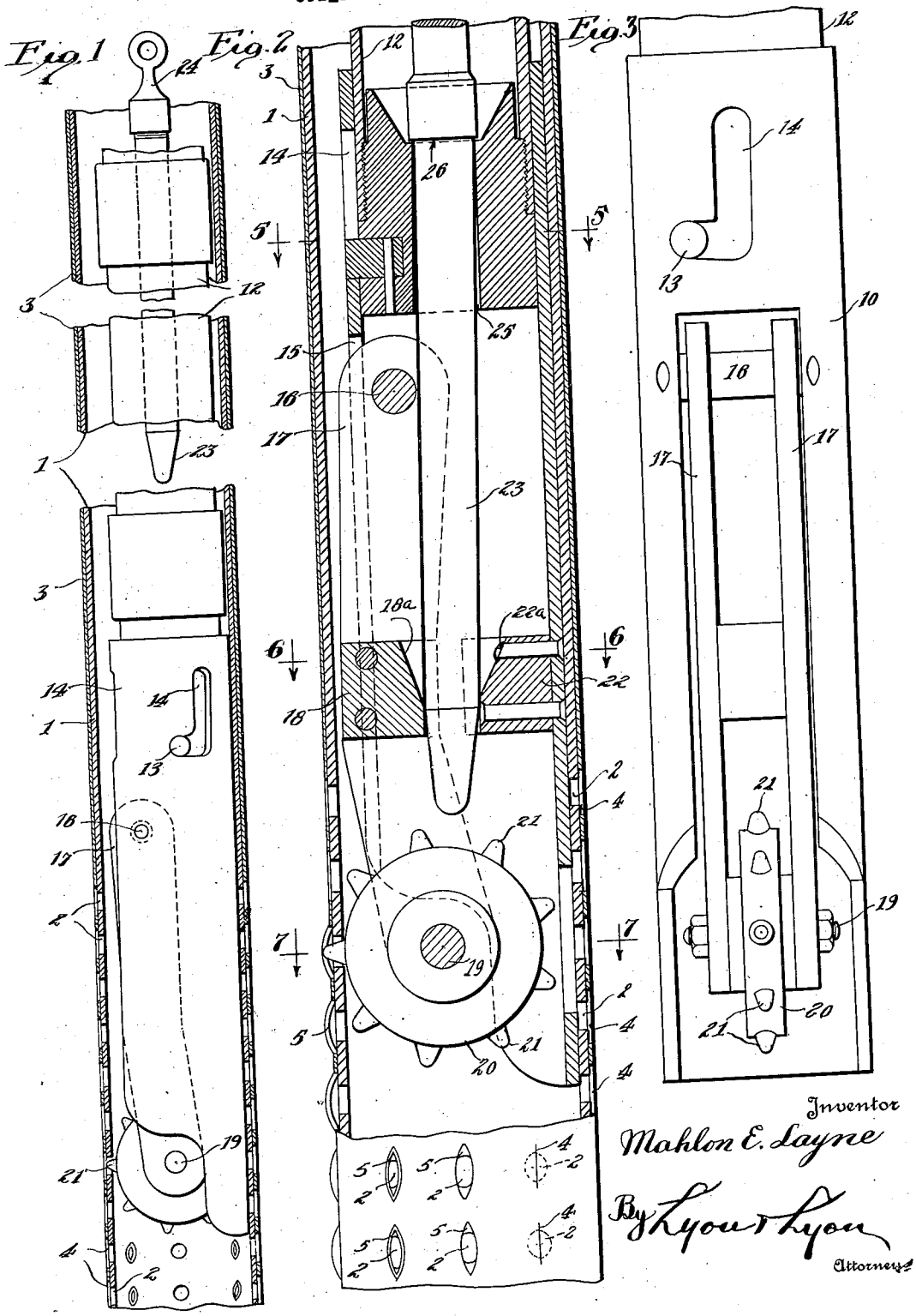
April 7, 1925.

1,532,592

M. E. LAYNE

MEANS FOR FORMING WELL SCREENS

Original Filed April 19, 1923 2 Sheets-Sheet 1



Inventor

Mahlon E. Layne

By Lyon & Lyon

Attorneys

April 7, 1925.

1,532,592

M. E. LAYNE

MEANS FOR FORMING WELL SCREENS

Original Filed April 19, 1923 2 Sheets-Sheet 2

Fig. 4

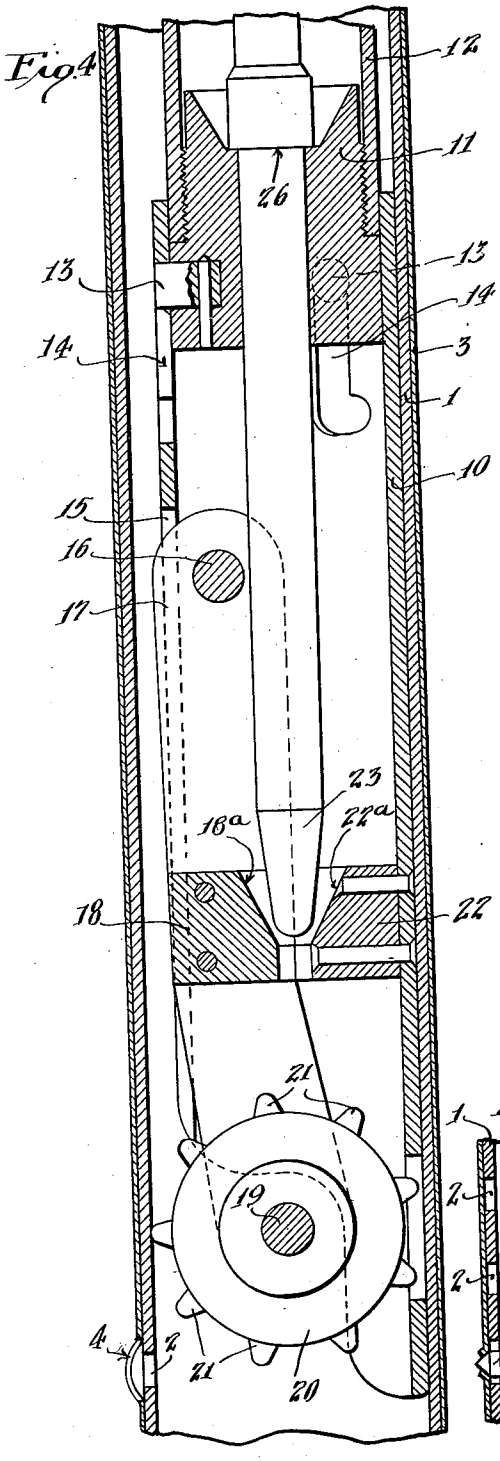


Fig. 5

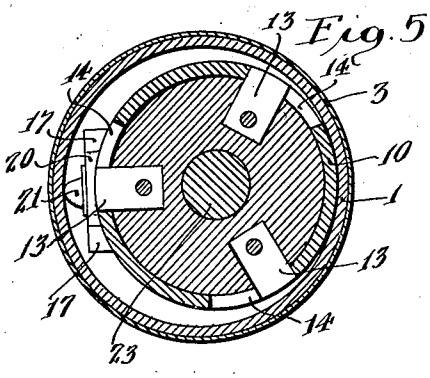


Fig. 6

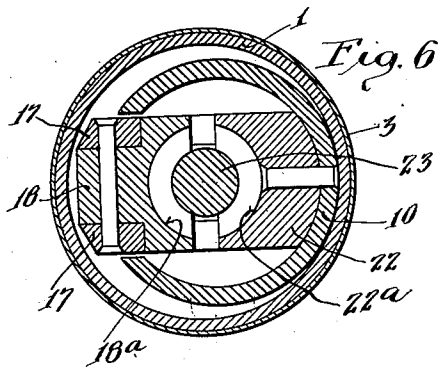


Fig. 7

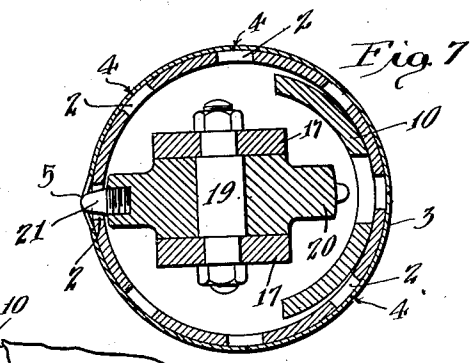
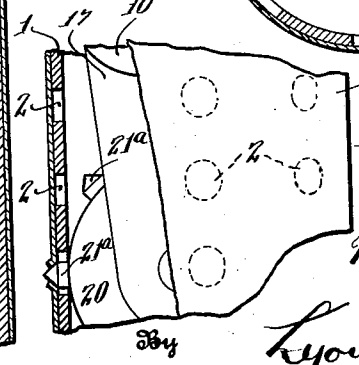


Fig. 8



Inventor

Mahlon E. Layne

By Lyon & Lyon

Attorneys

Patented Apr. 7, 1925. 1,532,592

UNITED STATES PATENT OFFICE.

MAHLON E. LAYNE, OF HOUSTON, TEXAS, ASSIGNOR TO LAYNE & BOWLER CORPORATION, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

MEANS FOR FORMING WELL SCREENS.

Original application filed April 19, 1923, Serial No. 633,084. Divided and this application filed January 22, 1924. Serial No. 687,717.

To all whom it may concern:

Be it known that I, MAHLON E. LAYNE, a citizen of the United States, residing at Houston, in the county of Harris and State of Texas, have invented a new and useful Means for Forming Well Screens, of which the following is a specification.

This invention relates to the general subject of well-screens, and is particularly directed to a device adapted to be lowered down into a well casing installed in position in a well for forming in the well casing perforations for admitting fluid through the casing and into the well. This application is a division of my co-pending application, Serial No. 633,084, filed April 19, 1923, issued July 8, 1924, Patent No. 1,500,829.

An object of this invention is to provide a device for forming well screens by which the screen aperture may be positively initially opened to a predetermined degree and subsequently positively opened to a greater degree.

Another object is to provide a device for forming well screens, by which the screen apertures may be repeatedly and accurately engaged after the screen has been installed within a well, by means manipulated from the well surface and under full control of the operator.

A further object is to provide a device for forming well screens, which permits a screen having normally closed screen apertures to be inserted into a well bore and to be subsequently positively opened by means operated from the well surface and functioning in a manner to positively insure a uniform spacing of the apertures and an accurate re-engagement of previously opened apertures.

Another object is to provide a mechanism adapted to be lowered into a well casing and manipulated from the well surface and vertically translated to form vertical rows of relatively spaced screen apertures with the rows circularly spaced at predetermined intervals.

Another object is to provide a mechanism comprising a perforator element normally inoperative for a perforating operation, and a cooperating member operable to follow said mechanism into the well and condition said element for a perforating operation.

A further object is to provide such cooperating member with an independent operating connection leading to the well surface, and to provide means associated with the perforator mechanism for operating said cooperating member when its operating connection is not available for such purpose, through breakage or through dropping thereof into the well.

Another object is to provide a mechanism which is particularly adaptable for use in connection with double wall well-screens in which the inner wall is provided with vertical rows of holes with which the perforator element has a rack and pinion engagement, and an outer wall normally closing said holes and in some instances scored or slit in the region of each hole to facilitate a perforating operation.

Various other objects and advantages will be more fully apparent from the following description of the accompanying drawings which form a part of this disclosure, and which illustrate a preferred form of embodiment of the invention.

Of the drawings:

Figure 1 is a vertical section through a well-screen casing showing the tool of the present invention in elevation therein.

Fig. 2 is an enlarged section through the well-screen casing and tool showing the parts positioned for a perforating operation.

Fig. 3 is a side elevation of the tool looking at the left-hand side of Fig. 2.

Fig. 4 is a section similar to Fig. 2, illustrating the use of the emergency connection for preparing the tool for withdrawal.

Fig. 5 is a section on line 5—5 of Fig. 2,

Fig. 6 is a section on line 6—6 of Fig. 2,

Fig. 7 is a section on line 7—7 of Fig. 2,

Fig. 8 is a detail view showing a modified form of perforating element.

The device herein described is especially adaptable for use in the formation of well screens which are manufactured with normally closed screen apertures to be subsequently opened after the screen is positioned in a well bore at the desired point of production, and is more particularly adapted for use in the formation of double wall well screens in which an inner apertured casing functions as a means of positively guiding a mechanical perforating device or tool in a perforating operation to open screen apertures in the outer wall or casing.

In making and installing well screens of this general character it has heretofore been proposed to open the screen apertures by hydraulic or explosive pressure, but such methods are objectionable, first for the reason that in producing a pressure within the casing of a degree sufficient to open the screen apertures, and especially in the use of explosives, there is great danger of injury to the well casing, it having been found that in some cases the explosion was so sharp as to open or stretch the connecting couplings to such an extent that when attempting to lift the casing the couplings would slip off the threads of the casing sections, and second for the reason that the degree to which the screen apertures are opened cannot be accurately determined or controlled, for instance those screen apertures which happen to be adjacent hard formations will not be opened to the same extent as those adjacent softer formations.

With the herein described apparatus, the screen apertures are positively opened to a predetermined degree regardless of the nature of the formation contacting the various portions thereof. And further, with the present apparatus it becomes possible to open the screen perforations to a limited extent in the first instance and to further open said perforations as conditions may require, and with a certainty of accurately reengaging the previously formed perforations. This is of great advantage in bringing in wells under high initial pressure, necessitating a screen with only limited openings or screen apertures, and where later the pressure subsides and a more liberal opening is needed. Further, in wells in sand formations, the fineness or coarseness of the screen openings should vary according to the fineness or coarseness of the sand in such formations and should be under positive control of the operator, so that in a well bore through formations of different characters it is possible to open one portion of the screen more than another. It will be understood that that portion of the screen adjacent hard formations should be opened to a greater degree than that which is adjacent soft formations for the reason that large screen apertures adjacent soft formations will usually admit too much sand into the well, and further it will be evident that with the heretofore proposed methods of opening the screen apertures by hydraulic or explosive pressure the reverse will be true, that is, in hard formations there is a greater resistance to the opening of the screen apertures, resulting in limited apertures where larger apertures are desired and in soft formations where such resistance is least the apertures will be relatively large where smaller apertures are desired.

With those types of mechanical perforators which are not positively guided in their perforating operation, an accurate spacing of the perforations is not possible, and in cases where it is desired to re-perforate a screen to provide a more open screen or to clean previously made perforations, such unguided perforator cannot be depended upon to engage or follow the previously made screen apertures and is exceedingly liable to form a new set of perforations so close to the first formed set as to seriously weaken the strength of the entire screen.

My improved device permits me to positively open the screen apertures in any portion of the screen to any degree desired, and after the screen has been set in the well bore, and to subsequently, accurately and positively re-engage said apertures to increase the degree of opening or to clean out such of the apertures as may have become clogged or cemented shut by the lime or other incrusting contents of the formations.

In the drawings I have illustrated a well-screen structure which consists of an inner casing 1 having a plurality of circularly spaced rows of holes 2 equally spaced vertically, and an outer casing 3 which is vertically slit as at 4 with each slit extending across one of the holes 2 in the inner casing. The slits are normally closed and in such condition the screen is lowered into the well to position of use, and means are subsequently manipulated within the screen to widen the slits to form screen apertures 5 in communication with the respective holes 2 of the inner casing.

A screen structure of this type is fully illustrated and described in my copending application entitled "Well screen and method of making same." Case B, Serial No. 633,083, filed April 19, 1923, issued July 8, 1924, Patent No. 1,500,828, to which reference may be had if desired.

It will be stated that in so far as the present invention is concerned, the specific construction of the screen is immaterial so long as it embodies the general characteristics of the type of screen shown, it being evident that other specific forms of screens are adaptable for use with the mechanism disclosed herein, one of such other forms being shown and described in my copending application entitled "Well screen and method of making same" Case A, Serial No. 633,082, filed April 19, 1923, and still another in the Patent #1,304,493 to Ollyn A. Layne.

The means as herein illustrated has a two-part body comprising a tubular member 10 which carries the perforating element, and a head 11 slidable within the upper portion of the member 10 and screw-threaded into the lower end of a tubular shank 12 which

preferably consists of a plurality of tubing sections extending to the well surface, from which point the tool is manipulated. The two body members 10 and 11 are joined by a pin and bayonet slot connection comprising, in the present instance three radial pins 13 carried by the head 11 and projecting into slots 14 in the member 10 (see Figs. 1 to 5). With particular reference to Figs. 1 and 3, it will be seen that normally with the pins 13 in the lateral portions of the slots 14, the two body members may be longitudinally translated within the well as a unit and a rotation of the shank 12 and head 11 in one direction will correspondingly rotate the body member 10. Further it will be evident that upon an independent reverse rotation of the head 11 the pins 13 will be brought into the vertical portions of the slots 14 and the head 11 then permitted a limited independent vertical movement, the purpose of which will later be explained.

The tubular body member 10 is longitudinally slotted as at 15 and pivoted on a pin 16 carried by the member 10 is a depending frame comprising two relatively spaced plates 17 joined together by a block 18. The frame 17 is positioned within the slot 15 and journaled to rotate on a stud 19 carried by the lower end of said frame, is a perforating element or wheel 20 having circularly spaced punch members 21 projecting from its periphery in the manner of a sprocket wheel. Attached to the inner wall surface of the tubular body member 10 and adjacent the block or shoe 18, is a companion block or shoe 22, the adjacent surfaces of the blocks or shoes 18 and 22 having tapered half-circular recesses 18^a and 22^a cooperating to form a tapered bore for cooperation with a wedge element or mandrel 23, said mandrel being in the form of a round rod having a tapered lower end, and provided with means 24 at its upper end for attachment to a cable leading to the well surface.

The mandrel 23 is adapted to slidably engage through a bore 25 in the body member 11 which bore is aligned with the tapered bore formed by the recesses 18^a and 22^a in the shoes, the upper surface of the body member 11 being formed to guide the mandrel 23 into the bore 25 when lowered through the tubular shank 12, a shoulder 26 on the mandrel limiting its insertion into said bore 25.

In the practice of the present invention the well screen with the slits 4 closed, is positioned in the well bore. The perforating tool, with the pins 13 in the lateral portions of the slots 14, is then lowered into the well casing to location of the screen. Due to the absence of the mandrel 24, the frame 17 carrying the perforator element, is free to swing laterally and upon reaching the screen the tool is rotated from the well surface, in a right hand direction, and is moved slightly up and down if necessary, until the punch members 21 engage one of the rows of holes 2 in the screen, (as shown in Fig. 1) this engagement of the punches with the holes in the screen being automatically effected by gravity of reason of the pin 16 being located considerably to one side of the vertical axis of the tool.

With the punch members 21 so engaged the mandrel 23 is lowered into the tubular shank of the tool and entering through the bore 25 in the body member 11, drops downwardly between the wedge shoes 18 and 22, forcibly separating said shoes and forcing the frame 17 and its perforator element laterally to drive the punch members 21 outwardly through the holes 2 in the inner casing 1 to open the slits 4 in the outer casing 3. In this operation the opposite wall of the tool body 10 engages against the inner periphery of the screen.

The tool will next be longitudinally translated to open a row of slits 4 to form the screen apertures 5, the perforator wheel 20 cooperating with the holes 2 in the inner casing 1 in the manner of a rack and pinion.

Upon completion of the first row of screen apertures, the mandrel 23 is withdrawn from between the opposed shoes 18 and 22 to release the perforator frame 17, after which the tool is elevated or lowered above or below the rows of holes 2 so that the punch members 21 engage an unbroken portion of the inner casing 1. The tool is then slightly rotated to bring the punch members 21 between the row of holes previously engaged and the next row and is then translated to bring the punch members 21 between said rows and subsequently rotated until the punch members find and engage in said next row.

The mandrel 23 is then again lowered and the tool operated as above explained, this sequence of operation being repeated until all of the screen apertures desired, are formed, after which the tool is withdrawn from the well.

In some instances it may happen that the mandrel cable is lost in the tool shank or that said cable become broken, and in this event the bayonet slot arrangement provides a means by which the tool may be conditioned for removal independently of a manipulation of said cable.

To accomplish this result, the shank 12 of the tool will be rotated in a left hand direction to bring the pins 13 in line with the vertical portions of the bayonet slots 14 and the tool shank 12 then elevated relative to the body member 10. By reason of the engagement of the body member 11 with the shoulder 26 on the mandrel 23 this inde-

pendent vertical movement of the tool shank 12 and body member 11 will cause the mandrel to be elevated and withdrawn from between the shoes 18 and 22 and in this manner allow the frame 17 and the perforating roller 20 to freely swing inwardly. When the pins 13 reach the upper ends of the bayonet slots 14, (see Fig. 4) a continued upward movement of the tool shank 12 and body member 11 will also carry upward the body member 10 and associated parts in a removal of the tool from the well.

In Fig. 8 I have shown a slightly modified form of perforating element in which the round nose punch members 21ª are designed to punch through an outer casing which has not been previously slit, the term perforating as used herein having a broad meaning including punching or forming of screen apertures.

While the form of mechanism herein illustrated and described is well adapted to fulfill the objects primarily stated and to carry into effect the herein described method, it is to be understood that I do not wish to limit the invention to specific embodiment herein disclosed, for it is susceptible of embodiment in various other forms all coming within the scope of the following claims.

I claim:

1. A well-screen forming tool comprising a body adapted to be longitudinally translated in a well casing in a perforating operation, a member pivoted on the body, the body and said member having opposed shoes, a perforator element journaled in said pivoted member and diametrically disposed to rotate in a vertical plane, said element having a plurality of relatively spaced punch members projecting from its periphery, and an independently operable wedge element adapted to have a wedge engagement between the opposed shoes to force the perforator element outwardly to cause the punch members to form screen apertures in the casing successively as the perforator element is rotated by a longitudinal translation of the tool.

2. A well-screen forming tool comprising a body adapted to be longitudinally translated in a well casing in a perforating operation and having a tubular shank extending to the surface of the well and by which the tool is manipulated, a member pivoted on the body, a perforator element journaled in said member and diametrically disposed to rotate in a vertical plane, said element having a plurality of relatively spaced punch members projecting from its periphery, a wedge element translatable within the tubular body shank and adapted to have a wedge engagement between the body and said pivoted member to force the perforator element outwardly to cause the punch members to form screen apertures in the casing successively as the perforator element is rotated by a longitudinal translation of the tool, and a cable attached to the wedge element and extending to the well surface.

3. A well-screen forming tool comprising a two-part body adapted to be longitudinally translated in a well casing in a perforating operation, said body including a lower member and an upper member operable from the well surface, perforating mechanism carried by the lower body member, independent means operable to condition said mechanism for a perforating operation and engaging the upper body member when in operated position, and means permitting a limited separation of the two body members to disengage the independent means from the perforating mechanism.

4. A well-screen forming tool comprising a two-part body adapted to be longitudinally translated in a well casing in a perforating operation, said body including a lower member and an upper member having a tubular shank extending to the surface of the well and by which the tool is manipulated, a member pivoted on the lower body member, a perforating element journaled in said pivoted member and diametrically disposed to rotate in a vertical plane, said element having a plurality of relatively spaced punch members projecting from its periphery, a wedge element translatable within the tubular body shank and adapted to have a wedge engagement between said pivoted member and the lower body member to force the perforator element outwardly to cause the punch members to form screen apertures in the casing successively as the perforator element in rotated by a longitudinal translation of the tool, a cable attached to the wedge element and extending to the well surface, said wedge element engaging the upper body member when in operated position, and a pin and bayonet-slot connection between the two body members, whereby said body members rotate together in one direction and upon a reverse rotation of the upper body member an independent upward movement of said upper body member is permitted carrying with it the wedge element to release the perforating element.

Signed at South Pasadena, California, this 7th day of January, 1924.

MAHLON E. LAYNE.