June 13, 1961 M. C. HENGEL 2,987,952

DYNAMITE PACKING MACHINE

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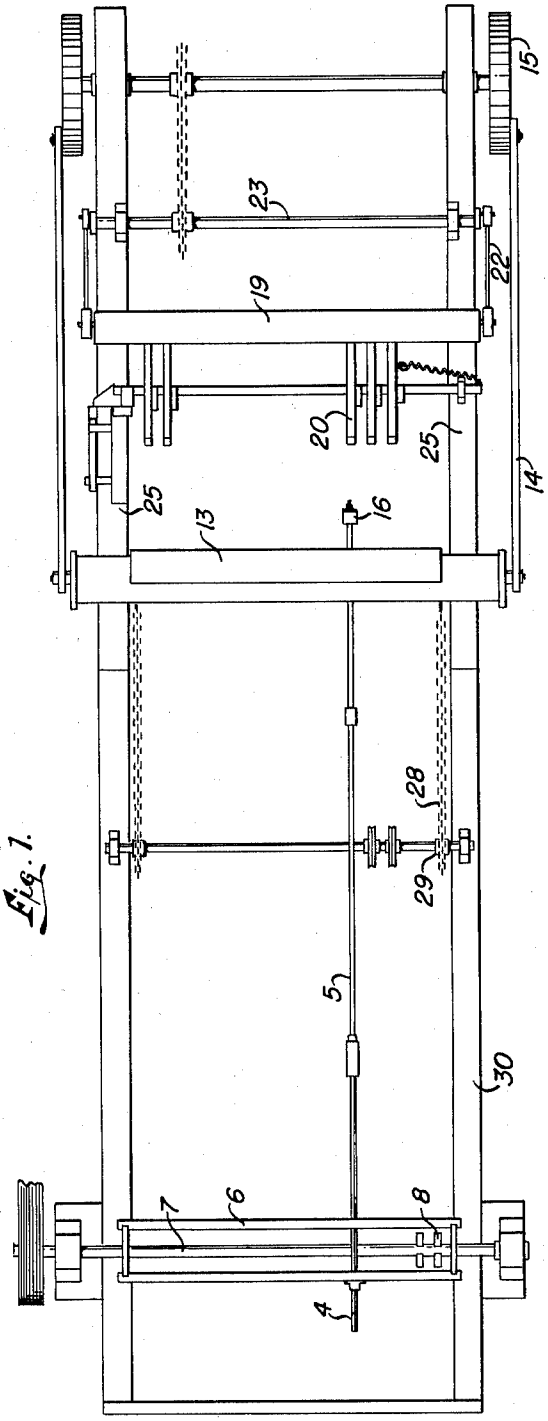

Fig. 1.

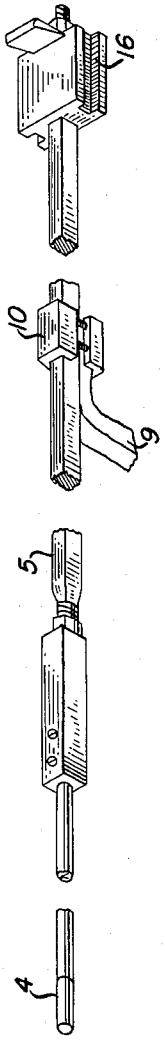

Fig. 2.

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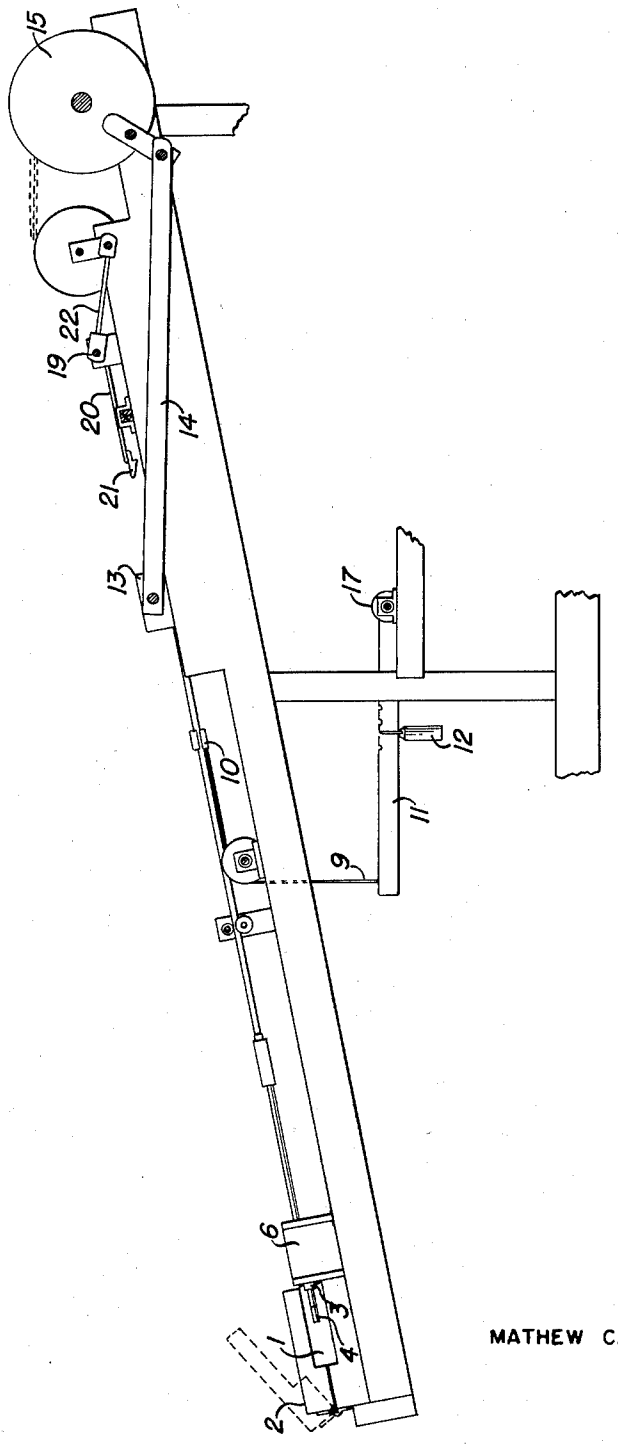

Fig. 3.

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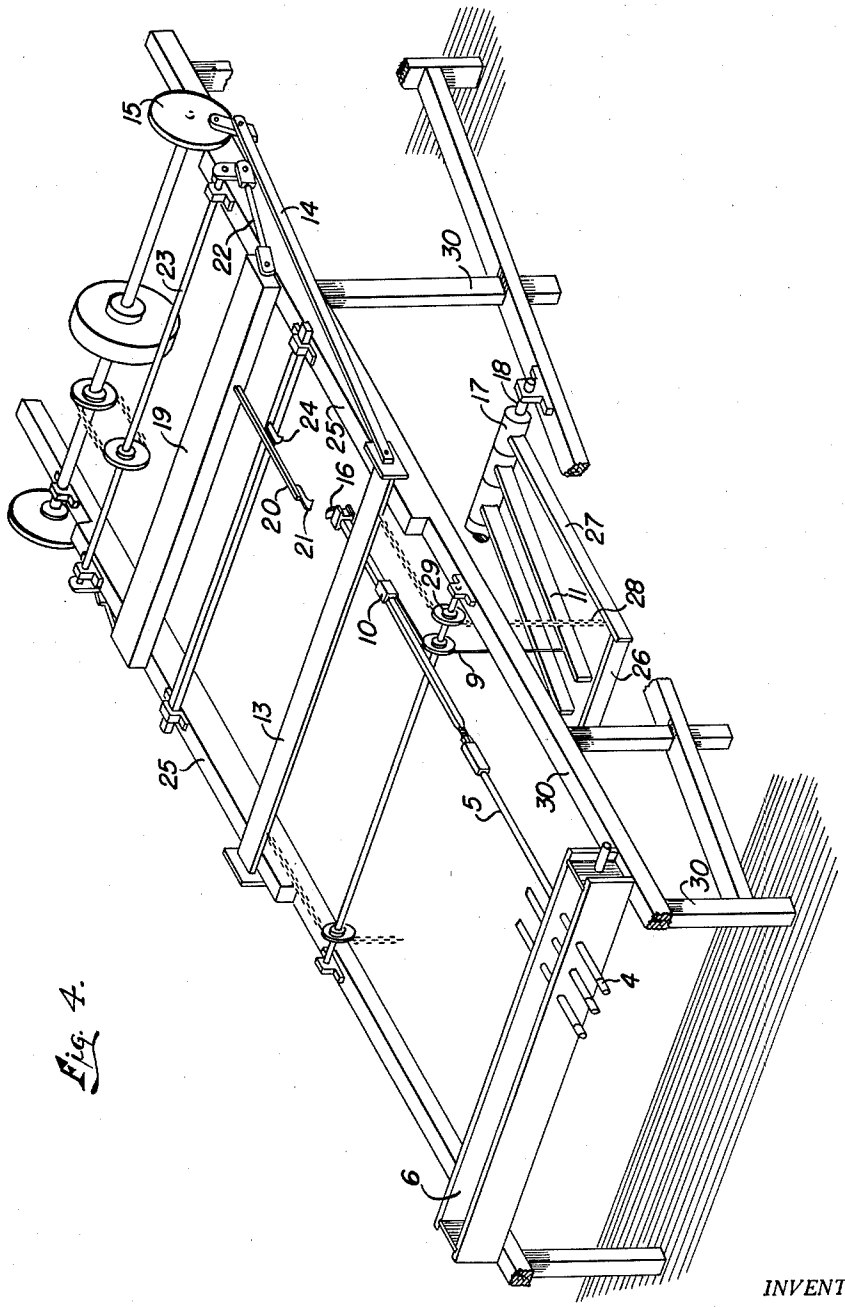

Fig. 4.

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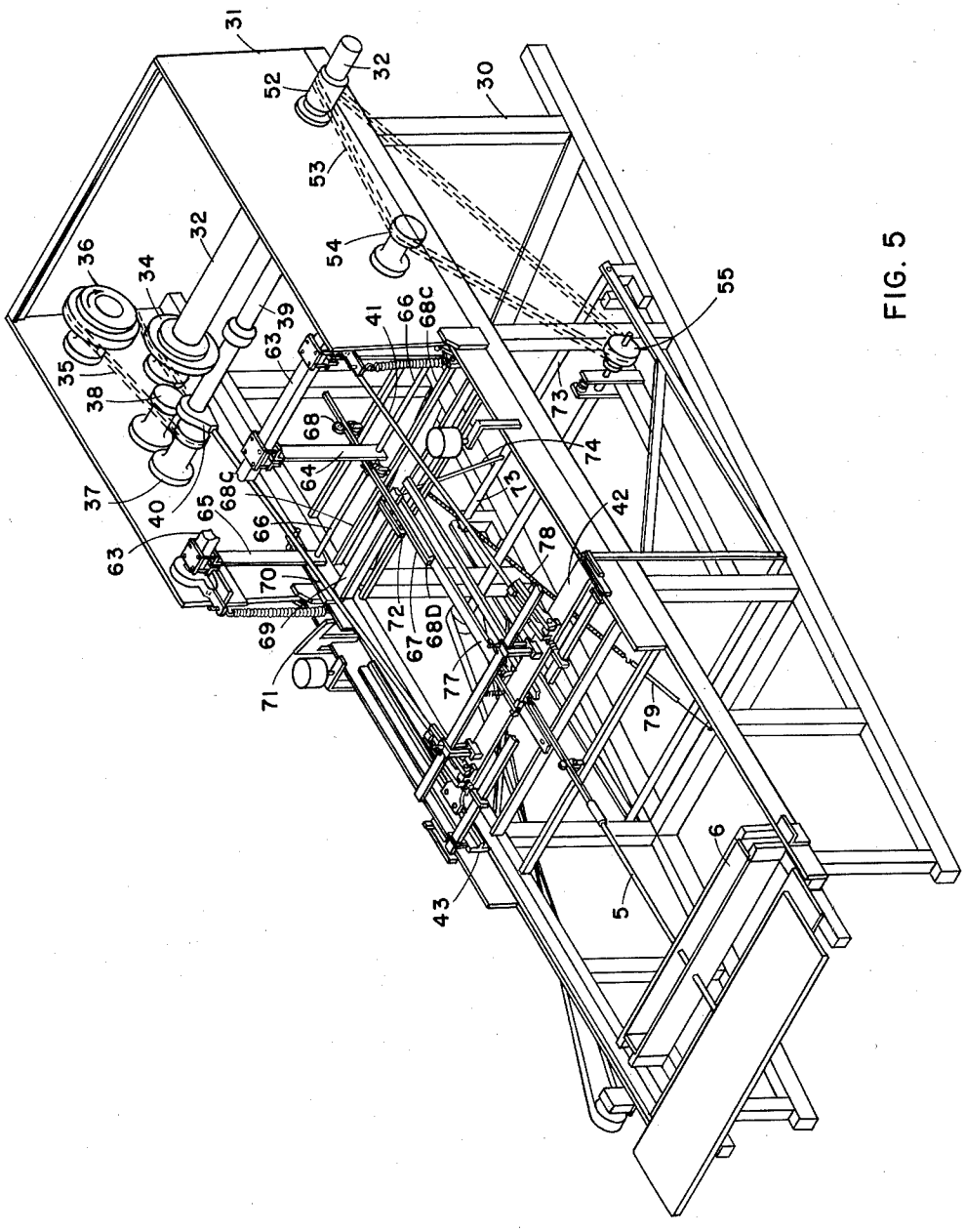

FIG. 5

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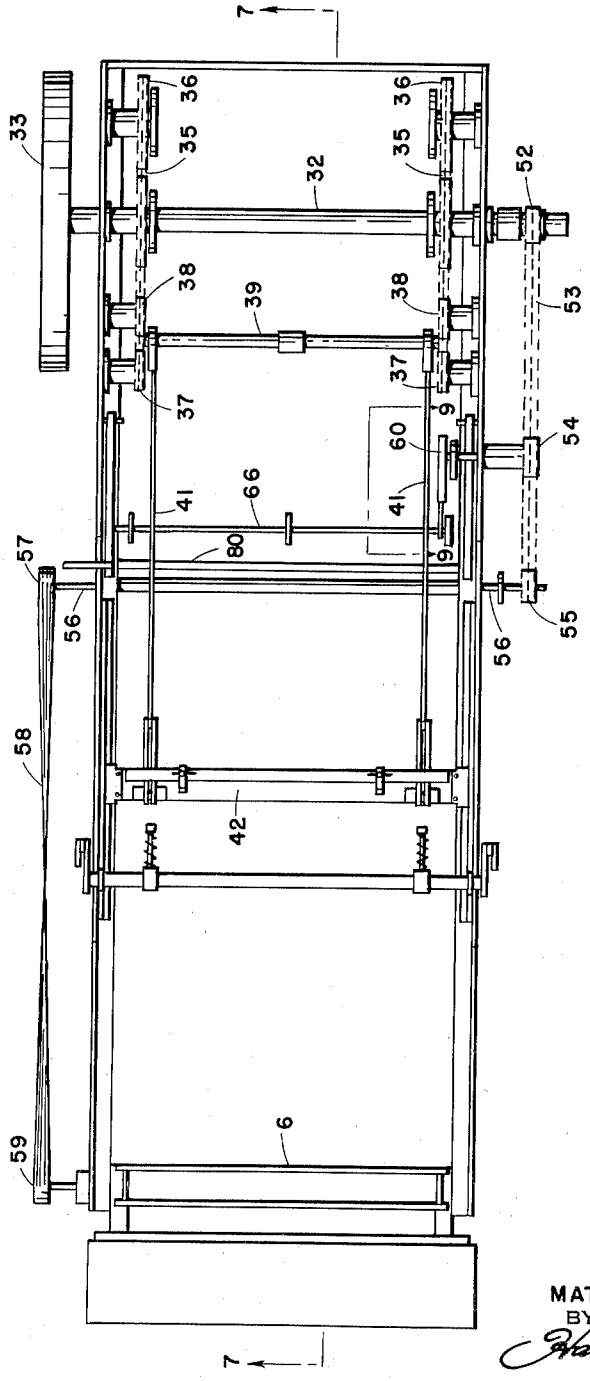
FIG. 6



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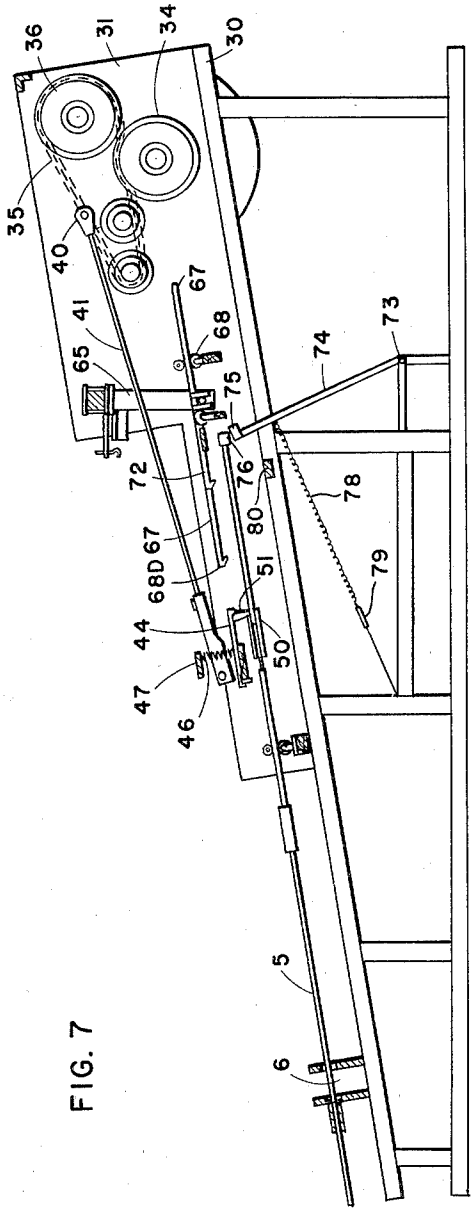


FIG. 7

FIG. 8

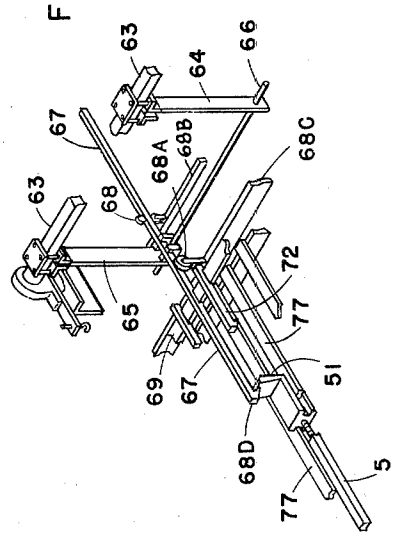
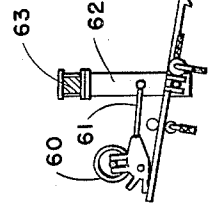


FIG. 9



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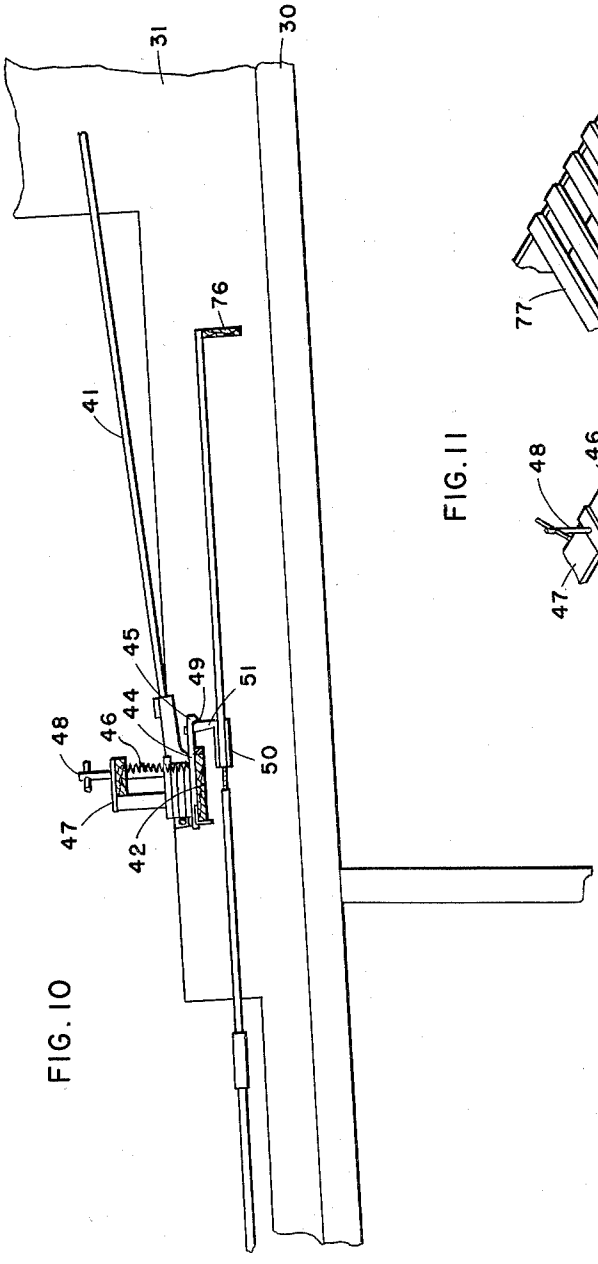

FIG. 10

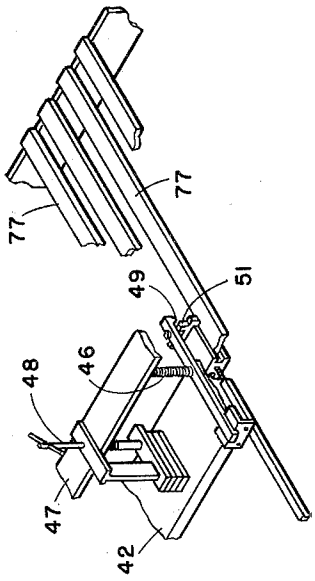

FIG. 11

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United States Patent Office 2,987,952 Patented June 13, 1961

2,987,952

DYNAMITE PACKING MACHINE

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Filed June 21, 1957, Ser. No. 667,266
3 Claims. (Cl. 86—20)

This invention relates to a machine for packing explosive material into shells and cartridges. More specifically, it relates to a machine which will effect such packing on shells or cartridges of varying lengths. Still more particularly, it relates to a dynamite packing machine of the Kimber type which can effect the packing of 16" cartridges and longer without the necessity for increasing the length of the dynamite packing machine itself.

Blasting requirements in recent years have changed sufficiently that longer sticks of explosives such as dynamite and blasting gelatins have become more and more feasible. Although the standard 8" stick is still in wide demand, longer sticks such as 14", 16", 18" and even 24" sticks have become more desirable in many applications.

Cartridge loading machines of the type illustrated in the patent to Kimber, No. 813,435, dated February 27, 1906, have long served to produce the standard 8" stick of dynamite. However, machines of this type may not be conveniently adapted to producing longer sticks of dynamite. The usual method of producing longer cartridges with a machine of this type is to fill the cartridge from both ends alternately. This system involves the necessity of reversing the half-filled cartridges with the attendant extra handling and waste of time. The resulting catridge is also largely unsatisfactory due to density differences in the explosives down the length of the cartridge.

It is the object of the present invention to provide a cartridge packing machine which can simply and efficiently pack explosive cartridges both of standard length and of lengths up to three times the standard length.

This object is achieved by apparatus which comprises in combination, cartridge supporting means, a container for explosive, and a plurality of packing sticks. The lower ends of the packing sticks are adapted to pass through the explosives container and thus drive a small amount of explosives into the cartridge which is supported inside the cartridge supporting means. Means for reciprocating the packing sticks serve to drive the lower end of the packing sticks repeatedly through the explosives container and into the cartridge until the cartridge is filled with explosives. When the cartridge is filled with explosives the packing stick is maintained in such a position at the bottom of the packing stick stroke that a separate reciprocating means adapted to engage the upper end of the packing stick can draw the packing stick to a position where the packing stick is maintained in a withdrawn position by latching means.

The details of construction in the operation of the two different versions of the apparatus will be more apparent from the following description read in conjunction with the accompanying drawings in which:

FIG. 1 is a plan view showing a portion of the improved apparatus having only 1 packing stick mounted therein;

FIG. 2 is a perspective of a packing stick assembly unattached to other apparatus;

FIG. 3 is a side elevation showing a single packing stick;

FIG. 4 is a broken perspective elevation showing a portion of the apparatus of the present invention;

FIG. 5 is a perspective view of a different and improved version of my apparatus, showing only one packing stick of the many actually used;

FIG. 6 is a plan view of part of the apparatus of FIG. 5, showing the newer mechanism for driving the packing crosshead;

FIG. 7 is a broken elevation of the apparatus along the line 7—7 in FIGURE 6 showing the driving mechanism and positioning of the crossheads and pack stick;

FIG. 8 is a perspective elevation of the alternative dogging crosshead and the improved mechanism for driving it;

FIG. 9 is a partial side elevation along line 9—9 in FIGURE 6 of the crank mechanism for driving the dogging crosshead;

FIG. 10 is a broken side elevation of the apparatus showing one pack stick connected to the various driving mechanisms; and

FIG. 11 is a broken perspective elevation of the improved pack stick trigger for driving the packing stroke.

Referring to FIGURES 1 to 4 of the drawings, the empty cartridges 1 are mounted in a shuttle 2 in such a way that the mouths of the cartridges fit over the ends of the packing nipples 3 such that the tamp 4 on the lower end of the packing stick 5 can pass through the packing nipple 3 and into the cartridges 1. The tamp 4 passes through the stirrer box 6 which is maintained substantially full of an explosive material such as dynamite. A hopper not shown, maintains the stirrer box 6 full of explosive. Inside the stirrer box is a crank shaft 7 on which may be mounted paddles 8. The rotation of the shaft 7 thus maintains the explosive in the stirrer box 6 substantially free of voids.

The filling stroke of the packing stick 5 is actuated by gravity in this modification. A V belt 9 is fastened to the packing stick 5 at connection 10. The other end of the belt 9 is fastened to the arm 11 on which may be suspended the weights 12. Thus it can be seen that the packing stick 5 will come to rest during the filling stroke only when the tamp 4 strikes against the solid backing of the cartridge 1.

The withdrawal stroke of the packing stick 5 is accomplished by the packing crosshead 13. A connecting rod 14 connects the packing crosshead 13 to the revolving flywheel 15 which serves to cause the reciprocation of the packing crosshead 13.

The upper end of the packing stick 5 is fitted with a dog 16. This dog 16 is such that the packing crosshead 13 engages the dog 16 when the packing crosshead 13 is traveling upwards in the direction of the flywheel 15. The engagement between the dog 16 and the packing crosshead 13 withdraws the packing stick 5 and thus causes the return stroke of the packing stick 5. When, however, the packing crosshead 13 is moving downward away from the flywheel 15 there is no engagement between the packing crosshead 13 and the dog 16 in this modification of my invention, and thus the packing stick 5 is gravity driven on the filling stroke by means of the belt 9 attached to the lever arm 11 on which are suspended the weights 12. The lever arm 11 will thus rise up and down as the packing stick 5 reciprocates back and forth. The lever arm 11 is mounted on the sleeve 17 which encloses the shaft 18.

As the packing stick 5 reciprocates and packs more and more material into the cartridges 1 the packing stick 5 and hence the dog 16 is maintained in a higher and higher position as the cartridge receives more and more explosive. In the meantime, the dogging crosshead 19 to which is fastened the dogging link 20 which terminates in the hook 21 reciprocates more or less in sequence with the packing crosshead 13. When the cartridges 1 are

filled with explosives, the dog 16 will be within reach of the hook 21. The dogging crosshead 19 moved by the connecting rod 22 which is reciprocated by means of the shaft 23 will then draw the packing stick 5 in an upward direction toward the shaft 23 until the latch 24 engages the upper end of the packing stick 5 and thus retains the packing stick 5 in a withdrawn position. Both the packing crosshead 13 and the dogging crosshead 19 reciprocate on the rails 25. The rails 25 may be kept lubricated by any means well known in the art.

It should be pointed out that the individual packing sticks in the apparatus of the present invention operate independently of each other in respect to being withdrawn from operation by the dogging crosshead once the individual cartridge is full. Although the packing crosshead 13 will lift and release all the packing sticks 5 at the same time, nevertheless some cartridges will fill faster than others. This merely means however, that the packing sticks 5 will be individually dogged and drawn into the withdrawn position as the individual cartridges fill with explosive. Since the reciprocating cycle of the packing crosshead 13 is preferably at the rate of 38 per minute, the cartridges 1 are swiftly filled with explosive. Once the last packing stick 5 has been latched into the withdrawn position by the latch 24 the shuttle 2 containing filled cartridges 1 may be removed and a new shuttle containing empty cartridges placed instead. During this interchange period both the packing crosshead 13 and the dogging crosshead 19 continue to reciprocate but neither of these two crossheads affects the packing sticks since they are latched into the withdrawn position. Once a new shuttle containing empty cartridges has been positioned near the bottom and adjacent to the stirrer box 6 the packing sticks may readily be released by a mechanism, not shown, which releases the latches 24. When the packing sticks 5 are disengaged they immediately slide forward so that the tamp 4 passes through the stirrer box 6 and thus drive explosive into the cartridges 1. On each successive stroke the packing sticks move forward a shorter distance until the cartridges are filled. The packing stick dogs are now within reach of the hooks 21. The dogging crosshead 19 now draws the packing stick 5 up until it engages the latch 24 at which point the cycle has been completed.

As pointed out earlier, the packing sticks 5 are actuated by gravity during the filling or driving stroke. This means that the packing crosshead must exert sufficient pressure against the dog 16 on the packing stick 5 in order to withdraw not only the packing stick, but also the lever arm 11 and the weight 12. In order to relieve this assembly along with V belt 9 from the undue strain of being lifted during each withdrawal stroke, the ends of the lever arms 11 are sufficiently long to rest on the arm 26. This arm is connected to the shaft 18 by means of supporting arm 27. Supporting arm 27 is connected to the packing crosshead 13 by means of the chain 28 which passes over the pulley 29. Thus, when packing crosshead 13 moves in an upwardly direction to accomplish the withdrawal stroke the arm 26 is raised in conjunction with the packing crosshead 13 so that the various lever arms 11 with the weight 12 hanging thereon are lifted by the arm 26. This system then prevents undue strain from being placed on the packing sticks 5 during the withdrawal stroke.

I have further found additional modifications which acting together with the improvements of the previously described modification, comprise a still more improved machine for packing explosive cartridges. The machine which embodies these additional modifications is depicted in FIGS. 5–10. These modifications are an improved chain drive mechanism for providing motive force to the packing crosshead, an improved dogging assembly, and a pack stick trigger assembly mounted on, and acting with, the packing crosshead and enabling the packing crosshead to provide the driving force for driving the pack stick 5 through the stirrer box 6. The assembly of this improved modification is shown in perspective in FIG. 5, and in elevation in FIG. 7, showing only one of the many packing sticks mounted thereon. The details of the improved mechanisms are shown in FIGS. 5–10.

This improved modification is constructed in the following manner. At the upper end of the frame 30, on either side there is mounted a raised mounting 31 which provides support for the various driving mechanisms to be described. A main drive shaft 32 projects through the mounting plate 31 on one side and fastened thereon is a pulley 33 through which power is supplied from an external source by means of a belt (not shown). The drive shaft 32 has mounted thereon, inside the places where said shaft is journalled into mounting plate 31, two driving sprockets 34 one at each end close to the mounting plate 31. Each of these driving sprockets 34 mesh with a drive chain 35 passing around large sprockets 36 journalled into the side plates 31 in front of the main drive shaft 32. Between the two sprockets 36 and 37 around which the chain passes, there is also journalled an alternative sprocket 38 which can be used instead of the sprockets 37 to provide a shorter stroke for the packing operation for smaller sticks of dynamite. To use this alternative sprocket 38, the chain 35 must be shortened by removing several links. A bar 39 is provided, each end of which is affixed by an appropriate pivot 40 to each of the chains 35 in such a way that it will follow chains 35 around the sprockets. The pivot 40 is ordinarily fastened directly to a link in the chains 35. This bar provides the driving mechanism for the packing crosshead, to be described.

The packing crosshead is driven by two connecting rods 41 pivoted on the bar 39 at either end of said bar near the chain 35. The other end of the rods 41 are pivoted on the packing crosshead 42 mounted to slide on rails 43 fastened to the front portion of the side plates 31. Upon the packing crosshead is mounted the pack stick trigger mechanism 44 whose detailed construction is shown in FIGS. 9 and 10, as discussed later.

The packing stick trigger mechanism is constructed as follows. There is fastened to the packing crosshead above each packing stick a pivoted latch 45 held down by a spring 46. The line of springs 46 are held down in turn by a bar 47 extending the length of the packing crosshead 42. At appropriate places in the spring bar 47, there are placed adjustment screws 48 which pierce the spring bar 47 and are fastened into the crosshead 42. Adjustment of the said screw 48 changes the compression on the springs 46 at each pivoted latch 45. Each pivoted latch 45 ends in a latching hook, whose tooth 49 is bevelled on both sides. On each pack stick 5 the dog 50 has a tooth 51 which is similarly bevelled.

This trigger mechanism operates as follows. As the packing crosshead 42 starts its upward stroke, it meets the packing latch wherever the packing stroke has left the pack stick (depending on the extent to which the cartridge is filled) at that particular stroke. The pivoted latch 45 slides upward on the bevelled tooth of the dog 50 and snaps into place under the compression of the spring 46. The crosshead itself then pushes against the tooth 51, bringing the stick with it to the top of the stroke. The crosshead then makes a downward stroke, taking the stick with it due to the bevelled tooth 49 on the pivoted latch 45, which is held by the spring 46 with sufficient pressure that the bevelled tooth 49 on the pivoted latch 45 does not slide upward and release the bevelled tooth 51 on the dog 50 until sufficient pressure is met in the downward stroke of the packing stick. The adjustment screw 48 is set such that the pressure is just enough so that sufficient downward push is given the packing stick to take it through the stirrer box, but not to drive with any excess force into the partly packed dynamite stick. When sufficient force is reached in the downward stroke, the pivoted latch 45 slides upward

on the bevels between the tooth 49 and the tooth 51 of the packing dog 50, releasing the packing stick 5 and permitting the crosshead to continue to the end of the downward stroke.

Having described the construction and operation of the improved packing crosshead and the pack stick trigger mechanism affixed thereto, I revert to the new and improved dogging and latching mechanism of this additional modification of my invention. On the opposite side of the apparatus from the main drive pulley 33, the main drive shaft 32 projects through the side plate 31. On this projection is mounted a sprocket 52 around which a chain 53 passes. This chain 53 also passes around two other sprockets 54 and 55. Sprocket 55 is mounted on a drive shaft 56 to which is mounted on the other side of the apparatus another pulley 57 over which a belt 58 passes. Belt 58 in turn passes over a pulley 59 which drives the stirrer mechanism (not shown) in the stirrer box 6. Sprocket 54 is journalled through the side plate 31 to a crank wheel 60 and bar 61 (see FIG. 9). The crank bar 61 is fastened by a pivot to a rocker arm 62 which is pivoted on an overhead support 63. Two similar rocker arms, 64 and 65 similarly pivoted on the support 63 are connected rigidly to the rocker arm 62 by the dogging bar 66, such that all three rocker arms reciprocate together upon the actuation of crank bar 61. The dogging link 67 for each pack stick 5 is pivoted on the dogging bar 66 and reciprocates on rollers 68 and 68A mounted on supports 68B and 68C as actuated by bar 66. The dogging link 67 terminates in a hook 68D positioned to catch the dog 51. A latch bar 69 is mounted in front of the dogging bar 66 and fastened by a lever 70 to a latch release 71 whose action is described below. For each pack stick 5 there is a latch 72 pivoted on the latch bar 69 and terminating in a hook. The latch 72 and dogging link 67 for each pack stick 5 are narrow compared with the width of the dog 51.

As the stick of dynamite is packed, each successive stroke of the packing crosshead 42 leaves the stick 5 in a higher resting position. When the stick is completely packed the dog 51 is within reach of the hook of the dogging link 67 at the lower end of its reciprocal stroke. The dogging link 67 then withdraws the pack stick 5 beyond the reach of the packing crosshead 42 and within reach of the latch 72. This stick is now withdranw from operation until the next packing cycle is started, after all cartridges are filled, all pack sticks are latched and new empty cartridges are in place. The operator then actuates the latch release 71 by any convenient means (not shown) such as a chain or cord. The release 71 operates the lever 70 to shift the latch bar 69 laterally a short distance, which disengages the latch 72 from the dog 51 and frees the pack sticks for a new packing cycle. In order to put the pack sticks within reach of the packing trigger mechanism 44 it is necessary, when such is used, instead of free falling weights, as the driving force, to give the sticks a starting push. This is accomplished by a starting booster which is constructed as follows. A bar 73 is journalled into a lower part of the frame 30 beneath the dogging mechanism. Levers 74 extend from this to a booster bar 75 extending laterally across the apparatus beneath the pack sticks 5. Each pack stick 5 has at its upper end a stop 76 extending beneath the tracks 77 which guide the movement of the said pack sticks. The booster bar 75 is fastened by a long spring 78 (whose tension is adjustable by a turnbuckle 79) to a lower part of the frame 30. When the dogging links withdraw and latch the pack sticks, they do so against the tension on the booster bar 75 from the spring 78. Thus, when the latches 72 are released, the tension of spring 78 pulls the booster bar 75 and thus pulls the pack sticks down to where the packing trigger mechanism 44 can reach them and start the packing. A booster stop 80 comprising a bar across a lower part of the frame, keeps the booster bar 75 in position to be picked up by the stops 76 when the first pack stick is dogged.

It is an advantage of the use of a chain drive mechanism such as has been described, that the packing stroke is driven by the chain in a straight line and therefore achieves a uniform speed in feet per minute. This results in uniform packing and density throughout the length of the cartridge. It is a further advantage of the chain drive over the crank shaft type of drive, that the chain drive is able to give more strokes per minute without increasing the maximum speed of the crosshead. This is a result of the elimination of most of the up and down motion which results when a crank wheel is used. It is a further advantage of the chain drive mechanism, that sticks of dynamite of lengths varying from 8 to 24 inches can be packed with a minimum of readjustment of the mechanism.

It is an advantage of the new pack stick trigger mechanism for actuating the down stroke of the packing stick, that it permits greater production by allowing the machine to run smoothly at high speeds, since the down stroke is no longer dependent solely on the acceleration of lead weights by gravity for its impetus. It further permits control of the density to which the stick is packed by adjusting the resistance to the release of the stick by use of the adjusting screws 48.

Both the chain drive mechanism and the packing stick trigger can be used separately on the originally described apparatus, or even on apparatuses of the prior art. Each of these subcombinations is thus a separate portion of my invention, independent of the overall machine. However, the use of these improved alternative mechanisms in combination, gives a machine which runs far more smoothly and is far more flexible than any machine available for the packing of dynamite sticks. Each runs better in combination with the other, since it is in such combination, that the advantages of each of these new mechanisms can be shown to the greatest extent. Such a combination of these additional features thus forms a greatly preferred embodiment of my broad invention.

In order that the danger of sparking may be avoided the frame 30 is generally made of wood. The tamps 4 at the end of the packing stick 5 may be fabricated from a hard rubber. Various metal parts may be made of aluminum or other non-sparking metals or alloys. The face of the packing crosshead 13 which comes in contact with the dog 16 may be padded with rubber as may other portions of the apparatus where metal comes into contact with metal as for example, on the upper face of the arm 26.

It will be clear that various changes may be made in the details of the invention without parting from the scope thereof.

This application is a continuation-in-part of my copending application Serial No. 454,320, filed September 7, 1954, now abandoned.

I claim:

1. In an apparatus for packing explosive material into cartridges which comprises in combination nearly horizontal cartridge supporting means, a container normally filled with explosive, a plurality of nearly horizontal packing sticks, the lower ends thereof being adapted to reciprocate through said container and into cartridges positioned within said cartridge supporting means, the upper ends of said packing sticks having dogs affixed thereon, means for reciprocating said packing sticks and latching means for holding said packing sticks in a withdrawn position,

the improvement which comprises a second reciprocating means separate from said means for reciprocating said packing sticks, said second reciprocating means being positioned to reciprocate in a plane parallel to said packing sticks and in the same linear direction as said sticks, the said second reciprocating means being adapted to engage said dogs when said cartridges are filled

with explosive and to carry said packing sticks to said withdrawn position.

2. In an apparatus for packing explosive material into cartridges which comprises in combination nearly horizontal cartridge supporting means, a container normally filled with explosive, a plurality of nearly horizontal packing sticks, the lower ends thereof being adapted to reciprocate through said container and into cartridges positioned within said cartridge supporting means, the upper ends of said packing sticks having dogs affixed thereon, means for reciprocating said packing sticks and latching means for holding said packing sticks in a withdrawn position,

the improvement which comprises, in combination, a second reciprocating means separate from said means for reciprocating said packing sticks, said second reciprocating means being positioned to reciprocate in a plane parallel to said packing sticks and in the same linear direction as said sticks, the said second reciprocating means being adapted to engage said dogs when said cartridges are filled with explosive and to carry said packing sticks to said withdrawn position, a chain drive mechanism comprising a pair of endless chains each passing around a plurality of sprockets, the plane of each set of said sprockets being perpendicular to the plane of said reciprocating packing sticks and parallel to each other, means for rotating one sprocket of each of said sets of sprockets, a rigid structure pivotably mounted in both said chains so as to follow the course of said chains around said sprockets, means for connecting said rigid structure with said means for reciprocating said packing sticks, and means for connecting said chain drive mechanism with said second reciprocating means.

3. In an apparatus for packing explosive material into cartridges which comprises in combination nearly horizontal cartridge supporting means, a container normally filled with explosives, a plurality of nearly horizontal packing sticks, the lower ends thereof being adapted to reciprocate through said container and into cartridges positioned within said cartridge supporting means, the upper ends of said packing sticks having dogs affixed thereon, means for reciprocating said packing sticks and latching means for holding said packing sticks in a withdrawn position,

the improvement which comprises, in combination, a second reciprocating means separate from said means for reciprocating said packing sticks, said second reciprocating means being positioned to reciprocate in a plane parallel to said packing sticks and in the same linear direction as said sticks, the said second reciprocating means being adapted to engage said dogs when said cartridges are filled with explosive and to carry said packing sticks to said withdrawn position, a chain drive mechanism comprising a pair of endless chains each passing around a plurality of sprockets, the plane of each set of said sprockets being perpendicular to the plane of said reciprocating packing sticks and parallel to each other, means for rotating one sprocket of each of said sets of sprockets, a rigid structure pivotably mounted in both said chains so as to follow the course of said chains around said sprockets, means for connecting said rigid structure with said means for reciprocating said packing sticks, means for connecting said chain drive mechanism with said second reciprocating means, and said means for reciprocating said packing sticks comprising in part a pack stick trigger mechanism comprising a pivoted hook, a dog on said packing sticks, said hook being adapted to meet said dog, said hook and said dog having bevelled surfaces such that said hook easily slides either way over said dog, and an adjustable means for controlling the resistance to said stick at which said pivoted hook will slide over said dog.

References Cited in the file of this patent

UNITED STATES PATENTS

813,435	Kimber	Feb. 27, 1906
849,185	Baldwin	Apr. 2, 1907
1,302,237	Sokolow et al.	Apr. 29, 1919
1,911,299	Bashford	May 30, 1933
2,097,080	Robison	Oct. 26, 1937
2,404,434	Clark et al.	July 23, 1946