Sept. 23, 1952 B. D. MULL 2,611,366

SUTURE GUN

Filed Nov. 20, 1951

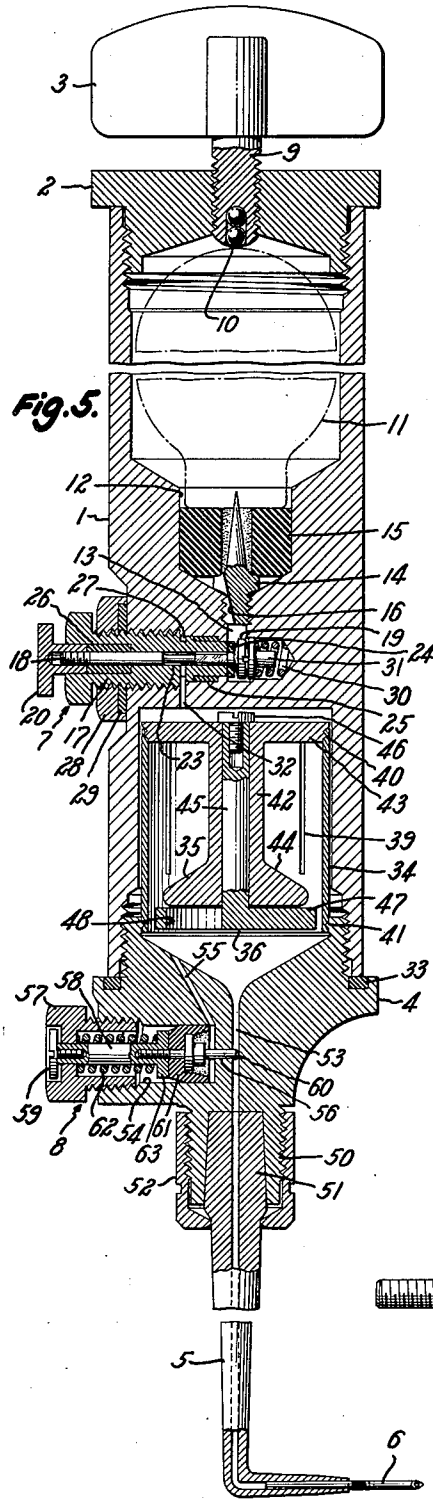

Fig. 5.

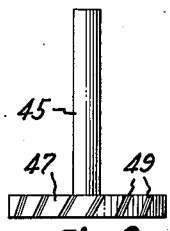

Fig. 2.

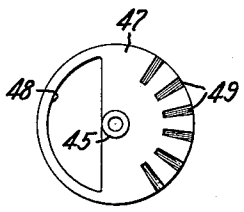

Fig. 3.

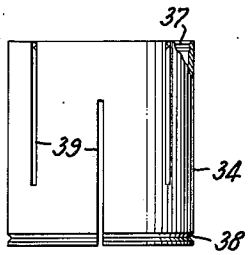

Fig. 4.

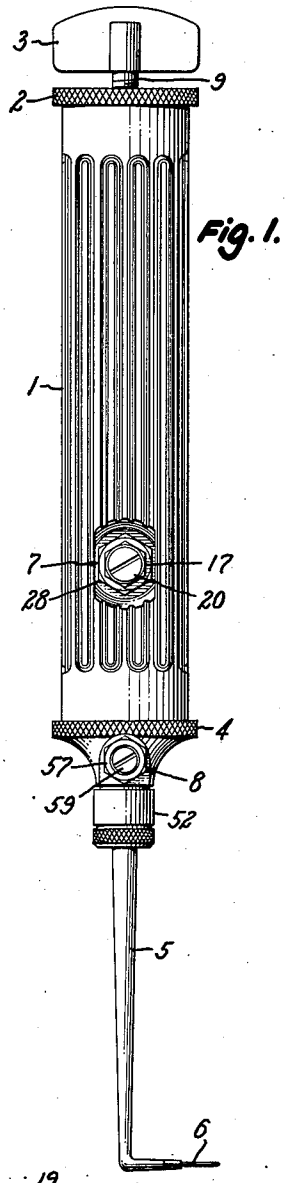

Fig. 1.

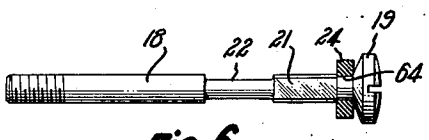

Fig. 6.

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SUTURE GUN

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4 Claims. (Cl. 128—340)

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This invention relates to a suturing instrument and more particularly to an instrument consisting of a suturing needle and a handle therefor, the latter containing a supply of thread or suture material and pneumatic means for feeding the suture through the needle.

An object of my invention is to provide an instrument which can be operated to insert the needle and feed the suture with one hand leaving the other hand free for other activities such as assisting in tying the suture.

Another object of my invention is to provide a self-contained instrument capable of feeding any desired length of suture upon simply pressing the suture feed or release button.

A further object of the invention is to provide means for positively holding the suture with respect to the instrument when it is not being fed or ejected.

A further object of the invention is to provide a self-contained instrument comprising means for supplying the motive force for ejecting the thread.

Other objects and/or advantages of the invention will appear from the following detailed description of an embodiment of the invention.

Briefly, the instrument consists of a tubular needle, a handle, a supply of suture and a capsule of gas under pressure within the handle for ejecting the suture through the needle and a control valve suitably operable by the thumb of the operator.

The invention is illustrated in the accompanying drawings in which:

Fig. 1 is a full size side elevation of the instrument;

Fig. 2 is a side elevation of a portion of the suture governor;

Fig. 3 is an end view of the suture governor;

Fig. 4 is a side elevation of the suture spool supporting sleeve;

Fig. 5 is a longitudinal section of the complete instrument on an enlarged scale, with portions of the handle and of the needle shaft omitted to reduce the length of the figure; and

Fig. 6 is a side elevation of the stem of the gas control valve.

Referring to Fig. 1, 1 is the handle of the instrument, 2 is a plug closing the rear end of the handle, 3 is a wing screw for applying pressure to the gas container (11, see Fig. 5), 4 is a plug closing the other end of the handle 1, 5 is the needle shaft, 6 is the curved needle, 7 is the gas control valve and 8 is the adjustable suture holder.

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Referring to Fig. 5, it will be seen that the wing screw 3 has a threaded shaft 9 extending through the plug 2. Shaft 9 has a socket containing the two balls 10 which provide a frictionless contact with the gas container 11.

The end of the handle 1 adjacent the plug 2 has a cylindrical cavity for the compressed gas container or cartridge 11 (shown in broken line in Fig. 5) of the type commonly used for making carbonated beverages. Such cartridges are provided with a soft metal closure at one end adapted to be punctured to release the carbon dioxide. At the lower end of the cylindrical cavity just referred to is the longitudinally extending large cylindrical smooth bore 12 and the smaller longitudinally extending bore 13, the latter being threaded at least at its upper end to receive the threaded shank of the spear 14. The large bore 12 contains the packing ring 15 which preferably is made of rubber or similar elastic material which in its uncompressed condition extends upwardly beyond the tip of the spear 14 so that the cartridge 11 may be inserted without contacting the spear 14 until the wing screw 3 is turned to force the cartridge downward to the position shown in Fig. 5 thereby compressing the ring 15 and causing the spear 14 to puncture the end of the cartridge. This downward movement of the cartridge 11 serves also to seal the end of the cartridge against the ring 15 and thus to prevent leakage of gas. After the cartridge 11 has been punctured by the spear 14 the screw 3 is backed off slightly to permit gas to escape through the puncture.

The threaded shank of the spear 14 is provided with a groove 16 to permit the flow of gas from the puncture in the cartridge around the point of the spear 14, through the central opening in the ring 15 and through said groove 16 to the gas control valve 7.

As seen in Fig. 5, the bore 13 communicates at its lower end with a laterally extending bore which contains the gas flow control valve 7. This valve comprises the valve body 17 and a movable stem which consists of the shaft 18 with the integral head 19 on one end and operating button 20 on the other end. The head 19 has a conical sealing surface at an angle of about 30° and a slightly rounded lower surface. The shaft 18 is provided with the longitudinal groove or flat 21 and circumferential groove 22 to permit the passage of gas through the opening 23 in the valve body 17 when the head 20 with the washer 24 is depressed and separated from its seat on the lower end of the valve body 17. The shaft

18 has a groove 64 for attaching the washer 24. The valve body 17 is provided with a circumferential groove 27 which communicates with the opening 23. The packing 25 serves to provide a gas-tight joint between the valve (19, 24) and the groove 27 and the packing 26 serves to provide a gas-tight joint between the valve body 17 and the stem 18. A nut 28 and washer 29 serve to seal the upper end of the valve body 17 to the handle 1. Below the head 19 are the spring 30 and spring guide 31 which serve to return the valve head 19 to its seat when pressure on the button 20 is released.

Opening 23 communicates with the cylindrical spool chamber in the other end of the handle 1 through an opening 32. The outer end of this spool chamber is screw-threaded to receive the plug 4 and the joint between the plug 4 and the handle 1 is made gas-tight by the washer 33. Within the spool chamber is the spool casing 34, the spool 35 and the suture governor 36. As appears from Figs. 4 and 5, the spool casing 34 is hollow and cylindrical and is provided at one end with an internal groove 37 for detachable connection to the spool. The spool casing is provided at its other end with the external groove 38 for detachable connection to the plug 4 and is further provided with longitudinal slits 39 dividing the wall thereof into flexible tongues which may be sprung over the ridge 40 on the spool 35 and over the ridge 41 on the plug 4.

The spool 35 consists of a hollow cylindrical middle portion 42, a flat disc-shaped end portion 43, the outer edge of which provides the ridge 40 referred to above, and the rounded end portion 44 which permits the suture to slide over its rounded surface as it is unwound and withdrawn from the spool endwise. The suture governor 36 consists of the cylindrical shaft 45 which extends through the cylindrical opening in the spool and is tapped at its free end to receive the screw 46 by means of which it is rotatably secured to the spool. Integral with or fixedly secured to the shaft 45 is the disc 47 having an opening 48 which serves the double purpose of providing a passageway for the suture and of unbalancing the disc. The size of this opening will depend upon the degree of unbalancing desired. The purpose of unbalancing the disc 47 is to control its rate of rotation as the suture is unwound from the spool. Depending upon the size and stiffness of the suture, the gas pressure and other factors, the suture tends to be ejected too rapidly and the governor 36, by being unbalanced and requiring force to rotate it, serves to retard the ejection of the suture to a suitable rate. A further optional expedient illustrated in Figs. 2 and 3 is to provide the disc 47 of the governor 36 with inclined slits 49 so that as the gas passes through these slits it ends to rotate the governor. As is apparent, these slits may be so inclined as to either assist or retard the rotation of the governor.

The plug 4 has the cylindrical projection 50 to receive the hub 51 of the needle shaft 5 and the outer surface of this projection 50 is threaded to receive the sleeve 52 to secure the needle shaft to the plug.

The plug 4 has passageway 53 leading directly from the spool chamber to the needle for the passage of the suture and the propelling gas. The plug 4 has also the lateral bore 54 for the suture holder 8, a passageway 55 from the spool chamber to the bore 54 and an opening 56 from the bore 54 into the passageway 53. The suture

holder 8 consists of the body 57 which is screw-threaded into the bore 54, the shaft 58 which is slidably supported in the body 57 by the screw 59, the holding pin 60 which is screw-threaded in to an opening in the shaft 58, the cup-shaped piston 61 and the spring 62. As appears in Fig. 5, the shaft 58 is provided with the head 63 which serves as a seat for one end of the spring 62 and also as a seat for the piston 61.

The instrument is operated as follows. The plug 2 is removed and the wing screw 3 turned counterclockwise to its retracted position. A gas cartridge 11 is inserted into the handle and the plug 2 is replaced. The wing screw 3 is then turned forcing the gas cartridge down on the spear 14 and puncturing it. Screw 3 is then turned counterclockwise to release the gas. The rate of gas release through the puncture may be regulated by retracting the screw 3 more or less. Gas will of course not flow from the cartridge until it is released into the spool chamber by operation of the valve 7.

The plug 4 with the needle and the spool assembly mounted thereon is then removed from the handle, a spool loaded with suture inserted and the suture threaded through the opening 48 and started into the passageway 53. The plug 4 is then attached to the handle and the button 20 depressed to release gas and eject the suture through the needle. In making a stitch any suture protruding from the needle is cut off by pulling the suture backwards against the sharp edge formed by the junction of the inclined surface of the needle point and the surface of the opening through the needle. The needle is then inserted through the tissue to be stitched and the button 20 pressed to eject a suitable length of suture, say, 10 inches which is caught and held by the other hand of the operator. The needle is then withdrawn, the suture tied and cut off.

When the button 20 is pressed it opens the valve (19, 24) and permits gas to flow from the cartridge 11 into the spool chamber and through the passageway 55 where it acts on the piston 61 and raises the suture holding pin 60 releasing the suture. Gas then flows through the passageway 53 and the needle carrying the suture with it. When the instrument is properly adjusted a brief depression of the button 20 of, say, 1-second duration will eject a suitable length of suture, say, 10 inches. With a little practice the operator will learn how long to hold the button 20 to secure the desired ejection of suture. Generally a momentary pressure on the button 20 is sufficient.

It will be noted that the suture is freed to move through the needle only when gas is released by the valve 7, the release of the suture by the holder and the flow of gas to eject the suture being simultaneous. The rate of ejection of the suture can be regulated by regulation of the rate of flow of gas by means of the wing screw 3 and by the use of a suture governor having a suitable degree of unbalance and, if desired, with slits 49 at a suitable angle. Such adjustments generally are necessary to compensate for different sizes of suture and different sizes of needles and for variations in the gas pressure supplied by the gas cartridge or capsule. The suture holder also may be adjusted by turning the body 57 thereof to apply greater or less pressure on the suture holding pin 60 through the spring 62. It may be necessary in threading the needle to release the suture holder so that the suture can be threaded by hand through the passageway 53 to a point beyond the suture holder before the plug 4 is at-

tached and gas released to eject the suture through the needle.

The use of gas under pressure to eject the suture permits the use of a highly flexible suture which could not be satisfactorily ejected or fed in any other way. The use of gas also serves to clear the tip of the needle and thus to prevent obstruction of the movement of the suture. The use of gas further serves to eject the end of the suture outwardly from a deep wound where it readily may be grasped by the operator without the use of any instrument. The use of gas further simplifies the threading of the needle since it is not necessary to thread the suture all the way through the needle by hand. It is only necessary to start the suture through the passageway **53** and the flow of gas thus completes the threading operation.

The fact that the suture is firmly held excepting when it is being ejected avoids waste of suture and permits the instrument itself to be used to hold one end of the length of suture while it is being tied. The use of gas as the ejecting force for the suture, together with the regulating features referred to, i. e., the wing screw **3**, the governor **36** and the suture holder **8**, permit the instrument to be used with suture materials varying in size and stiffness. It is to be noted that although the suture holder serves to hold the suture against accidental movement it may be so adjusted that the suture may be pulled through the holder without being broken. The end of the pin **60** which engages the suture may be either flat or rounded or even roughened to increase its frictional holding force but generally it is preferred to round the pin **60** so as to avoid abrasion of the suture. The tension of the spring **61** may be increased, if necessary, to provide the desired holding force.

It will be appreciated that the instrument specifically shown and described is only one embodiment of my invention and that many changes in the details of construction may be made by a skilled mechanic without departing from my invention as defined in the appended claims.

I claim:

1. A suture gun comprising a tubular needle and a handle therefor, a first gas chamber in said handle adapted to contain gas under pressure, a spool chamber in said handle, a first passageway connecting said spool chamber to said needle, a second passageway connecting said first gas chamber with said spool chamber, a valve controlling the passage of gas through said second passageway, a second gas chamber adjacent said first passageway, an opening connecting said second gas chamber with said first passageway, a spring-pressed holding member extending through said opening, a piston in said second gas chamber connected to said holding member and a third gas passageway from said spool chamber to said second gas chamber.

2. A suture gun comprising a tubular needle and a handle therefor, a first gas chamber in said handle adapted to contain gas under pressure, a spool chamber in said handle, a first passageway connecting said spool chamber to said needle, a second passageway connecting said first gas chamber with said spool chamber, a valve controlling the passage of gas through said second passageway, a spool mounted in said spool chamber, a disc rotatably mounted adjacent said spool, said disc having an opening through which the suture runs as it unwinds from the spool and moves toward said needle.

3. A suture gun as defined is claim 2 in which the disc is unbalanced.

4. A suture gun as defined in claim 2 in which the disc is provided with inclined surfaces in the path of flow of the gas through the spool chamber.

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