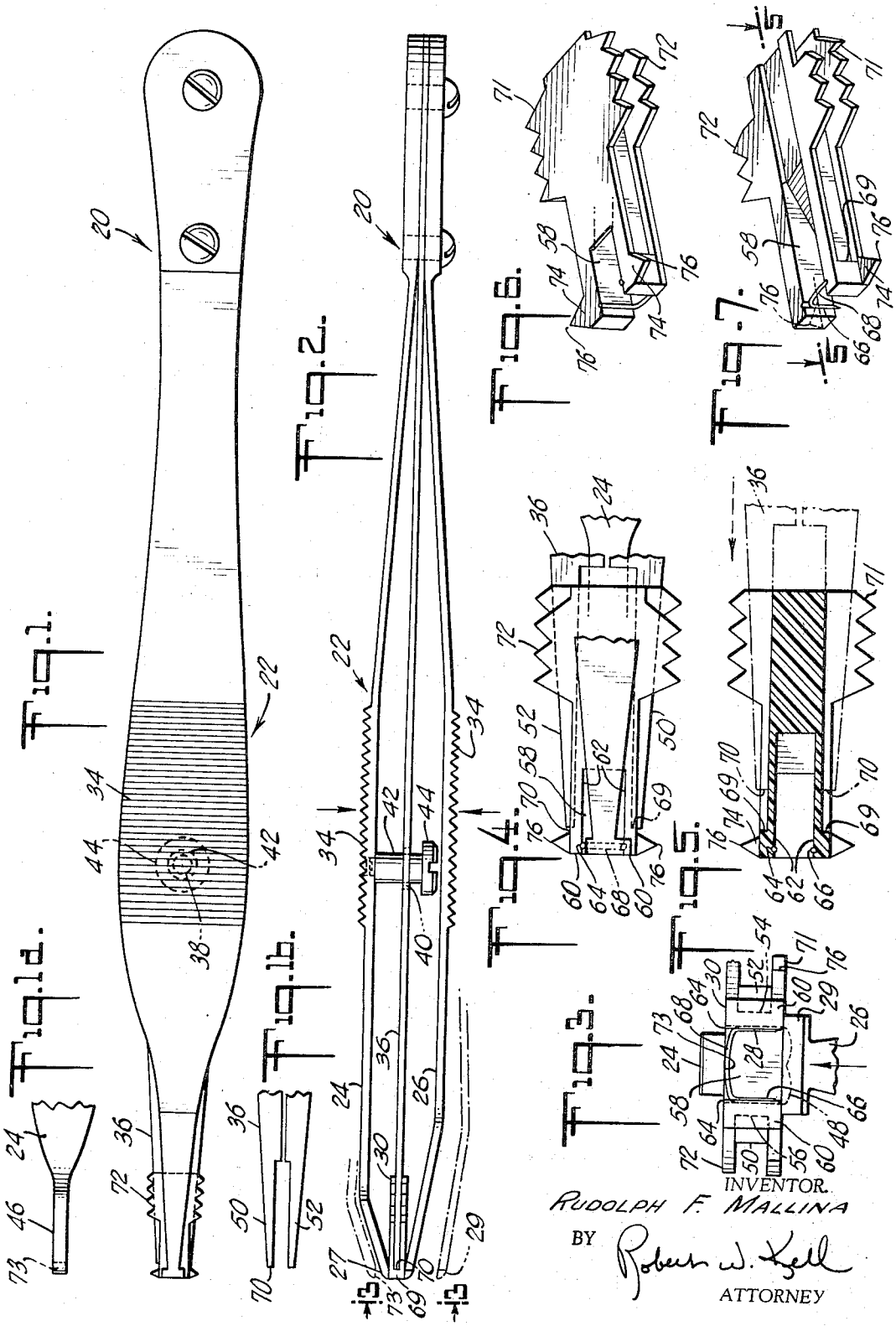
Nov. 7, 1967 R. F. MALLINA 3,351,191

SURGICAL STAPLE CARTRIDGE

Filed Sept. 30, 1965 2 Sheets-Sheet 1



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SURGICAL STAPLE CARTRIDGE

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Fig. 8.

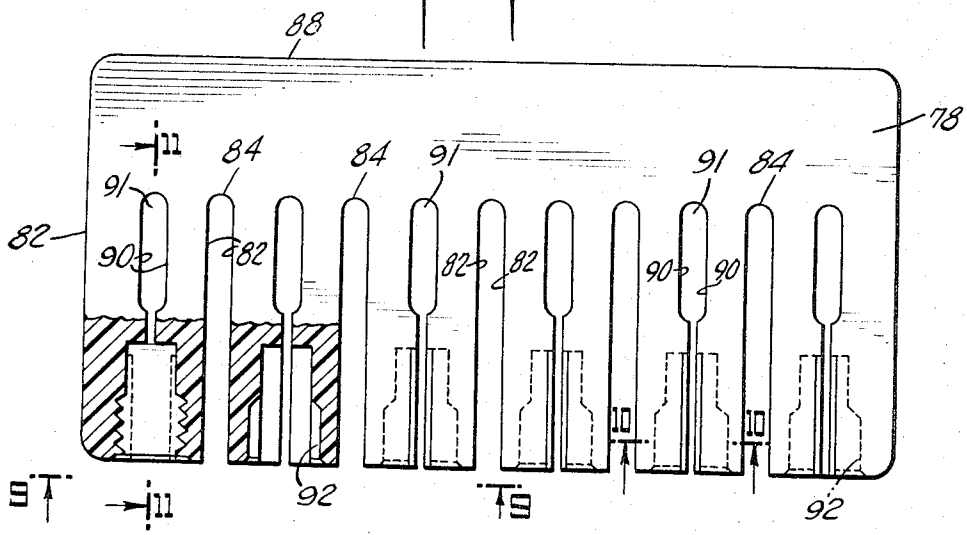


Fig. 9.

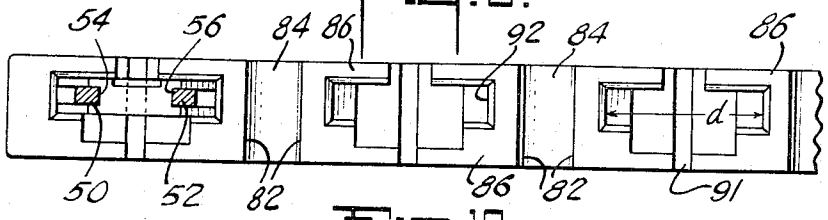


Fig. 10.

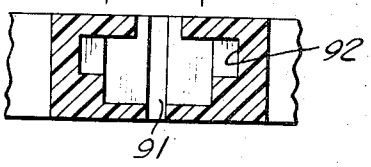
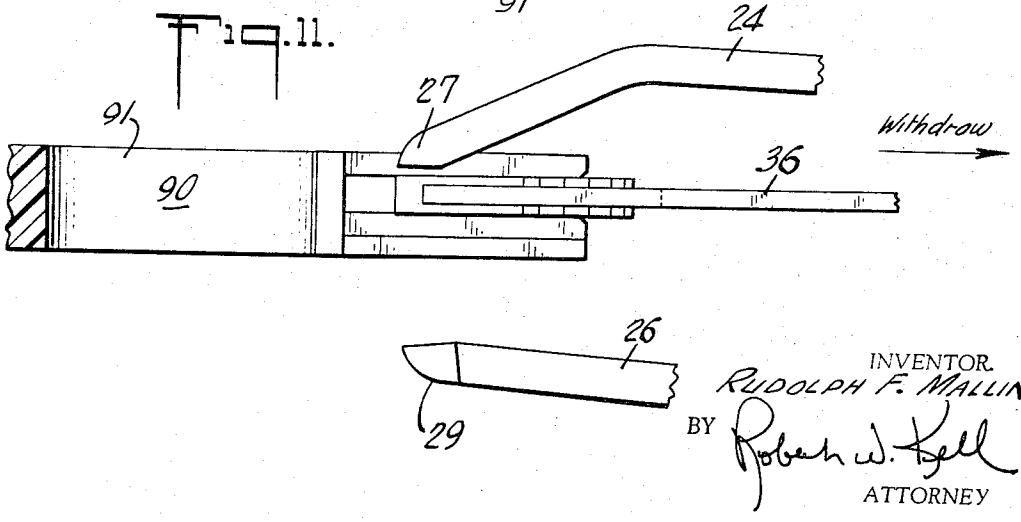


Fig. 11.



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SURGICAL STAPLE CARTRIDGE

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ABSTRACT OF THE DISCLOSURE

A staple cartridge adapted to be used with a surgical stapler is molded of plastic with a rectangular opening at the forward end thereof having a single pair of opposite straight parallel grooves in the sidewalls defining said opening; each of said grooves being adapted to receive and frictionally engage a leg of a single staple, thereby suspending the staple with the crown extending across the opening. The cartridge is characterized by two opposite longitudinal grooves that extend substantially the entire length of the cartridge. A cartridge magazine is also provided with a plurality of parallel prongs extending from a base section, the prongs being spaced apart a distance sufficient to engage the longitudinal grooves in said cartridge and frictionally support the cartridge in the magazine.

This invention relates to miniature staplers of the type used for medical stapling of tissue, and more particularly to exchangeable cartridges for such staplers and to magazines that releasably hold a plurality of such cartridges.

The instant invention has for its principal object the provision of a magazine which will accommodate a plurality of staple cartridges and is adapted to be packaged in a sterile condition.

It is also an object of this invention to provide a magazine that will retain a plurality of exchangeable staple cartridges in such a manner that each individual cartridge may be conveniently and rapidly loaded into a medical stapler.

It is still another object of the invention to provide a method of loading a medical stapler that is accurate, foolproof and reliable.

Another object of the invention is to provide a staple cartridge that is disposable.

Further objects and advantages of the invention will be set forth in part in the following specification and in part will be obvious therefrom without being specifically referred to, the same being realized and attained as pointed out in the claims hereof.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings, wherein;

FIGURE 1 is an elevation of a stapler for dispensing single miniature staples individually;

FIGURE 1–*a* is an enlarged fragmentary view of a staple driver;

FIGURE 1–*b* is an enlarged fragmentary view of a cartridge holder;

FIGURE 2 is a side view of FIGURE 1 showing the stapler in a closed position;

FIGURE 3 is an end view thereof;

FIGURE 4 is an enlarged fragmentary view of a stapler with a staple cartridge in the cartridge holder;

FIGURE 5 is a large scale fragmentary sectional view on the line 5—5 of FIGURE 7;

FIGURE 6 is an enlarged perspective view of a staple cartridge;

FIGURE 7 is an enlarged perspective view of the staple cartridge of FIGURE 6, as seen from a different angle;

FIGURE 8 is a plan view, partly in section, of a cartridge magazine;

FIGURE 9 is a fragmentary end view taken on the line 9—9 of FIGURE 8 with the cartridge holder shown in position;

FIGURE 10 is a fragmentary large scale end view on the line 10—10 of FIGURE 8; and,

FIGURE 11 is a large scale fragmentary sectional view of the magazine and cartridge taken on the line 11—11 of FIGURE 8, and illustrates the position of the stapler at the time of loading.

In carrying the invention into effect in the embodiments which have been selected for illustration in the accompanying drawings and for description in this specification, and referring now particularly to FIGURES 1–4, there is provided a stapler generally indicated at 20 that comprises a pair of forceps generally designated 22. The forceps 22 include upper and lower arm portions, such as a driver arm portion 24 and an anvil arm portion 26. Those arm portions 24 and 26 terminate in a driver 27 and an anvil 29, movable towards and from each other for driving a staple 28 that is held in a cartridge 30 towards the anvil 29. Both arms are provided on the exterior with knurling 34 for easier manual grasping.

A cartridge holder 36 is secured to the forceps 22, for instance bolted or otherwise rigidly secured to the forceps 22 between the arm portions 24 and 26 thereof.

Each of the arm portions 24 and 26 is resilient and forms a leaf spring, and the cartridge holder 36 is elongated and resilient and forms a leaf spring therebetween. The resilience of the arms 24 and 26 will normally result in the open position illustrated by the dotted line in FIGURE 2.

A limit stop, such as a screw 38, is provided to limit the upward movement of the upper arm portion 24 relative to the cartridge holder 36. The screw 38 is surrounded by an opening 40 that is formed in the cartridge holder 36 and which is larger than the shank 42 of the screw 38, but smaller than the head 44 of the screw 38. By this means, the driver arm portion 24 is pre-tensioned.

As usual in connection with staplers, the lower or anvil arm 26 is more easily deflected than the driver arm 24; so that, when the two arms 24 and 26 are pressed towards each other, the anvil 29 will first be placed in a position close to the staple 28 where the tissue is engaged between the cartridge 30 and the anvil 29, and only thereafter will the driver 29 make contact with the staple 28 and subsequently drive the staple through the tissue.

The anvil 29 includes two clinching grooves 48, and the holder 36 has two converging prongs 50 and 52 dimensioned to frictionally engage longitudinal grooves 54 and 56 in the staple cartridge 30. Near the front end, the cartridge 30 has a recess or opening 58 that is defined between two projections 60. Each of the projections 60 has an inner surface 62, that confines the opening 58, and in which there is formed a straight groove 64. The two grooves 64 are opposite, and parallel to each other, and have a length that exceeds the length of the leg 66 of the staple 28. The legs 66 will be held frictionally in the two grooves 64, so that the staple 28 will be held suspended frictionally, with the legs 66 in the grooves 64 and the free ends of the legs 66 pointing towards the anvil 29. The legs 66 of the staple 28 are connected by a crown 68 that is disposed across the opening 58. Thus, the staple 28 is held suspended by friction in the cartridge 30, ready to be closed by the driver 27.

When a new staple is needed, the nurse will insert a new sterilized staple-holding cartridge 30 into the holder 36.

As best shown in FIGURES 2, 4, and 5, a shoulder or stop 69 located at the forward end of the cartridge 30 abuts against a forward end 70 of the holder 36, to

limit the movement of the cartridge **30** and to determine the position of the cartridge **30** when emplaced in the holder **36**. The converging prongs **50** and **52** owing to their frictional engagement with the cartridge **30** will retain the cartridge **30** in that position until it is removed manually by the nurse. For this purpose, the cartridge is provided with serrated projections **71** and **72**, which extend beyond the cartridge holder **36** and may be readily grasped by the nurse.

As best shown in FIGURE 1–*a*, the driver **29** may form an integral part of the driver arm portion **24**, and be movable therewith. The driver **27** terminates in a surface **73** (FIGURE 3) that has a width slightly smaller than the width of the opening **58** and which is capable of engaging the crown **68** of the staple **28** to move it towards the anvil **29**. After the stapling, the resilient spring action of the arms **24** and **26** will return the forceps to the position indicated in dotted lines (FIGURE 2).

The staple **28** may be made of wire of an inert material, such as tantalium or stainless steel, but may also be made of any other suitable material, for instance plastic or the like, which lends itself to stapling and to being sterilized.

Regarding the staple sizes that may be used where miniaturization is important, the following are examples of desirable sizes:

	Millimeters
Diameter of wire	0.15
Length of crown **68** (width of staple)	2
Length of leg **66** (height of staple)	2 to 2.5

The cartridge **30** is preferably disposable for instance made of inexpensive thermoplastic material such as the material known under the trademark "Delrin," so that the re-loading of the cartridge becomes unnecessary.

Preferably the cartridge is formed with two projections **74** at the forward end thereof terminating in points **76** that are in alignment with the crown **68** of the staple. These points indicate the position of the staple with respect to the end of the stapling instrument and enable the surgeon to place a number of staples in perfect alignment.

The loading of the stapler with a cartridge is facilitated by a cartridge magazine, the construction and operation of which will be apparent from consideration of FIGURES 8–10. The cartridge magazine like the cartridge itself may be formed of thermoplastic material, and is generally rectangular in shape. The length of the magazine will be determined by the number of cartridges it is designed to accommodate. The magazine illustrated in FIGURE 8 will accommodate six staple cartridges but it is apparent that longer magazines might be constructed to accommodate any number of cartridges. The width of the magazine is approximately three times the length of a staple cartridge but it will be obvious that the magazine may be made wider if desired.

The thickness of the magazine may be approximately three times the thickness of the staple cartridge, as illustrated in FIGURE 9.

The magazine consists of a base section **78** from which a plurality of magazine prongs **80** extend. External walls **82** of the magazine prongs **80** are parallel to each other and extend perpendicular from the base section **78** to define therebetween a recess **84**. The end of each magazine prong **80** forms a surface **86** that is parallel to one surface **88** of the base section. Internal walls **90** of the magazine prongs **80** are parallel to each other and extend perpendicular from the base section to define therebetween a recess **91**. Grooves **92** in the internal walls **90** receive and releasably retain the cartridge **30**. The cartridge **30** is retained in the magazine by friction, and the force required to withdraw the cartridge from the magazine is dependent upon the distance *d* between the walls of the grooves **92**, the coefficient of friction of the material of which the magazine is made and the dimensions of the recesses **84** and **90** which control the resiliency of the magazine prongs **80**. Careful control of these factors result in a magazine that will retain the cartridge with just sufficient frictional force to prevent accidental dislodgment of the cartridge from the magazine prior to use.

When the cartridges are positioned in the magazine, there is no possibility of accidental dislodgment of the staples **28** from the cartridge **30** and the magazine forms a convenient package that may be sealed in a paper or foil overwrap and sterilized by gamma radiation.

The operation of the cartridge magazine will be understood with reference to FIGS. 9 and 11. The nurse, after removing the wrapping from the cartridge magazine and exposing the sterile cartridges therein loads the medical stapler by aligning the cartridge holder **36** with the longitudinal grooves **54** and **56** in the cartridge **30**, taking care that the driver **27** is positioned over the crown **68** of the staple **28** and the anvil **32** is positioned beneath the legs **66** of the staple **28**. The stapler is then pushed in the direction of the base **78** of the magazine until the ends **70** of the cartridge holder contact the stops **69**. The position of the prongs **50** and **52** of the cartridge holder **36** with respect to the longitudinal grooves **54** and **56** is shown in FIG. 9. The stapler is then withdrawn from the magazine in the direction of the arrow (FIG. 11). The cartridge **30** is retained on the cartridge holder **36** and withdrawn with the stapler from the magazine because the frictional force between the prongs **50** and **52** of the cartridge holder **36** and the longitudinal grooves **54** and **56** of the cartridge **30** is much greater than the frictional force between the magazine prongs **80** and the cartridge **30**.

When the medical stapler is actuated by the surgeon, the arms **24** and **26** will move towards each other and the staple is driven through tissue and clinched on the anvil. After the staple is applied, the arms **24** and **26** return by spring action to the position shown by dotted lines in FIG. 2. The assisting nurse then withdraws the empty cartridge from the cartridge holder by grasping the projections **71** and **72** and the stapler is loaded with another sterile cartridge from the magazine as described above.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same.

It is accordingly understood that I do not desire to be limited to the exact details of construction shown and described.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

What is claimed is:

1. A cartridge containing a single miniature staple having two legs and a crown connecting the legs and adapted to be mounted on a holder between two arms of a medical stapler; said cartridge defining a rectangular opening at the forward end thereof having a single pair of opposite straight parallel grooves in the sidewalls defining said opening, each of said grooves being adapted to receive a leg of a staple pointing with its free end in a direction perpendicular to the longitudinal axis of the cartridge, the grooves being spaced apart from each other for a distance comparable with the width of the staple thereby engaging frictionally the legs of the staple and suspending the staple with the crown extending across said opening; and said cartridge being characterized by two opposite longitudinal grooves that extend substantially the entire length of the cartridge on opposite sides thereof bisecting the cartridge in a plane perpendicular to the legs of the staple.

2. A cartridge according to claim **1** characterized by projections at the forward end thereof that terminate in points on opposite sides of said cartridge, said points being in alignment with the crown of the staple.

3. A cartridge according to claim 2 wherein the two longitudinal grooves terminate a short distance from the forward end of the cartridge.

4. The combination of a cartridge magazine and a plurality of staple cartridges, wherein said cartridge magazine has a base section from which a plurality of prongs extend an equal distance parallel to each other and perpendicular to said base section; the ends of said prongs forming a face parallel to said base section; each of said prongs having internal side walls that defines with the internal side wall of the prong adjacent thereto an elongated aperture extending perpendicular from the face of the magazine in the direction of the base section; and a

plurality of staple cartridges each of which includes lateral flanges whose configuration complements said elongated aperture of said magazine so as to enable said cartridge to be placed in said aperture and frictionally retained therein.

References Cited

UNITED STATES PATENTS

3,275,211 9/1966 Hirsch et al. ---------- 128—334

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MARTHA L. RICE, *Examiner.*