *v* extends. *x x* are guides in which rod *w* slides. *y* is a spring coiled about the rod and confined between one of the guides *x* and a collar *z* on the rod. The spring normally holds the rod down, holding the platform *s* on a level with the table. When, however, the lever *v* rides on the high part of cam *u*, the rod *w* and platform *s* are raised, causing the knives *r* to cut the strips to length as before described. Fig. 2 shows the strips after they are cut to length by the knives.

30 is a cap above the platform *s* and substantially corresponding in dimensions thereto. At the same time that the platform *s* is raised the cap 30 is also raised a greater distance, forming between them a chamber 41, bounded on the side by the knives *r*, through which the bunching slide is adapted to slide as hereinafter described.

The cap 30 is raised by the following means: Secured to the cap 30 is the curved end of a rod 31, whose opposite straight end is in line of travel of the cam *u*. The straight end of the rod slides in guides 32, 32, and is held normally down by means of a coiled spring 33 surrounding the rod 31 and confined between one of the guides 32 and a collar 34 on the rod. At the same time that the rod *w* is raised by the cam *u*, the same cam elevates the rod 31.

When the platform *s* and cap 30 are raised as just described, the former is brought on a level with the bunching slide 40, which is of a thickness just less than the distance between the platform *s* and cap 30 when they are uplifted. The bunching slide 40 is then caused to move transversely of the platform *s*, pushing before it

the strips 23 into the bunching die 50. The die 50 registers with the chamber 41 when the platform *s* and cap 30 are raised as described, and is provided with a semi-cylindrical rear face, as shown in Figs. 18 and 19. The front of the bunching slide 40 is also provided with a concave semi-cylindrical recess. When the bunching slide is given the movement stated and reaches the limit of its travel, the strips are bunched together within a cylindrically shaped recess formed by the opposing faces of the bunching slide and bunching die, and are then inserted into the shell as hereinafter described.

To actuate the bunching slide as described, the following mechanism is provided. Secured to the frame of the machine, at the side of the platform *s*, is a guide 42, within which slides a plunger 43 secured to the bunching slide 40, 44 is a grooved cam on the shaft *t*. 45 is an upright rock-shaft turning in bearings on the machine frame. 46 is an arm, secured to the lower end of the shaft 45, whose free end engages the groove of cam 44. 47 is an arm, secured to the upper end of shaft 45, whose forked end is attached to the outer end of plunger 43. As the cam 44 turns, it actuates at the proper time, through the mechanism specified, the bunching slide 40, moving it transversely inward toward the bunching die, bunching the strips as before described.

The shells 24 are carried on a cylinder 60, which is secured to a shaft 67 turning in bearings in a machine frame. To give the shell cylinder the necessary intermittent rotary movement, the following mechanism is provided. Secured to the shaft *t* is a gear wheel 61 driving a gear wheel 62 on a shaft 63 turning in bearings in the machine frame. 64 is a crank disk on the end of shaft 63. 65 is a rod pivoted at one end to the disk 64 and at the other end to the pawl lever 66 loose on the shaft 67. 68 is a ratchet wheel secured to shaft 67 and actuated by the pawl lever 66.

The shell cylinder 60 has formed in its periphery a number of pockets 69, as best shown in Figs. 11 and 12. At each partial turn of the cylinder imparted to it by the pawl lever 66, one of the pockets is brought under a chute 71 leading from a receptacle 72 containing empty shells, and a shell is fed into said pocket; another pocket containing an empty shell is brought opposite the bunched strips which are inserted into said pocket by a plunger 70; another pocket containing a shell so charged is brought opposite a holder 81 containing a bullet 25 which has been fed therein from a chute 82 leading from a receptacle 83, the bullet being inserted into the charged shell by means of a plunger 80; while another pocket containing a shell so loaded and charged is brought opposite a plunger 90, which ejects the loaded and charged shell from the cylinder.

The plungers 70, 80 and 90 are all operated in unison by reason of being secured to a common bracket 91 secured on a slide 92 reciprocating in a guide 93 on the machine frame. The slide 92 is actuated by means of a cam 94 that engages a roller 95 on a lever 96, one end of which is pivoted to the machine frame and the other of which is connected, by a link 97, with the slide 92. A spring 98, connecting the lever 96 and the machine frame, holds the roller 95 constantly against the working face of the cam.

Following the insertion of a bullet into a shell, the shell is crimped in the usual manner by moving it toward the bullet holder 81 causing the wall of the holder, within which the bullet neatly slides, to engage the neck of the shell and crimp it into close contact with the bullet. The shell is given this slight movement by means of a tappet 100. The tappet is secured to an arm 101 on a rock-shaft 102, which is rocked in bearings on the guide 93 by means of an arm 103 secured at one end to the rock shaft and at the other end pivoted to a vertically sliding rod 104 operated by a cam 105 on the shaft *t*.

I have hereinbefore referred to the fact that shaft *t* is clutched to the shaft *a* and I have also described how the cutting or shearing rolls are actuated from the shaft *a*, while the mechanisms for cutting the strips to length bunching them, turning the shell cylinder, and charging, crimping and ejecting the shells, are actuated from the shaft *t*. I have found this arrangement desirable in order that, when the end of a sheet is reached, all the mechanism so actuated from the shaft *t* may be thrown out of action by unclutching shaft *t* from the shaft *a*, while permitting an independent operation of the cutting rolls when a new sheet is introduced, in order that the sheet, cut into strips by the cutting rolls, may be fed forward a distance sufficient to bring it into position to be operated upon by the other mechanisms, at which time the shaft *t* is again clutched with shaft *a*.

The clutch consists of the clutch member 110 secured to the shaft *a* and the clutch member 111 feathered to the shaft *t* there being a spring 112 confined between the clutch member 111 and one of the bearings in which the shaft *t* rotates, the function of the spring being to normally hold the clutch members in engagement.

The following mechanism is provided to cause the shaft *t* to be automatically unclutched whenever a sheet of explosive material is nearly exhausted. 113 is a peripheral cam groove in the clutch member 111. 114 is an upright plunger, the lower end of which is adapted to extend into the cam groove 113. The plunger 114 is vertically movable in a guide in a bracket 115 secured to the machine frame, and a spring 116, confined between the head of the bracket and a shoulder on the plunger, tends to force the plunger into the cam groove 113 when the latter, in the rotation of clutch member 111, passes immediately beneath the plunger. The plunger, however, is normally held out of engagement with the cam groove by means of a catch 117 engaging a notch in the plunger 114. The catch 117 can slide laterally in a guide in the bracket and is secured to one end of a link 118, which extends through a lever 119 secured to a rock-shaft 120 in bearings on the main frame. The end of lever 119 is held between the nut 122 and the spring 123 on link 118. One end of this spring 123 rests against a fixed collar on link 118 and the other end presses the lever 119 against the nut 122. This arrangement permits the catch 117 to be positively drawn from the notch in the plunger 114 and also drop back into the notch again when it is so desired, as will be hereinafter described. Secured to shaft 120 are levers 121, 121, supporting the ends of the shaft of the feed roll *n*. During the passage of the

sheet between the rolls *n* and *o*, the roll *n* is held above the roll *o* (which turns in bearings on the machine frame) by the sheet itself; but when the end of a sheet passes beyond the rolls *n* and *o*, the roll *n* drops into contact with the roll *o*. This rocks the shaft 120, which through the medium of arm 119, and link 118, withdraws the catch 117 from engagement with the plunger 114, permitting the latter to drop into the cam groove 113 as soon as the latter is brought immediately under the plunger by the rotation of the shaft *t*. Continued rotation of the shaft *t* causes the clutch member 111 to be drawn longitudinally of the shaft *t* until it is unclutched, thus stopping the rotation of shaft *t* and throwing out of operation all the mechanism controlled from shaft *t*. The unused portion of the sheet remaining on the table *l* is now cleaned off, and a new sheet is introduced to the cutting rolls. The new sheet feeds forward passing under the feed roll *n* and lifting it, this compressing the spring 123 when the sheet is in position to be acted upon by the shearing platform *s*, the plunger 114 is lifted by hand out of engagement with the groove 113, and the spring 123 causes the catch 117 to engage the notch in the plunger 114 and so hold the latter raised. This permits the spring 112 to move the clutch member 111 into engagement with the clutch member 110. The whole machine is thus again thrown into operation.

In Figs. 14 and 15 is shown, on an enlarged scale, the mechanism for cleaning or stripping from the table, the unused strips at the end of a sheet after the shaft *t* and its actuated mechanism are thrown out of action. 135 is a bracket on the machine frame having guides for vertically slidable rods 136 and 137. The rods 136 carry at their lower ends the frame 150 carrying the roll *p*. The rods 137 are secured at their lower ends to a frame 138, in which are journaled two shafts 139 each having three pulleys 140. About each pair of pulleys 140 extends a belt 141 having projections on their outer faces. When the frame 138 is lowered the belts 141 drop into contact with the unused strips remaining on the table *l*, and when the pulleys 140 are rotated the belts driven thereby sweep the strips laterally off the table. To so actuate the pulleys 140 when the frame 138 is lowered, the following mechanism is provided: 130 is a friction wheel on a shaft 131 turning in bearings on the frame of the machine. 132 is a pulley on the shaft 131, constantly driven from a pulley 133 on the main driving shaft *a* by means of a belt 134. 142 is a bevel gear wheel on one of the shafts 139. 143 is a bevel gear wheel, meshing with gear 142, on a shaft 144 journaled in the frame 138. 145 is a friction wheel on shaft 144. When the frame 138 is lowered, the friction wheel 145 is brought into engagement with the friction wheel 130, and the latter drives the former, which, through the medium of the gears 143 and 142, the shafts 139 and pulleys 140, drives the belts 141, thereby cleaning off the unused strips as before described. The frame 138 is lowered by means of a lever 146 secured to a shaft 147 journaled in bracket 135. Secured to the shaft 147 are arms 148 the opposite end of each of which engage respectively oppositely disposed rods 136 and 137. When the hand lever 146 is depressed, the rods 136 are raised, lifting frame 150 and roll *p* away from the table, and the rods 137 are depressed, thus lowering the frame 138 and operating the cleaning mechanism as before described.

The guide plates *m* are provided along their side edges with lips 160 that extend on each side of and below the table, so as to hold the sheared sheets from lateral displacement during their passage over the table. The guide plates are supported along their side edges from bars 161, 161, secured to frame 150, so that, as the frame 150 and the feed roll *p* are raised as before described, the guide plates will also be raised, elevating the lips 160 to permit the cleaning mechanism to sweep off the unused strips.

The operation of the machine, constructed as hereinbefore specified, may be briefly described as follows:—The plunger 114 is in engagement with the clutch member 111, thereby holding the shaft *t* out of operative engagement with the driving shaft *a*. Power being applied to the latter, the shearing rolls, *i*, *j*, and feed roll *p* are put into operation, and a sheet of explosive material is fed to the shearing rolls. The sheet is thereby cut longitudinally into strips and at the same time fed forwardly over the table *l* until the forward ends of the strips pass over the platform *s*. At this time, the plunger 114 is raised, allowing the spring 112 to move the clutch member 111 into engagement with the clutch member 110. Thereupon the shaft *t* and all the mechanism driven thereby, are put into operation. The platform *s* and cap 30 are raised, causing the knives *r* to cut off the strips to proper length, the bunching slide 40 bunches the strips so cut against the bunching die 50, the plunger 70 charges the bunched strips into the shell registering with the die, the bunching slide, platform and cap return to their initial position, and the shell cylinder 60 is given a partial turn, bringing the charged shell into alinement with the plunger 80 and an empty shell into alinement with the plunger 70. The cutting rolls are now given another motion, again bringing the forward ends of the strips over the platform *s*, and then the platform and cap, the bunching slide and die, and the plunger 70, act as before, the plunger 80 inserts a bullet into the previously charged shell, and the shell cylinder is given another turn, bringing the charged and loaded shell into alinement with the ejector plunger 90, the freshly charged shell into alinement with the loading plunger 80, and another empty shell into alinement with the charging plunger 70. The cutting rolls are now given another motion, and the operation proceeds as before, all the plungers 70, 80 and 90 being now operative.

The operations described are repeated until the end of the sheet passes through the cutting rolls and the ends of the strips pass beyond the roll *n*, whereupon the roll *n* drops, setting into operation the chain of mechanism for releasing the plunger 114. The advance of the strips is now effected solely by the feed roll *p;* but as soon as the cross-cutting, bunching, charging, loading and ejecting mechanisms have completed another operation, the plunger 114, engaging with the clutch member 111, shifts it out of engagement with the clutch member 110, thereby stopping the shaft *t* and throwing out of operation all the last named mechanisms. The automatic clutch shifting mechanism is quite important, in that it prevents the charging of strips of improper length from the end of the sheet

and makes the machine entirely automatic after a sheet has been properly started into it by the attendant.

When the mechanism controlled from shaft t is stopped as described, the lever 146 is operated, lifting up the feed roll p and guide m and depressing the cleaning mechanism into operative position. The cleaning belts are at once set into operation by the engagement of the friction wheel 145 with the constantly rotating friction wheel 130, and the unused strips remaining on the table are swept off. While the shaft t and its controlled mechanism are thus rendered inactive just before the exhaustion of each complete sheet, the cutting rolls, the feed rolls p, and the friction wheel 130 operate continuously, so that the machine is ready at any time to receive another sheet.

Now having fully described my invention, what I claim and desire to protect by Letters Patent is:—

1. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material into sets of strips, of bunching mechanism for collecting the strips of a set preparatory to insertion into shells, and common driving means actuating said mechanisms.

2. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material longitudinally into strips, of mechanism to cut said strips laterally into sets of strips, bunching mechanism for collecting the strips of a set, and common driving means actuating said mechanisms.

3. In a machine for charging shells, the combination with cutting rolls for cutting a sheet of explosive material longitudinally into strips, of knives to cut said strips laterally into sets of strips, feeding mechanism to advance the strips from the cutting rolls to the knives, and means actuating the cutting rolls and feeding mechanism and rendering the knives operative.

4. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material into sets of strips, of bunching mechanism for collecting the strips of each set, shell charging mechanism for inserting the bunched sets of strips into shells, a main driving shaft, and connections therefrom actuating said mechanisms.

5. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material longitudinally into strips, of mechanism to cut said strips laterally into sets of strips, feeding mechanism to advance said strips from the longitudinal cutting mechanism to the lateral cutting mechanism, bunching mechanism for collecting the strips of each set, shell charging mechanism for inserting the bunched sets of strips into shells, a main driving shaft, connections from the driving shaft to the longitudinal cutting mechanism, and connection from the driving shaft to the bunching and shell charging mechanism.

6. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material longitudinally into strips, of a table along which said strips travel, mechanism to cut said strips transversely, bunching mechanism to consolidate the cut strips into bunches, shell charging mechanism to charge the bunches strips into shells, and means to actuate said mechanisms.

7. In a machine for charging shells, the combination, with cutting mechanism for cutting a sheet of explosive material into sets of strips, of a bunching die, a bunching slide adapted to engage a set of strips and move them to the bunching die, shell charging mechanism for removing the strips from the bunching die and inserting the strips into shells, and means to actuate said cutting and shell charging mechanisms and said bunching slide.

8. In a machine for charging shells, the combination with cutting rolls for cutting a sheet of explosive material longitudinally into strips, of a table along which said strips travel, a platform beyond the table, knives cooperating with the platform to cut said strips transversely, bunching mechanism to consolidate strips into bunches, shell charging mechanism to charge the bunched strips into shells, and means to actuate said mechanisms.

9. In a machine for charging shells, the combination with cutting rolls for cutting a sheet of explosive material longitudinally into strips, of a table along which said strips travel, a platform beyond said table, feed rolls between the cutting rolls and platform, knives coöperating with said platform to cut said strips transversely, a bunching die, a bunching slide adapted to engage a set of cut strips and move them to the bunching die, shell charging mechanism for removing the strips from the bunching die and inserting them into shells, and means to actuate said mechanisms.

10. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material into sets of strips, of a platform to receive said sets of strips, a cap above the platform, means to retract the cap from the platform, a bunching slide, a bunching die, means to cause said slide to travel between said cap and platform and bunch successive sets of strips between the slide and die, and shell charging mechanism to remove the bunched strips from between the slide and die and insert them into shells.

11. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material longitudinally into strips, of a platform to which said strips are fed, a cap above the platform, a laterally extending knife on each side of the cap, means to move the platform and cap thereby cutting the strips to length, a bunching slide adapted to slide laterally between said cap and platform and knives and bunch said strips, and shell charging mechanism to insert the bunched strips into shells.

12. In a machine for charging shells, the combination, with mechanism for cutting a sheet of explosive material longitudinally into strips, of a platform to which said strips are fed, a cap above the platform, a laterally extending knife on each side of the cap, a bunching slide above the cutting edges of the knives, means to elevate the platform above the cutting edges of the knives to substantially the level of the bottom of the slide, means to elevate the cap to substantially the level of the top of the slide, a bunching die, means to cause said slide to travel between said cap and platform and knives and bunch successive sets of strips between the slide and die, and shell charging mechanism to remove the bunched strips from between the slide and die and insert them into shells.

13. In a machine for charging shells, the combination with a pair of cutting rolls for cutting a sheet of explosive material into strips, knives for cutting the strips to length, a bunching die, and a bunching slide adapted to engage a set of strips cut to length and move them to the bunching die.

14. In a machine for charging shells, the combination with a pair of cutting rolls for cutting a sheet of explosive material into strips, a table in advance of the cutting rolls, means to feed the strips along the table, knives for cutting the strips to length, a bunching die, a bunching slide, and means to move the bunching slide over the platform into the bunching die.

15. In a machine for charging shells, the combination with a pair of cutting rolls for cutting a sheet of explosive material into strips, a table in advance of the cutting rolls, means to feed the strips along the table, a platform beyond the table, stationary knives on opposite sides of the platform, means to elevate the platform thereby cutting the strips to length, a bunching die, a bunching slide, and means to move the bunching slide over the platform into the bunching die.

16. In a machine for charging shells, the combination, with mechanism for cutting a sheet of explosive material longitudinally into strips, of mechanism for cutting the strips transversely to length, a table between the two cutting mechanisms, means to feed the strips over said table from one cutting mechanism to the other, cleaning mechanism for removing from the table the waste material at the ends of the strips uncut to length, and means to move the cleaning mechanism into operative position.

17. In a machine for charging shells, the combination,

with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material is fed, cleaning mechanism normally above the table, means to depress said cleaning mechanism into contact with the material on the table and means to operate the cleaning mechanism.

18. In a machine for charging shells, the combination, with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material is fed, a vertically movable frame, pulleys thereon, a cleaning belt engaging said pulleys, means to depress said frame to bring said belt into contact with said explosive material, and means to rotate said pulleys.

19. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material is fed, a vertically movable frame, cleaning mechanism carried by said frame, a friction wheel carried by said frame and adapted to actuate said cleaning mechanism, a second friction wheel, the driving shaft, driving means between the driving shaft and the second friction wheel, and means to depress the frame thereby moving the cleaning mechanism into contact with the explosive material on the table and moving the first friction wheel into contact with the second friction wheel.

20. In a machine for charging shells, the combination, with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material is fed, a vertically movable frame, pulleys thereon, a cleaning belt engaging said pulleys, a friction wheel carried by said frame adapted to actuate said pulleys, a second friction wheel, means to drive the latter, and means to depress the frame, thereby moving the first friction wheel into contact with the second friction wheel and the cleaning belt into contact with the explosive material on the table.

21. In a machine for charging shells, the combination, with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material is fed, a feed roll adapted to feed said material along the table, cleaning mechanism above the table, and means for simultaneously raising the former and lowering the latter.

22. In a machine for charging shells, the combination, with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material is fed, a feed roll adapted to feed said material along the table, cleaning mechanism above the table, a rod carrying said feed roll, a rod carrying said cleaning mechanism, a rock shaft, an arm secured on the shaft, and means to rock the shaft, thereby raising one rod and lowering the other.

23. In a machine for charging shells, the combination with mechanism for cutting strips of explosive material to definite length, of bunching mechanism, shell charging mechanism, a feed roll normally engaging the explosive material, a driving shaft, a shaft driven thereby, connections between the driven shaft and said mechanism by which the latter are operated, means to disconnect said shafts, and connections from the feed roll controlling the disconnecting means and adapted to actuate them when the explosive material passes beyond said feed roll.

24. In a machine for charging shells, the combination, with means for cutting a sheet of explosive material into strips, of mechanism to cut said strips to length, bunching mechanism, shell charging mechanism, a driving shaft, connections therefrom to said means for cutting the sheet into strips, a driven shaft, connections therefrom to said mechanisms, and coacting clutch members on the two shafts.

25. In a machine for charging shells, the combination, with mechanism for bunching previously formed strips, shell charging mechanism, a driving shaft, a fixed clutch member thereon, a driven shaft, a clutch member, feathered thereon and provided with a cam groove and normally engaging the clutch member on the driving shaft, a plunger adapted to engage the groove, a spring tending to move said plunger into engagement with the groove, a catch normally holding said plunger out of engagement, a feed roll, and connections from the feed roll to the catch, said feed roll tending to actuate said connections to withdraw the catch but normally held out of action by the traveling sheet.

26. In a machine for charging shells, the combination, with means for cutting a sheet of explosive material into strips, of mechanism to cut said strips to length, bunching mechanism, shell charging mechanism, a driving shaft, connections therefrom to the strip forming means, a driven shaft, connections therefrom to said mechanisms, coacting clutch members on the two shafts, a table between the strip forming means and said mechanism along which the sheet travels, a feed roll engaging the sheet as it travels along the table, connections from the feed roll for disconnecting said clutch members, said feed roll tending to actuate said connections but normally held out of action by the traveling sheet.

27. In a machine for charging shells, the combination, with cutting rolls for cutting a sheet of explosive material longitudinally into strips, of knives for cutting said strips to length, bunching mechanism, shell charging mechanism, common actuating means for the bunching and charging mechanisms, a table between the cutting rolls and knives, along which the sheet travels, a feed roll between the cutting rolls and knives, a second feed roll between the first feed roll and the knives, and connections from the first feed roll adapted to be operated to render said actuating means inoperative when the sheet passes beyond the first feed roll.

28. In a machine for charging shells, the combination, with cutting rolls for cutting a sheet of explosive material longitudinally into strips, of knives to cut said strips to length, a table between the cutting rolls and knives along which the strips travel, a bunching die, a bunching slide, cleaning mechanism, a feed roll between the cutting rolls and knives, and means to simultaneously retract the feed roll and advance the cleaning mechanism into operative position.

29. In a machine for charging shells, in combination, the cutting rolls for cutting sheets of explosive material into longitudinal strips, a driving shaft, driving connections from the shaft to the cutting rolls, the knives for cutting the strips laterally, bunching mechanism, shell charging mechanism, shell loading mechanism, shell ejecting mechanism, a driven shaft, normally clutched to the driving shaft, connections from the driven shaft to operate said mechanisms and cause the knives to cut, a table between the cutting rolls and knives, a feed roll engaging the strips in their travel along the table and means controlled by the feed roll to unclutch said shafts, said feed roll moving to throw said means into action when the end of the sheet passes beyond the feed roll.

30. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material longitudinally into strips, of a table along which said strips travel, a platform beyond the table, knives at the sides of the platform, and means to elevate the platform thereby severing the strips longitudinally.

31. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material travels, guides adjacent to the table, cleaning mechanism above the table for removing the waste material therefrom, and means for simultaneously withdrawing the guides and moving the cleaning mechanism to operative position.

32. In a machine for charging shells, the combination with mechanism for cutting a sheet of explosive material into strips, of a table along which said explosive material travels, a feed roll adapted to feed said material along the table, cleaning mechanism for removing the waste material from the table, guides for the material adjacent to the table, and means for withdrawing the guides and feed roll and moving into operative position the cleaning mechanism.

33. In a machine for charging shells, the combination, with cutting rolls to cut a sheet of explosive material longitudinally into strips, of mechanism to cross-cut said strips to length, a table, a feed roll to advance the strips from the cutting rolls along the table to the cross-cutting

mechanism, bunching mechanism, shell charging mechanism, a driving shaft for the cutting rolls and feed roll, and separate driving means for the remaining mechanism, thereby enabling the last named mechanism to be rendered inactive before the exhaustion of a sheet and during the initial operation of the cutting rolls and feed rolls upon a new sheet.

34. In a machine for charging shells, the combination, with a driving shaft, of means for cutting a sheet of explosive material longitudinally into strips, connections thereto from said driving shaft, a driven shaft, mechanism to cross-cut said strips to length, bunching mechanism, shell charging mechanism, connections from the driven shaft to said mechanisms, and means to disconnect the two shafts before the end of the sheet reaches the cross cutting mechanisms, thereby throwing said mechanism out of action while the operation of the strip cutting means continues.

In testimony of which invention, I have hereunto set my hand, at Wilmington, on this third day of July, 1905.

FRANCIS I. DU PONT.

Witnesses:

CLIFFORD V. MANNERING,

WILLIAM G. JONES, Jr.