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Termet

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[54] **SAFETY DEVICE FOR SEAL FIXING APPARATUS**

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[51] **Int. Cl.²** **B25C 1/14**

[58] **Field of Search** 227/8, 10

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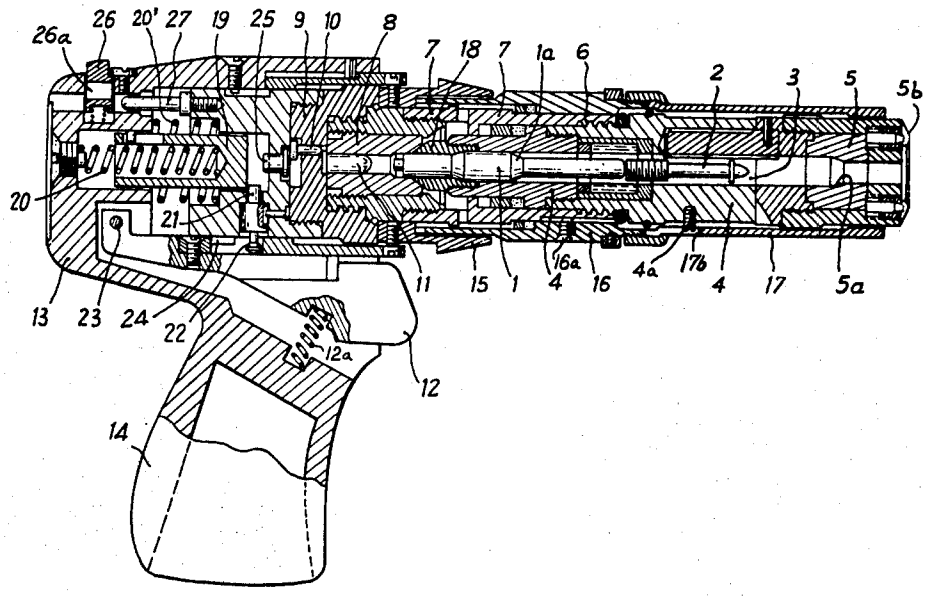
[57] **ABSTRACT**

Fastening apparatus in the form of a gun in which the energy resulting from the explosion of a cartridge drives a piston which in turn drives the fastener, such as a nail, bolt or the like into the material to be fastened.

The barrel with its muzzle, cartridge chamber, breech block, and firing device forms an assembly which slides in a tubular casing rigidly attached to the stock of the apparatus which carries the trigger, the assembly being urged by means of a spring in the firing direction. The trigger is only able to operate the firing device when the front end of the muzzle of the barrel is protruding from the tubular casing by a length less than a given length.

7 Claims, 6 Drawing Figures



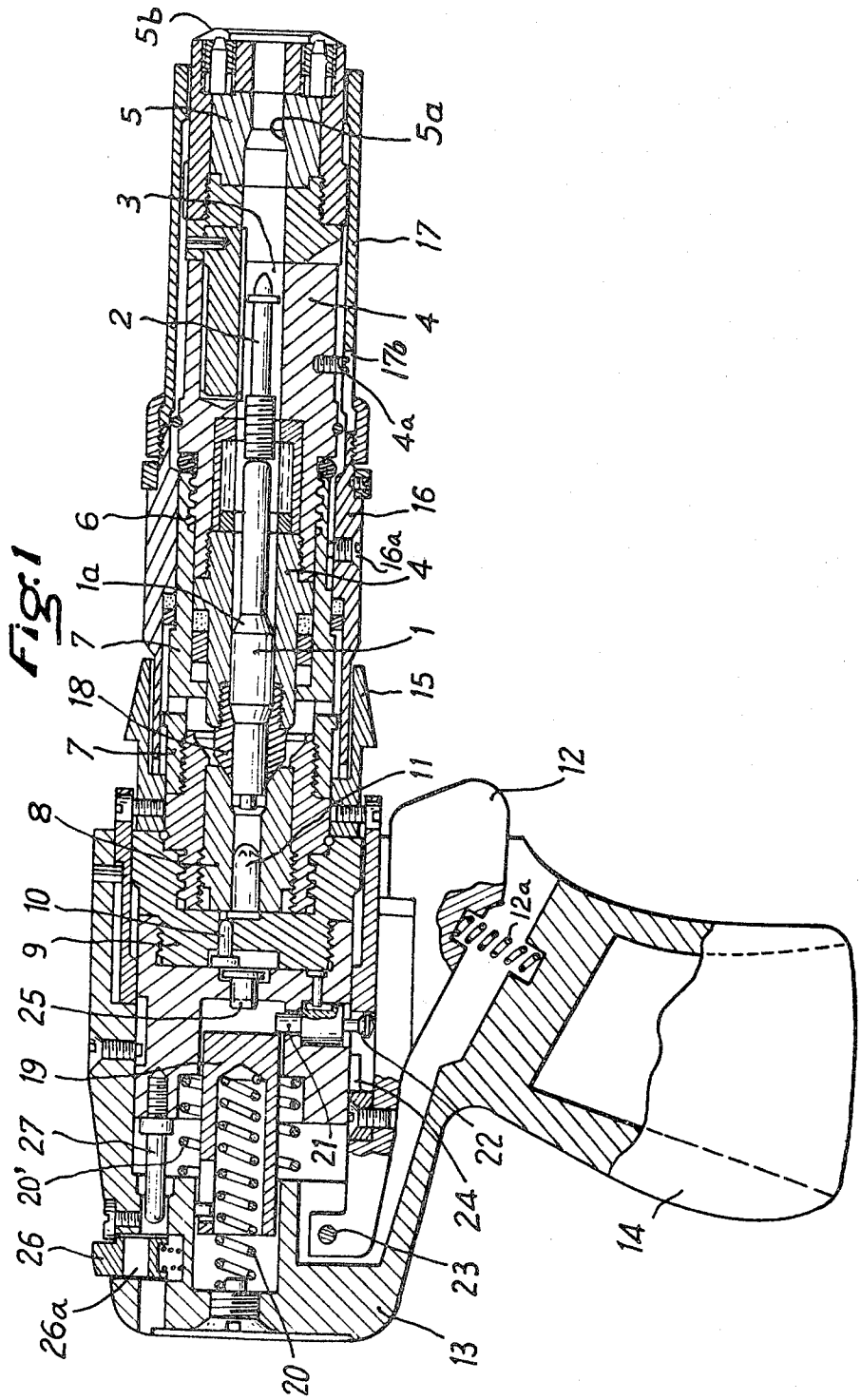

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Fig. 1

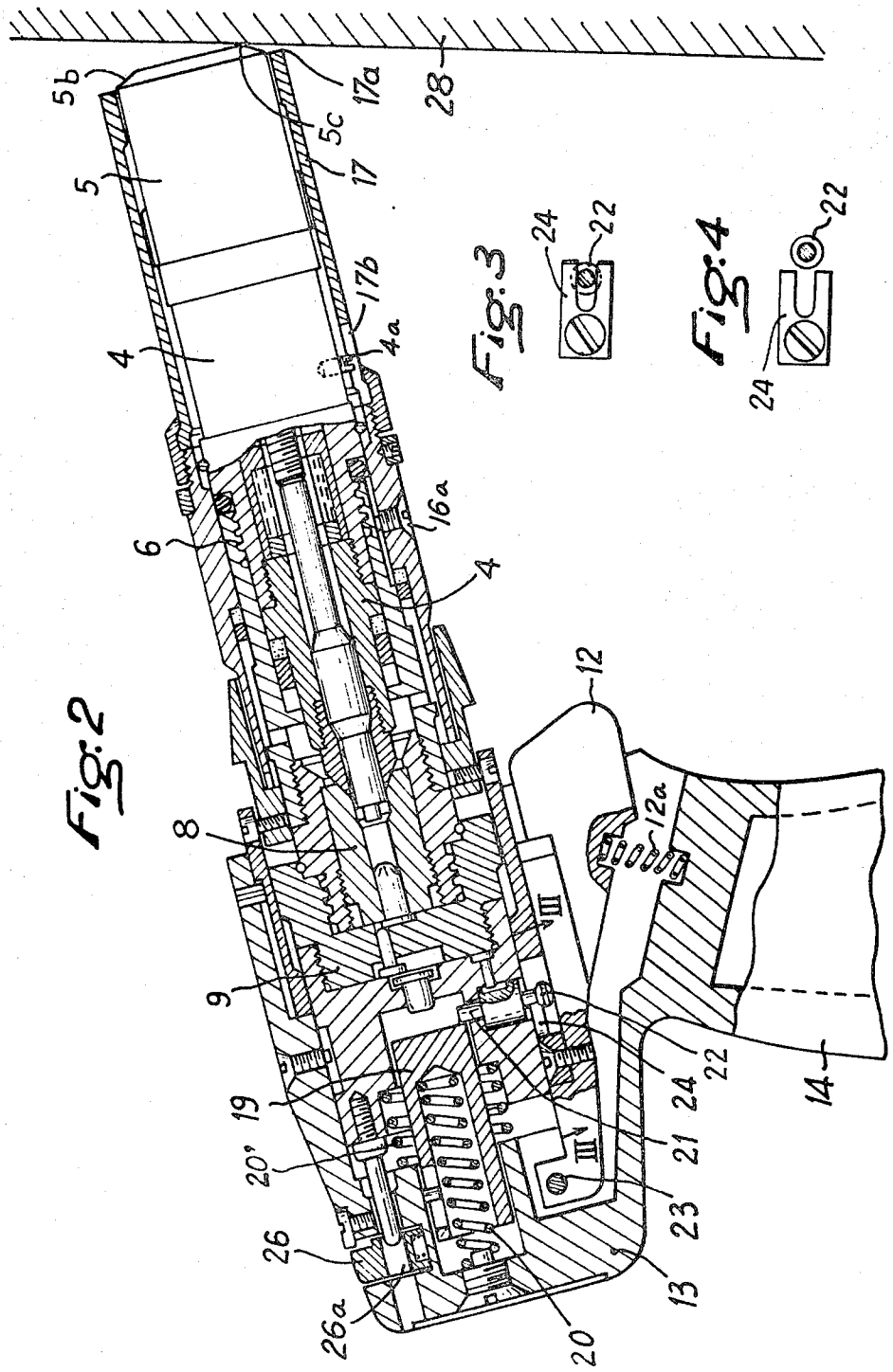

Fig. 2

Fig. 3

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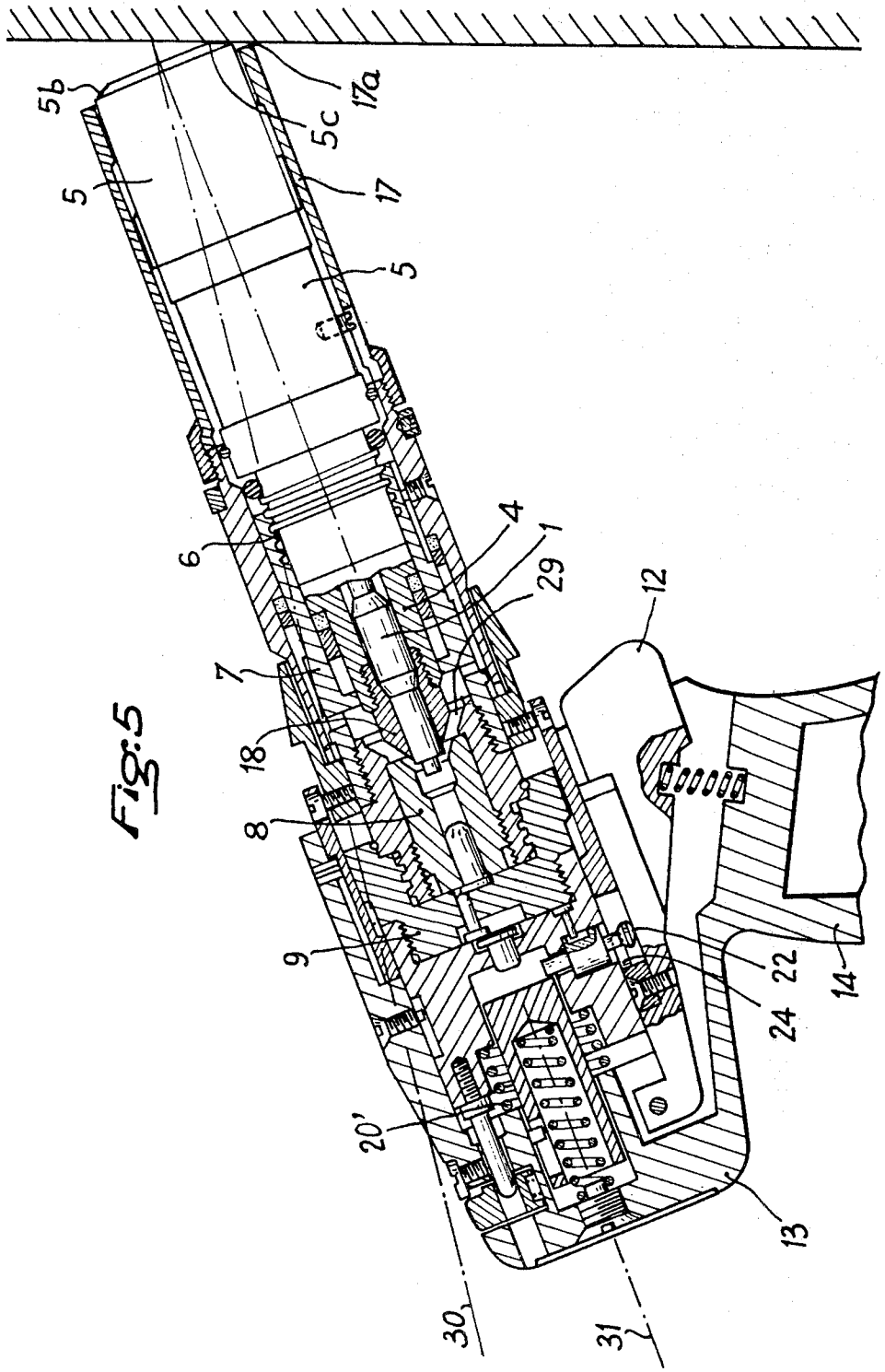

Fig. 5

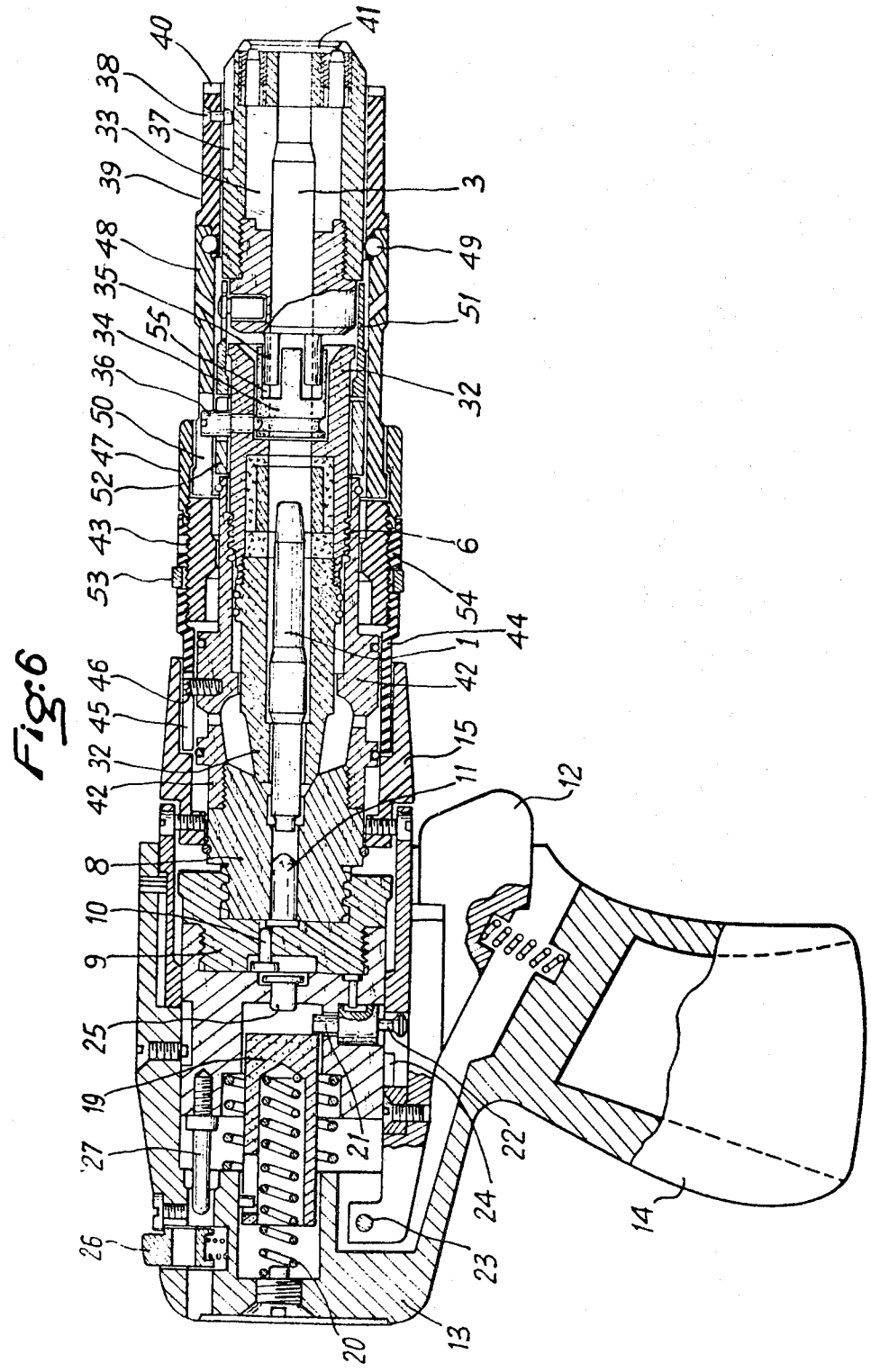
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Fig. 6

SAFETY DEVICE FOR SEAL FIXING APPARATUS

The present invention relates to a novel safety device for fastener-driving apparatus of the type in which a fastener such as a pin, a nail or a bolt is driven into suitable material by the force produced by the explosion of a cartridge.

Such apparatus is already known in which the gases emanating from the explosion of the cartridge propel the bolt by means of a drive-piston which remains permanently inside the apparatus and which is subjected on one side to the pressure resulting from the explosion of the cartridge, while its other side bears against the bolt to drive it into the material.

Such apparatus enables bolt driving velocities to be obtained which are of the order of 60 to 180 metres/-second, while apparatus known as "direct firing" guns in which the gases emanating from the explosion of the cartridge propels the bolt directly operate with driving velocities of the order of 400 metres/second.

The so-called piston-driven apparatus is therefore much safer to use than the so-called "direct firing" apparatus. It is for this reason that in the majority of applications it is not necessary to place a protective shield on the end of the barrel to protect the user from possible ricochets of the bolt when it is fixed.

However, excessive inclination of the apparatus relative to the perpendicular to the surface of the material into which the bolt is being driven may cause ricochets even in the case of the piston-driven apparatus. Although these ricochets (taking into account the low initial velocity of this type of apparatus and of the velocity reduction inherent in the penetration of the bolt into the material) are of no great danger, it has appeared useful, especially in the case of piston-driven apparatus having driving velocities greater than approximately 100 metres/second, to provide means whereby the said apparatus cannot fire the cartridge while its axis makes an angle greater than a given angle, which is 15° to 30° for example, with the perpendicular to the material to be penetrated.

The aim of the present invention is to permit construction of such apparatus which cannot be fired while it is excessively inclined relative to the position which it should occupy at the moment of firing.

Another object of the invention is to provide a device of this type in which the maximum angle at which the axis of the device may be positioned with respect to a perpendicular to the material to be penetrated without making it impossible to fire the device decreases as the velocity with which the device is fired increases.

These aims are attained by the present invention.

The object of the present invention is to provide a new article of manufacture consisting of a fastener driver operating by means of the energy resulting from the explosion of a cartridge, of the piston-driven type, characterized by the fact that the assembly formed by the barrel with its muzzle, the cartridge chamber, the breech block and its firing device, slides in a tubular casing forming an integral part of the stock of the apparatus which carries the trigger, the above-mentioned assembly being resiliently urged in the firing direction by the action of a spring, and the trigger only being able to actuate the firing device when the front end of the muzzle of the barrel is projecting from the tubular casing by a length less than a given length.

In a particular embodiment of the invention, the trigger, which is pivoted at a point adjacent to the rear portion of the apparatus, has a fork-shaped part which, when the assembly including the barrel is pushed backwards at the moment of firing, positions itself around a lug provided with a head, so that the operation of the trigger applies traction to this lug, which releases a spring-biassed mass, with the result that this mass hits the striker.

It will be observed that, in this embodiment, when the assembly including the barrel is not pushed far enough backwards, the fork cannot engage the lug so that operation of the trigger cannot cause striking.

Under these conditions it is necessary to push the front end of the gun into the tubular casing by a sufficient amount to be able to fire.

As moreover this minimum insertion of the barrel corresponds to a given angle of the axis of the apparatus relative to the surface of the material to be penetrated which is such that said material bears both on the outer edge of the front portion of the casing of the apparatus and on the font end of the barrel, it will be understood that the apparatus in accordance with the invention can only fire when its inclination relative to the perpendicular to the reception material is less than a given inclination.

In accordance with a particular embodiment of the invention, the forward end of the muzzle of the barrel is formed with a chamfer so that this forward portion of the muzzle of the barrel has a flattened frusto-conical form (for example with an apex angle of the order of 60°).

In this way, the maximum angle of inclination is determined by the contact with the surface of the material to be penetrated of the apex of the truncated cone of the muzzle and of the outer edge of the casing of the apparatus.

In accordance with a particular embodiment of the invention, the fastening apparatus has a power adjustment device of the type in which a portion of the gases emanating from the explosion are vented through a gas-port of adjustable size, situated on the periphery of the barrel adjacent to the cartridge explosion chamber.

This embodiment of the invention is characterized by the fact that the size of the above-mentioned gas-port is determined by the axial displacement of the barrel and its muzzle relative to the assembly forming the cartridge chamber, the breech and the striking device.

As a result, in the limit position of the breech relative to the stock of the apparatus which carries the trigger, (the said position permitting firing), the distance by which the muzzle of the barrel projects from the tubular casing which surrounds is proportional to the section of the gas port which is open and consequently to the bolt driving capacity.

Consequently the maximum angle of inclination which the apparatus may assume with respect to a perpendicular to the surface of the material to be penetrated, and still be fired, decreases as the speed at which the bolt is projected increases.

In this way, the maximum angle with the perpendicular to the material may be varied on firing as a function of the driving velocity, it being understood that in accordance with experience and the regulations laid down up to the present time, it is not necessary to impose a particular firing angle in the case in which the

bolt is driven with a velocity of less than 100 metres/-second.

It will be seen that, in a particularly simple and efficient manner, the invention enables the risk of ricochets which may occur in apparatus of the piston-driven type for velocities of the order of 100 to 180 metres/seconds to be avoided, since the gun may be fired only when at an angle as close to the position perpendicular to the material to be penetrated which is dependent on the penetration velocity.

However, in a modification of this particular embodiment, while the muzzle of the device cooperates with the barrel to guide the projectile, the muzzle is axially movable with respect to the barrel, and the maximum depression of the muzzle is determined by the abutment of the muzzle against a member located radially outward of the barrel and fixed to the member defining the cartridge chamber.

Under these circumstances, the axial displacement of the barrel relative to the cartridge chamber, which determines the size of the gas-port, either does not affect the muzzle during any part of the displacement of the barrel, thus maintaining constant the maximum angle of inclination of the apparatus, or in a modification, affects it only during a portion of this adjustment stroke, so that the limit angle is fixed for the highest firing velocities and then increases when the lower velocities are reached, due to adjustment of the gas-port.

Furthermore it is possible, whether the muzzle is axially connected to the barrel or whether it is axially independent of the barrel, to render the muzzle independent of the barrel for rotation when axial displacement of the barrel is effected under the influence of its own rotation caused by an adjustment ring.

In order to provide a better understanding of the invention, an embodiment taken as an example and illustrated in the drawings will now be described purely by way of illustration and example.

In these drawings:

FIG. **1** is a diagrammatic axial sectional view of a fastener driver in accordance with the invention;

FIg. **2** is a view corresponding to FIG. **1,** showing the apparatus being applied to a material to be penetrated while being inclined at the maximum angle for which firing is possible, the power being adjusted to the maximum;

FIGS. **3** and **4** are two detail views taken along the line III—III of FIG. **2,** illustrating the case in which striking is possible and the case in which striking is not possible respectively;

FIG. **5** is a view corresponding to FIG. **2** illustrating the case in which the apparatus is adjusted to fire at a lower velocity; and

FIG. **6** is an axial section of the apparatus in accordance with a modification of the invention.

The apparatus which is shown in the drawings is of the type in which it is possible to adjust the power, i.e. to use an explosive charge of uniform power to perform jobs requiring different energy values.

FIG. **1** shows the drive-piston **1** which propels a bolt **2** with a threaded head as it slides in the bore **3** of a barrel **4** which is provided with a muzzle **5** able to move axially relative to barrel **4** at the moment when shoulder **1***a* of drive-piston **1** impinges against shoulder **5***a* of the mobile muzzle.

This apparatus is known in prior art and will not be described here in more detail.

The barrel **4** is screwed by means of threads **6** into a sleeve **7** rigidly attached to the member **8** defining the peripheral wall of a cartridge chamber.

A breech block **9** having a firing pin **10** closes the rear end of cartridge chamber **8** which contains cartridge **11.**

The assembly just described is surrounded by a cylindrical casing, forming the body of the apparatus and supporting trigger **12.**

This casing consists of a rear member **13** including the grip **14** and surrounding the striking device.

The member **13** is connected in a known manner to cylindrical members **15, 16** and **17** which constitute the tubular casing of the barrel up to adjacent the front end of the gun.

The member **17** may be manually rotated relative to the grip **14,** and this causes rotation of the barrel **4** due to engagement of the screw **4***a*, which projects from the barrel, in the longitudinal slot **17***b* formed in the member **17.** As the barrel **4** is rotated it screws or unscrews relative to sleeve **7** by means of thread **6** moves the member **18,** which is rigidly attached to barrel **4,** nearer to or farther from cartridge chamber **8.**

A gas-port of smaller or larger size is thus formed between the member **8** and **18** which, in known manner, enables the exhaust gases resulting from the explosion of the cartridge to be evacuated from the apparatus.

In the position shown in FIG. **1,** the members **8** and **18** are in contact so that the gas-port has a zero section which corresponds to a maximum driving velocity.

Inside member **13** constituting the stock of the apparatus is a mobile mass **19** subjected to the action of a spring **20** which is retained in the position shown in FIG. **1** by pin **21** which is urged upwards by the trigger **12,** which is biassed upwardly by the trigger spring **12***a*.

Pin **21** is rigidly attached to a lug **22** provided with a head which can move towards trigger **12** which is pivoted at **23** at the back of the apparatus.

Trigger **12** has a fork-shaped part **24** which, when the barrel of the apparatus is pushed backwards, engages the head of lug **22.**

It will be understood that under these circumstances, when the trigger is operated, pin **21** moves downwardly and releases mass **19** which, under the influence of the spring, hits the member **25** which operates the percussion pin **10.**

To permit backward movement of the barrel inside the stock of the apparatus against the action of spring **20'**, it is also necessary to move the member **26** downwardly, so that an orifice **26***a* in the member **26** comes into alignment with the pin **27** which is rigidly attached to the barrel, so that the pin **27** may enter the orifice. This constitutes a safety catch of a type already known.

It will also be noticed in FIG. **1** that the forward end of muzzle **5** has a frusto-conical surface **5***b* having an apex angle relative to the axis of approximately 60°.

The operation of the apparatus is relatively simple. The cylindrical member **16,** is fixed to the sleeve **7,** by the screw **16***a*. AS hereinbefore pointed out, this sleeve is fixed to the member **8** defining the cartridge chamber so that the members **16, 7** and **8** rotate as a unit. The member **8** therefore may be unscrewed from the member **9,** by simply rotating the sleeve **16.** A cartridge may then be inserted into the cartridge chamber, and a bolt dropped into the muzzle of the gun. After introduction of a cartridge and a bolt into the apparatus, all that is necessary is to apply the end of muzzle **5** of the barrel

against the surface of the material into which it is required to drive the bolt and to apply a force towards this material by bearing on grip **14.** If the safety member **26** is pressed simultaneously, it is possible to move the stock of the apparatus towards the material into which it is required to drive the bolt. As this is done, fork **24** embraces the lug having the head **22,** which permits firing by squeezing trigger **12.**

FIG. 2 shows the fastening apparatus of FIG. **1** placed against a material **28** which is to be penetrated, the axis of the barrel being inclined relative to the perpendicular to the surface of this material **28,** by the maximum angle compatible with firing.

In this position, the assembly formed by barrel **4** with its muzzle **5,** cartridge chamber **8** and breech **9** is pushed backwards against the action of spring **20'**, safety member **26** being withdrawn into the stock **13** of the apparatus. Mass **19** bears against pin **21,** while spring **20** is compressed.

At the front of the apparatus, the peripheral edge **17***a* of cylindrical member **17** bears against reception material **28,** as does the edge of smaller diameter **5***c* of frusto-conical surface **5***b* of muzzle **5.**

It will be noted that because of the frusto-conical chamfer **5***b*, the apparatus can bear on thet surface of material **28** at two points **5***c* and **17***a*, which are situated at a not negligeable distance from each other, thus permitting determination with good precision of the maximum firing angle for a projection of a given distancce of the muzzle of the barrel **5** from sleeve **17.**

In the position shown in FIG. **2,** fork **24** rigidly attached to the trigger engages the lug **22** just sufficiently to permit firing. This position corresponds to the maximum angle at which firing remains possible.

FIGS. **3** and **4** show diagrammatically views along the line III—III of FIG. **2.** Each of these views again shows fork **24** and the lug **22.**

In the case of FIG. **3,** fork **24** completely engages the lug **22** so as to allow firing, the pistol being in a normal firing position, with its axis substantially perpendicular to the surface of material **28.**

On the other hand, in the case of FIG. **4,** fork **24** is not in engagement with lug **22,** either because the apparatus is not applied against the material to be penetrated, or because the apparatus is forming an angle with the perpendicular to material **28** which is incompatible with the possibility of firing.

The respective positions of fork **24** and lug **22** are in the case of FIG. **1** intermediate between the positions of FIG. **3** and FIG. **4,** with the end of fork **24** only just engaging lug **22.**

In the case of FIG. **5,** the apparatus has been adjusted to fire with a reduced power.

For this barrel **4** and its muzzle **5** have been rotated relative to sleeve **7** rigidly attached to cartridge chamber **8,** which rotation has moved the barrel by means of thread **6** in the firing direction, creating a circular gas-port **29** for evacuation of a portion of the gases emanating from the explosion of the cartridge **11.**

An outward displacement of muzzle **5** of the barrel has thus been produced, the members supported by cartridge chamber **8** and breech **9** having remained in the same positions relative to stock **13** of the apparatus.

As a result, in the position shown in FIG. **5,** fork **24** rigidly attached to trigger **12** is in the limit position in which it can engage the lug **22.**

It will be observed that in accordance with the invention, the distance by which muzzle **5** of the barrel projects from member **17** corresponds to the extent to which circular gas-port **29** is opened.

Consequently the apparatus in accordance with the invention permits firing with the axis of the barrel further removed from the perpendicular to material **28** when the power and consequently the driving speed of the projectile are reduced.

At **30** in FIG. **5** is shown the position of the firing axis most distant from the perpendicular to material **28** for the maximum power of the apparatus (FIG. **2**) and at **31** is shown the corresponding position of the firing axis of the apparatus in accordance with FIG. **5.**

It is quite clear that power adjustment requires the apparatus to fire with its axis closer to the perpendicular to the surface **28** when the driving velocity of the projectile is higher.

It arises from the explanations given above with reference to the drawings that the invention enables a safety device to be formed in a particularly simple and efficient manner for piston-driven apparatus which does not require the use of a shield arranged at the end of the barrel.

Reference is now made to FIG. **6** in which the corresponding parts have received the same references as in FIG. **1.**

In contrast to the preceding apparatus, the apparatus shown in FIG. **6** has a muzzle **33** which is, even when in its position of maximum depression, axially separated from the barrel **32.** In its front portion barrel **32** has a dog **34** co-operating with four arms **35** of a counter-dog rigidly attached to muzzle **33.** Of course central bore **3** is continued inside dog **34** which, like arms **35,** is not shown in axial section in the figure. Dog **34** also has a circular groove which receives the end of a screw **36** screwed through barrel **32.** In this way dog **34** is axially immovable with respect to barrel **32** by the groove and screw, but capable of rotation relative to this barrel, so that the rotation of barrel **32** will not be transmitted to muzzle **33.**

It will therefore be understood that the dog device **34, 35** is simply provided to ensure continuity of bore **3,** while disconnecting barrel **32** from muzzle **33** both axially and in rotation.

On its outer periphery muzzle **33** has a longitudinal groove **37** which cooperates with a lug **38** projecting inwardly from the front cylindrical part **39** of the casing so that muzzle **33** and part **39** will rotate together. In its front end the part **39** has a double notch **40** in the same vertical plane as a notch **41** in the front edge of muzzle **33.** These notches are designed to receive complementary parts carried by the projectiles so as to prevent rotation of the projectile.

The member **8** defining the peripheral wall of the cartridge chamber carries a generally cylindrical extension **42** which has internal threads **6** co-operating with a corresponding threads on barrel **32.** The extension **42** is surrounded by an externally threaded ring **43** on the left end of which is screwed a ring **44** forming part of the casing and having a longitudinal slot **45** through which passes the head of a screw **46** screwed into the extension **42** so that ring **44** and ring **43** cannot rotate. on the right edge of ring **43** is screwed an annular nut **47** which by means of an interior groove axially retains a cylindrical member **48** having an extension **39,** which

can turn relative to the member **48** in ball-bearings **49** housed in suitable grooves.

The member **48** has a longitudinal slot **50** in which screw **36** is slidable.

it will also be observed that an annular member **51** is inserted between the right end of extension **42** and muzzle **33**, and rigidly attached to muzzle **33** for rotation therewith.

This member **51** is in contact with a ring **52** having a slot for the passage of screw **36.**

It will be understood that members **43, 44, 47, 48** and **39** form the casing generally referenced **13** end it will be observed that the total length of this casing may be adjusted by screwing ring **43** more or less into ring **44** and that furthermore member **48** can rotate relative to members **43, 47** and **39** but is not axially slidable relative thereto.

On ring **43** may be placed a short ring **52** bearing an adjustment marker adapted to be locked in place by a nut **53** screwed onto ring **43.** This marker cooperates with graduation lines carried by the outer visible face of the member **48.**

In the position shown in the drawing barrel **32,** screwed completely onto threads **6,** has its end against the cartridge chamber **8** so that the gas-port is closed. When, in the position shown in the drawing, thrust is applied to the end **41** of muzzle **33** which tends to cause the muzzle to enter the casing, this thrust is transmitted by member **51** and **52** to member **42** and from there to cartridge chamber **8** and to the whole firing mechanism so that this assembly slides inwards, carrying with it barrel **32.** It will be seen that, in this position, an axial clearance **55,** of the order of 2 mm, for example, exists inside dog **34.**

When it is required to reduce the firing velocity, the operator turns the graduated member **48** manually. In doing this, through screw **36,** he turns barrel **32** in thread **6** so that the barrel moves axially away from the member **8,** thus forming a gas-port reducing the thrust of the gases on piston **1** upon firing. In this motion of barrel **32** to the right, the dog is driven axially to the right but is free to rotate because of the groove which receives screw **36.** It is therefore possible to rotationally position muzzle **33** in any suitable manner, whatever may be the position of the barrel. Moreover, because of the clearance **55,** it will be observed that the displacement of barrel **32** to the right does not modify the axial position of muzzle **33,** at least while a clearance remains in the dog. As a result, for small gas-port openings with clearance **55** still present, muzzle **33** retains its axial position and the maximum angle of inclination permitting firing remains constant.

On the other hand, if a very large gas port is formed by moving barrel **32** a large amount to the right, greater than 2 mm for example, clearance **5** is finally eliminated and from this moment the subsequent displacement of the barrel under the effect of the rotation of the gas-port adjustment member **48,** causes the corresponding displacement of muzzle **33,** so that from this moment the angle of inclination is increased as was seen with regard to the preceding apparatus.

It is self-evident that if a sufficiently large clearance **55** is provided to start with, it is possible to obtain an apparatus having a limited firing angle which remains constant through the whole range of adjustment of the gas-port and consequently of the firing velocity.

It will be understood that the embodiment given above is given purely by way of example and any desirable modification may be made to it without thereby departing from the scope of the invention.

In particular it is obvious that the trigger apparatus which controls the firing may be of a different type, the only condition being that it is automatically rendered inoperative as soon as the apparatus is inclined by a given angle relative to the perpendicular to the material to be penetrated.

I claim:

1. Cartridge-actuated fastening device including:

a slidable assembly comprising a barrel, a muzzle at one end of said barrel, a cartridge chamber at the other end of said barrel, and a breech-block and percussion means for exploding said cartridge located on the side of said chamber remote from said barrel,

a driving piston slidably mounted in said barrel for actuation by the gases produced by an explosion in said cartridge chamber to eject a fastener from said muzzle and,

a tubular casing having a handle near one end thereof, said assembly being mounted for axial sliding movement in said casing, spring means biassing said assembly so that said muzzle projects from the other end of said casing for a predetermined distance except when said spring means is compressed by pressing said muzzle against a material in which said fastener is to be driven,

latch means carried by said assembly and movable between a first position in which said latch means does and a second position in which it does not prevent operation of said percussion means,

a trigger mounted on said handle,

catch means carried by said trigger moving said latch means to said second position when said catch means is in engagement with said latch means and said trigger is actuated,

said latch means being spaced from a position in which it is engaged by said catch means by a distance no greater than said predetermined distance whenever said muzzle projects said predetermined distance from said tubular member.

2. Device as claimed in claim **1** in which said catch means is in the form of a fork and the latch means is a rod having a head beneath which said fork engages to move said latch means when said trigger is actuated with said muzzle pressed into said tubular member.

3. Device as claimed in claim **1** in which said muzzle has an external peripheral chamfer at an angle of 60° to the axis of said nozzle.

4. Device as claimed in claim **1** in which said barrel carries threads which engage correspondingly threaded means fixed to said cartridge chamber and comprising a control member connected to rotate said barrel relative to said threaded means and thereby alter the axial position of said barrel relative to said cartridge chamber to provide at least one gas vent between said barrel and cartridge chamber.

5. Device as claimed in claim **4** in which said muzzle is slidably mounted in said casing for movement toward and away from said barrel and said muzzle and casing are provided with abutment means which interengage to limit the sliding movement of said muzzle.

6. Device as claimed in claim **5** in which the abutment means on said muzzle is brought closer to the

abutment means on said casing as said barrel is moved away from said cartridge chamber, thereby decreasing the extent to which said muzzle is permitted to move away from said barrel.

7. Device as claimed in claim 4 in which said control member is a sleeve forming part of said casing and rotatable with respect to the remainder of said casing, said sleeve encircling said barrel, and said barrel and sleeve being provided with interfitting slot and projecting means which cause said barrel to rotate with said sleeve, while permitting relative axial sliding movement therebetween.

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