United States Patent [19]

Kim et al.

[11] **3,789,852**

[45] **Feb. 5, 1974**

[54] **EXPANDABLE TROCHAR, ESPECIALLY FOR MEDICAL PURPOSES**

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[21] Appl. No.: **261,794**

[52] **U.S. Cl.** **128/347,** 128/343

[51] **Int. Cl.** **A61b 17/34**

[58] **Field of Search** ..... 128/347–351, 341, 128/343, 345, 214 R, 215, 221, 3–9, 17, 18, 20, 342

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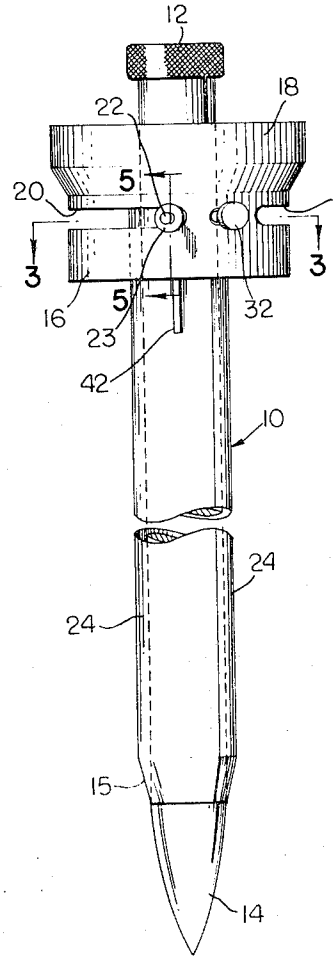
Primary Examiner—Dalton L. Truluck

Attorney, Agent, or Firm—Albert L. Jeffers; Roger M. Rickert

[57] **ABSTRACT**

An expandable tubular element, especially for use as a trochar, in which one or more thin metal strips, such as stainless steel, are arranged to form a tubular element with the tubular element being radially expandable and contractible.

17 Claims, 12 Drawing Figures



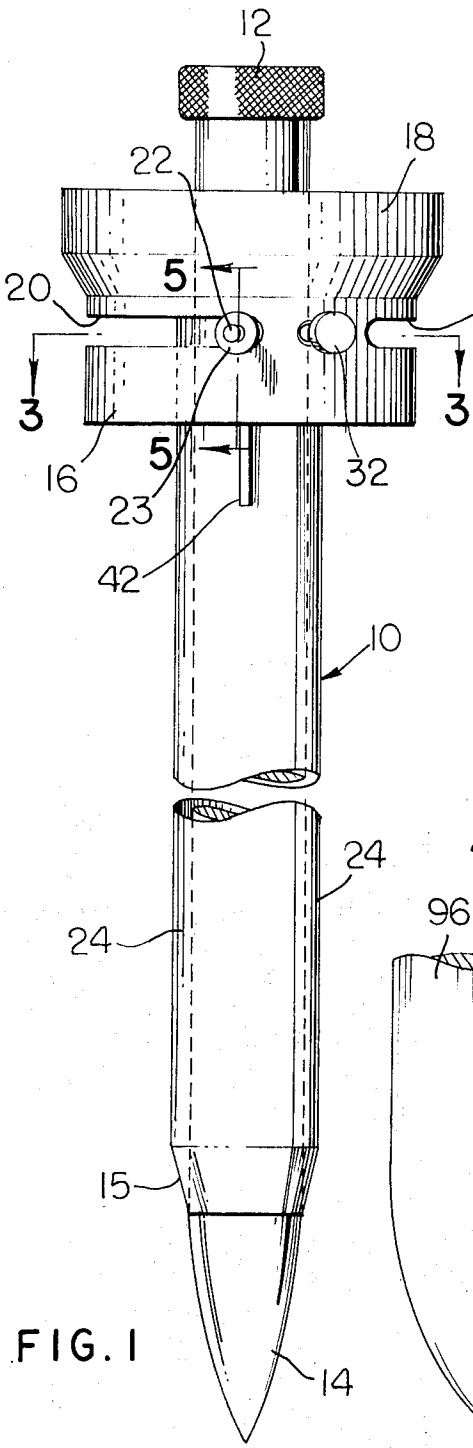


FIG. 1

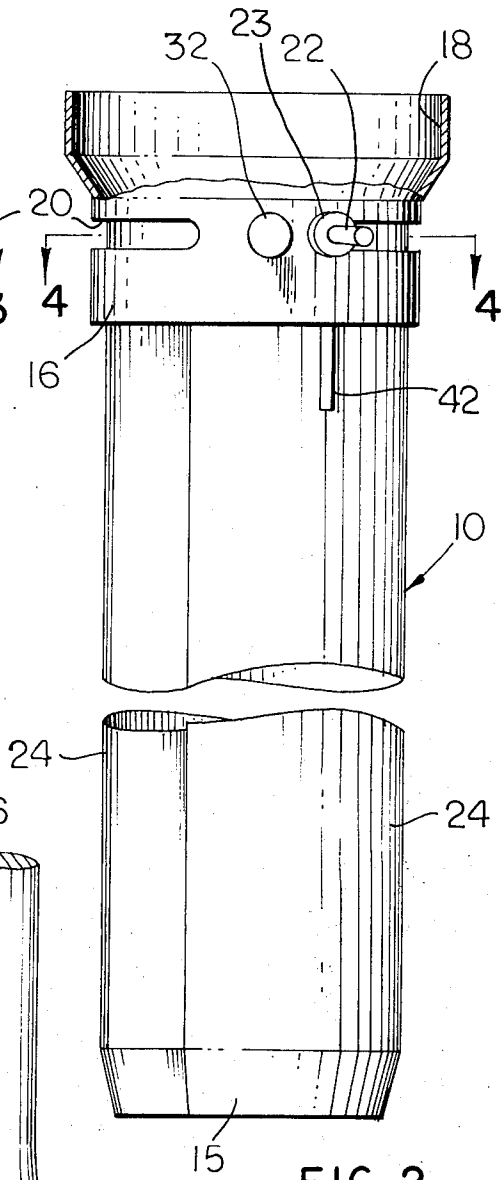


FIG. 2

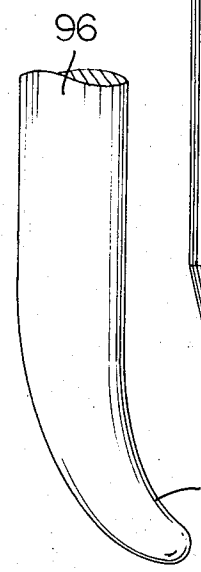


FIG. 12

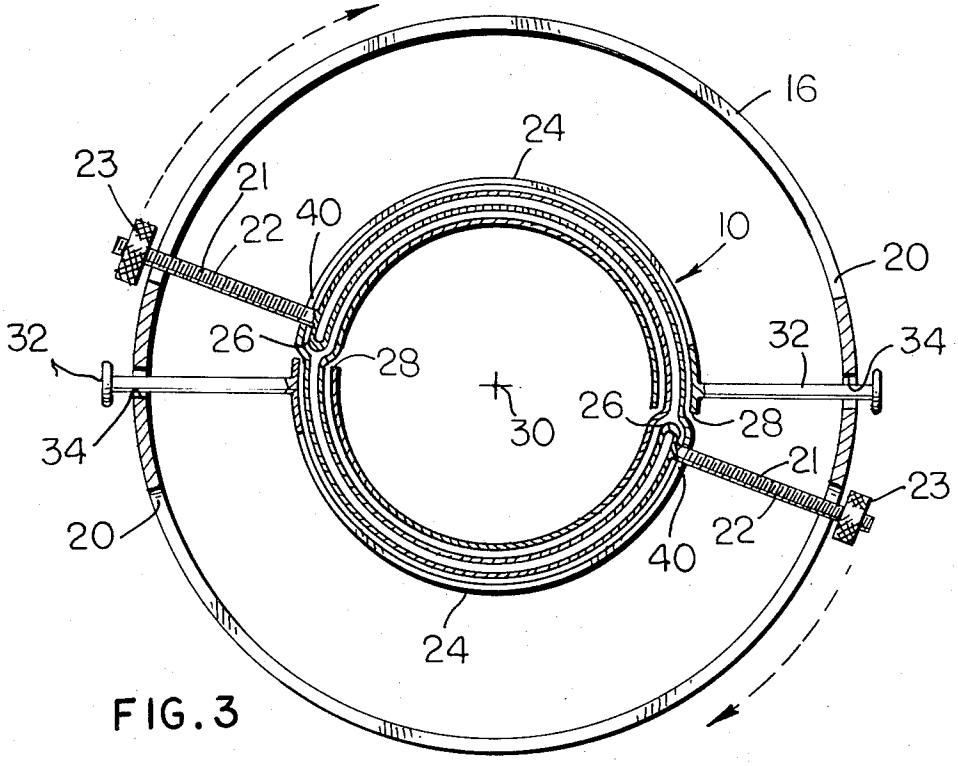

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FIG. 3

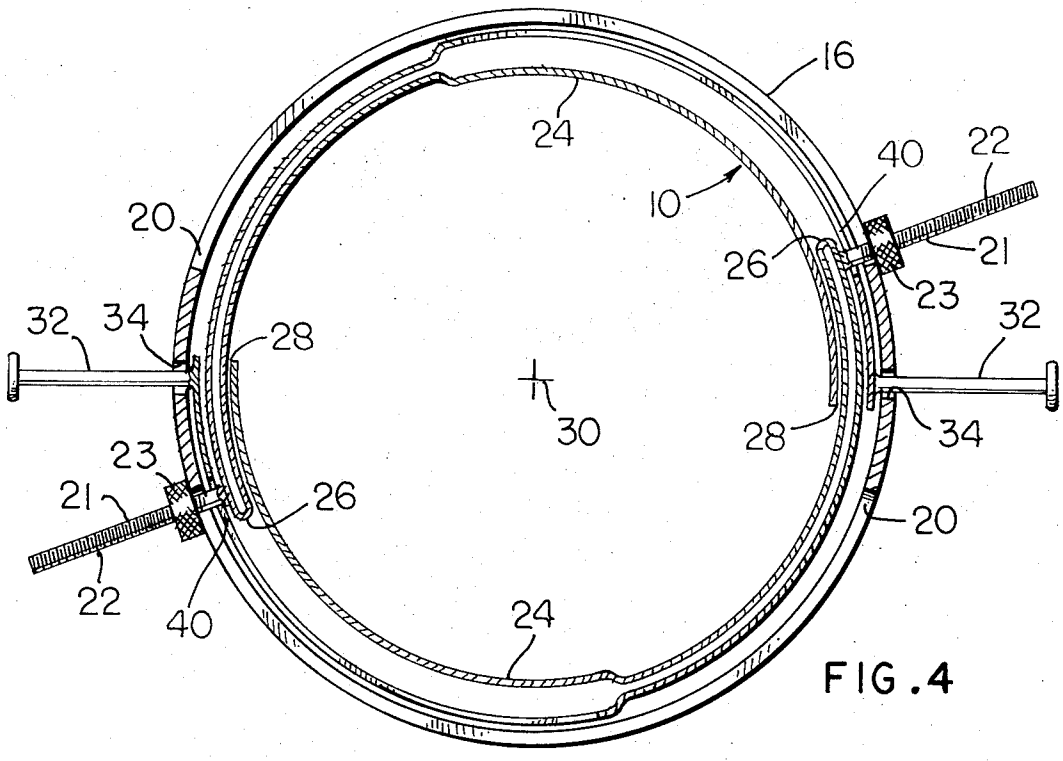
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FIG. 4

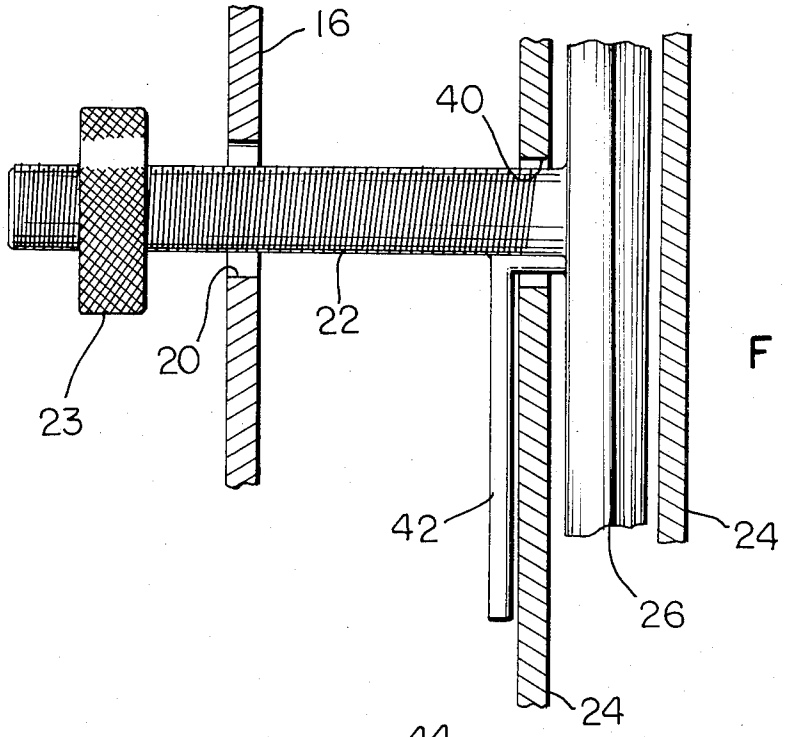

FIG. 5

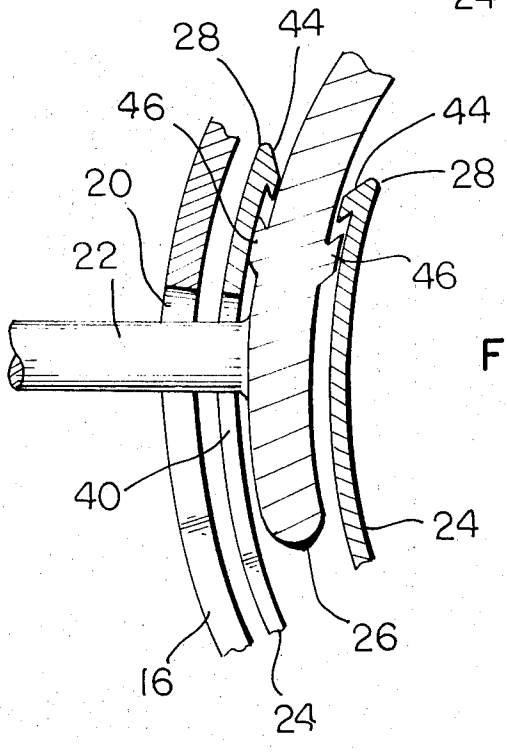

FIG. 6

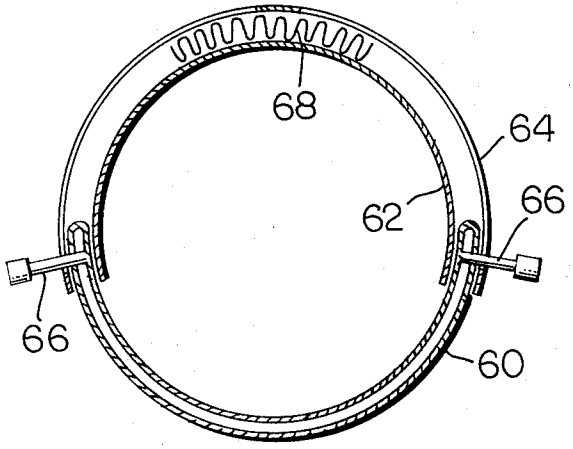

FIG. 7

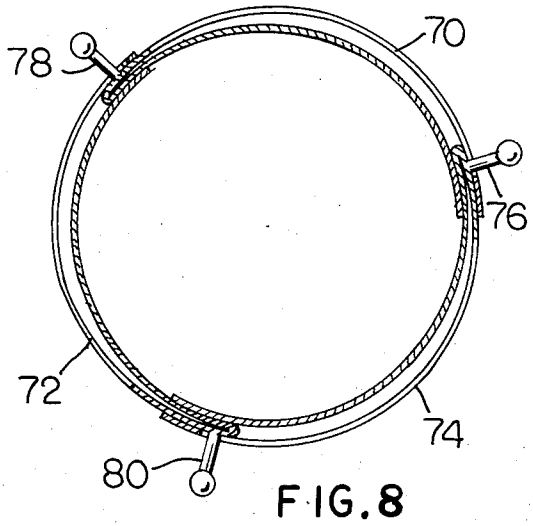

FIG. 8

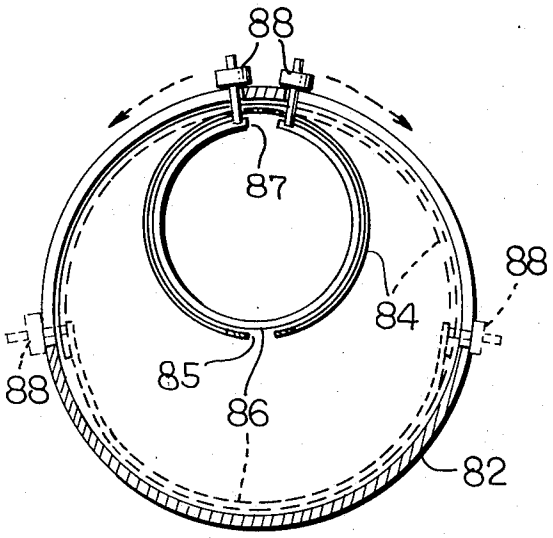

FIG. 9

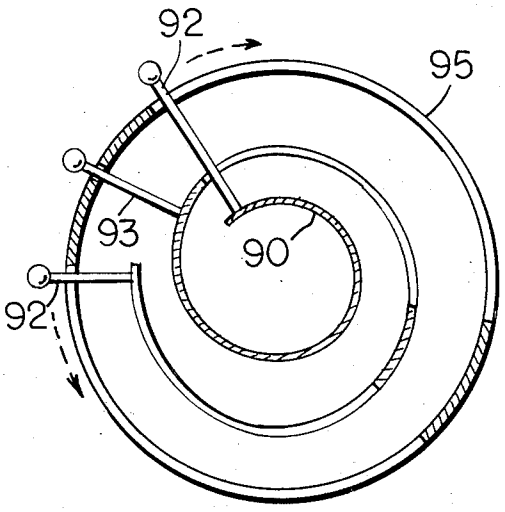

FIG. 10

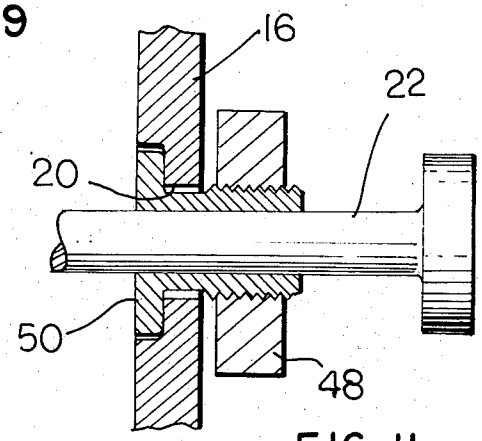

FIG. 11

EXPANDABLE TROCHAR, ESPECIALLY FOR MEDICAL PURPOSES

The present invention relates to an expandable and contractible tubular element, especially for medical purposes and is referred to herein as a trochar.

Trochars are employed in medical and surgical practice for gaining access to interior regions of the body for the purpose of draining fluid therefrom, for the placement of treatment materials therein, or for the placement of catheters. Also, trochars are employed for examination purposes in connection with the placement of such instruments as a peritoneoscope or a thorascoscope. Trochars can be employed as suprapubic devices to drain distended bladders, or to place catheters therein.

Trochars are also employed in connection with the evacuation of fluid from the abdominal cavity, a procedure referred to as paracentesis, and for the evacuation of fluid from the plural cavity or the placement of a tube into the plural cavity, a procedure referred to as thoracentesis.

Most of the foregoing procedures in which a trochar is employed require the forming of an incision, or a puncture, in a certain body area and the introduction of the trochar into the body through the incision or puncture.

In any case, a high degree of skill is required to insert the trochar into the proper position, especially when the trochar is of substantial diameter. It will be evident, from the foregoing, that some trochars, especially those large enough to accommodate an instrument, such as an optical viewing instrument, must be of substantial size and the placement of such trochars involves a high degree of skill on the part of the operator and involves considerable discomfort to the patient.

With the foregoing in mind, a primary objective of the present invention is the provision of a trochar which avoids the drawbacks and difficulties referred to above.

Another object of the present invention is the provision of a trochar which requires the minimum amount of skill for placement and involves the minimum amount of discomfort to the patient.

A particular object of the present invention is the provision of a trochar which can radially be expanded after placement.

Still another object of the present invention is the provision of a trochar which is radially expansible and which is also reusable.

It is also an object to provide an expandable trochar so constructed as to be able to receive a removable puncturing instrument which will form the puncture to receive the trochar and which will guide the trochar into position.

A still further object of the invention is the provision of an expandable trochar having a curved removable blunt shaped guiding portion which can be used as an urethral dilator or uterine dilator.

BRIEF SUMMARY OF THE INVENTION

The expandable trochar according to the present invention comprises a tubular element, especially a stainless steel element, which can be expanded in the radial direction.

Trochar has been defined in the dictionary as a sharp object guiding the introduction of a tube into a body-

like needle. In medicine and in this application the term trochar is used to define in combination a puncture guiding rod cooperating with a tube. Also, the tube can be referred to as a trochar when the puncture guiding rod is removed.

The trochar in its simplest form can be a strip of stainless steel or other suitable material wound up spirally to form the tube with the free ends of the thus wound up tube being movable in the circumferential direction to cause expansion and contraction of the trochar.

In another form which the trochar can take, two tubular stainless steel elements which are split in the longitudinal direction are placed in coaxial, coextensive, nesting relation and expansion and contraction of the trochar is accomplished by varying the diameter of the inner one of the split tubular elements.

In still another form, which the trochar can take, two or more strips of stainless steel are folded back on themselves to form U-shaped members with about half of the length of each member commencing from the other end whereby, upon forming the members so as to be arcuate when viewed endwise, the members can be disposed in mutually telescopic engagement.

In this case, the diameter of the trochar is adjusted by adjusting the degree of telescopic engagement of the members with each other.

In yet another form which the trochar can take, a tubular stainless steel element is flattened out and is then formed to an arcuate configuration and the ends thereof are inserted between a pair of spaced parallel curved stainless steel strips to form the tubular trochar. In this case, the diameter of the trochar is adjusted by adjusting the degree of telescopic engagement of the ends of the first mentioned sheet with the last two mentioned parallel sheets.

In every case, the trochar is tubular so that it can receive a removable piercing instrument. The trochar at the end opposite the end which is introduced into the body, has a guide ring which supports the elements of the trochar and permits manipulation thereof and the securing thereof to the body.

The foregoing objects as well as still other objects and advantages of the present invention will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a side elevational view of a trochar according to the present invention in radially collapsed position and with a puncture device mounted therein.

FIG. 2 is a side elevational view similar to FIG. 1 but showing the trochar in maximum expanded position.

FIG. 3 is a plan sectional view indicated by line III—III on FIG. 1.

FIG. 4 is a view like FIG. 3, but shows the trochar in maximum expanded condition.

FIG. 5 is a fragmentary sectional view indicated by line V—V on FIG. 1, showing a guide member forming a part of the trochar.

FIG. 6 is a fragmentary plan view drawn at enlarged scale and showing tab elements which limit the expandability of the trochar.

FIG. 7 is a plan sectional view, showing a modified form which a trochar according to the present invention can take.

FIG. 8 is a plan sectional view, showing a further modification.

FIG. 9 is a plan sectional view, showing a still further modification.

FIG. 10 is a plan sectional view of still another modification.

FIG. 11 is a fragmentary sectional view showing a device for locking the trochar in adjusted positions of expansion thereof.

FIG. 12 is a fragmentary view showing a modified form of the guiding portion for the trochar when used as a dilator.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings somewhat more in detail, the trochar of FIGS. 1 through 6 will be seen to comprise a rather elongated tubular portion indicated at **10** which is contractible to its FIGS. 1 and 3 positions and expansible to its FIGS. 2 and 4 positions.

The trochar when in its FIG. 1 position is hollow from end to end and can receive a removable piercing instrument **12** with a piercing point, or needle, **14.** The end of the tubular portion of the trochar which is adjacent point **14,** may be beveled or tapered as at **15** to facilitate introduction of the trochar into a puncture made by point **14.**

The end of the trochar opposite point **14,** namely, the outer end of the trochar, is provided with a guide ring **16** which is flanged at **18** as shown in FIGS. **1** and **2.** Guide ring **16** is provided with slot means **20** in which is slidable rod means or post means or finger piece means **22** extending in the radial direction of the trochar.

Reference to FIG. **3,** will show more in detail the various elements of the trochar. The tubular portion **10** of the trochar is formed of two elements **24,** each of which is a stainless steel strip or other suitable material folded back on itself so as to have a closed end at **26** and an open end at **28.** Commencing at the closed end, about half the length of each element is formed to a smaller radial dimension, while the remainder of each element is formed to a larger radial dimension. Each element is formed concentrically about the longitudinal axis **30** of the trochar and the smaller end of each element telescopically engages the larger end of the other element. The elements are formed of thin corrosive resistant metal, such as stainless steel, and are thus flexible.

Attached to the larger end of each of the elements on the radially outer side is a post **32** extending radially outwardly through a pertaining aperture **34** in guide ring **16.**

Also attached to each element near the closed end thereof and on the radial outer side is the rod or post, or finger piece, **22** extending radially outwardly through the circumferential slot **20** in guide ring **16** and also through a circumferential slot **40** in the radially outer side of the larger end of the other element. By manipulating finger pieces **22** along their slots **20,** the degree of telescopic engagement of the elements with each other can be adjusted and this will adjust the diameter of the trochar. The finger pieces **22** are threaded at **21** and a lock nut **23** serves to lock the trochar in adjusted position.

FIG. **3** shows the trochar in maximum collapsed, minimum diameter, position and FIG. **4** shows the trochar in maximum expanded, maximum diameter, position and also shows the manner in which finger pieces **22** are adjusted in guide ring **16** to accomplish the expansion and contraction of the trochar.

It is advantageous for the closed end of each element to have connected thereto an angle piece, or side bar, **42** as shown in FIG. **5** extending outwardly through the adjacent slot **40** in the other element and then downwardly along the outside of the other element, thereby retaining the outer part of each of the said elements in close engagement with the inner part of the other element which is telescopically engaged therewith.

FIG. **6** will show that the free ends of the longer end of each element are advantageously provided with turned in edges, or tabs, **44** which cooperate with turned out tabs **46** near the closed ends of the other elements, thereby to limit the expanding movement of the trochar and to prevent the telescopically engaged elements from becoming disengaged.

FIG. **11** shows how a modified lock arrangement could be mounted on each finger piece **22** to lock the trochar in adjusted position. The lock arrangement comprises a nut **48** threaded to tubular element **50** so that the nut can be tightened up to clamp the respective finger piece **22** fixedly to guide ring **16** in any adjusted position of the finger piece.

In FIG. **7,** a stainless steel tube is flattened out and formed to an arcuate shape to form a double walled tubular member as indicated at **60** with the ends thereof telescopically engaged between a pair of parallel arcuate sheets **62** and **64.** Finger pieces **66** on the ends of the element **60** are disposed in slots in sheet **64** and can be employed for adjusting the diameter of the trochar. In this modification, a spring **68** may be disposed between sheets **62** and **64** and engages the ends of element **60** when the diameter of the trochar is reduced and urges the said ends outwardly. The spring **68** may be omitted if desired and the finger pieces **66** can be utilized to expand the trochar.

FIG. **8** shows a modification similar to that first described except three folded sheet elements **70, 72** and **74** are arranged in telescopic engagement. The diameter of the trochar of FIG. **8** can be adjusted in the same manner as in respect of the first described modification, except that the FIG. **8** modification has three adjustable finger pieces **76, 78** and **80.**

FIG. **9** shows a modification in which there is mounted within guide ring **82,** an outer tubular element **84** split down one side at **85** while inside element **84** is an inner tubular element **86** split down the opposite side at **87.** The free ends of inner element **86** are provided with finger pieces **88** extending radially through circumferential slots provided therefor in outer element **84** and guide ring **82** to permit expansion and contraction of the trochar.

FIG. **10** shows a modification in which a single strip **90** of stainless steel is wound up in a spiral to form a tube with finger pieces **92** connected to the inner and of the spiral and extending radially outwardly through a slot formed in the other convolutions of the spirally wound sheet. A post **93** is provided and serves the same purpose as previously described. By adjusting the finger pieces relative to the outer end of the wound up sheet, the diameter of the trochar can be adjusted.

Finally, FIG. **12** shows a modification in which a blunt shaped guiding portion **96** having an obliqued or curved blunt tip portion **97** is provided for substitution of the sharp tipped piercing instrument **14.** The trochar with the curved tip guiding portion **96** is used as a uterine or urethral dilator. After placement of the trochar

in the desired position the tube can be expanded in the same manner as previously described.

All of the trochars described are tubular for receiving a puncturing or guiding instrument, and all are adjustable as to diameter, and all can be provided with locking means to lock the trochar in adjusted positions.

The invention has been described with reference to particular modifications but it will be understood that modifications may be made within the purview of the appended claims.

What is claimed is:

1. A trochar comprising an elongated tubular portion open at both ends having slidable received therein a removable piercing instrument having a body piercing point protruding from one end of said tubular portion, said tubular portion being formed of at least two thin expandable sheet elements concave toward the axis of said tubular portion and having the circumferential terminal regions in overlapping relation to define said tubular portion, and adjustable means disposed at the other end of the tubular portion including means connected to said concave elements for radially expanding and retracting the sheet elements to increase or decrease the diameter of the tubular portion substantially throughout the longitudinal length of the elongated tubular portion.

2. A trochar according to claim **1** wherein the piercing instrument is provided with a curved blunt tip portion protruding from one end of the tubular portion.

3. A trochar according to claim **1** in which one end of said tubular portion is adapted for insertion into the body, and a guide ring at the other end of said tubular portion supporting said sheet means and said adjustable means.

4. A trochar according to claim **3** in which said adjustable means includes at least one finger piece connected to said sheet elements and projecting radially outwardly therefrom, and circumferential slot elements formed in said guide ring and moveably receiving said finger piece means.

5. A trochar according to claim **3** in which said sheet means comprises at least two elements each of which is in the form of a sheet of metal doubled back on itself so as to have one end closed and the other open, each element having a smaller radial thickness extending from the closed end about half the circumferential length of the element and the remainder of the circumferential length of the element having a larger radial thickness, each element being concave toward the axis of the trochar and the closed end of each element telescopically engaging the open end of the element next adjacent thereto.

6. A trochar according to claim **5** in which stop tabs are provided on the opposite ends of said elements which interengage with the stop tabs at the next adjacent element in the position of minimum telescopic engagement of said elements to prevent said elements from becoming disengaged from each other.

7. A trochar according to claim **5** which includes a post fixed to the radially outer side near the open end of each element and projecting radially therefrom, an aperture in said guide ring for each post, a finger piece connected to each element near the closed end thereof and projecting radially therefrom, and slots formed in said guide ring and in the radially outer part of the radially trochar part of each element through which said finger pieces extend and along which said finger pieces are moveable.

8. A trochar according to claim **3** in which said sheet elements comprises a first sheet element concave toward the axis of said trochar, and second and third sheet elements concave toward the said of said trochar and in radially spaced relation and receiving therebetween the circumferential ends of said first sheet element.

9. A trochar according to claim **8** which includes a compression spring between said second and third sheet elements adapted to engage the circumferential ends of said first sheet element.

10. A trochar according to claim **8** in which said first sheet element comprises a double walled tubular member which is thin in the radial direction of said trochar.

11. A trochar according to claim **3** in which said trochar includes flange means at the guide ring end thereof.

12. A trochar according to claim **11** in which said flanges are connected to the axially outwardly facing end of said guide ring.

13. A trochar according to claim **1** which includes means for locking said adjustable means in adjusted position thereof.

14. A trochar according to claim **1** in which said sheet means is formed of corrosion resistant metal.

15. A trochar according to claim **14** in which said metal is stainless steel.

16. A trochar according to claim **3** which includes retaining means retaining the overlapping regions of said sheet means in close face to face sliding engagement.

17. A trochar according to claim **16** in which each said retaining means comprises an element secured to the radially inner one of said sheet means and projecting outwardly therefrom and then axially along the outside of the radially outer one of said sheet means and slidably engaging the outside of said radially outer one of said sheet means.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,789,852 Dated February 5, 1974

Inventor(s) Sung Soo Kim and Andress Dusseau

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 5, line 33, (Claim 3) "means" should be --- elements ---.

Col. 5, line 38, (Claim 4) "elements" should be --- means ---.

Signed and sealed this 4th day of June 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents