July 1, 1969 W. F. MULLER 3,452,740

SPRING GUIDE MANIPULATOR

Filed May 31, 1966 Sheet 1 of 4

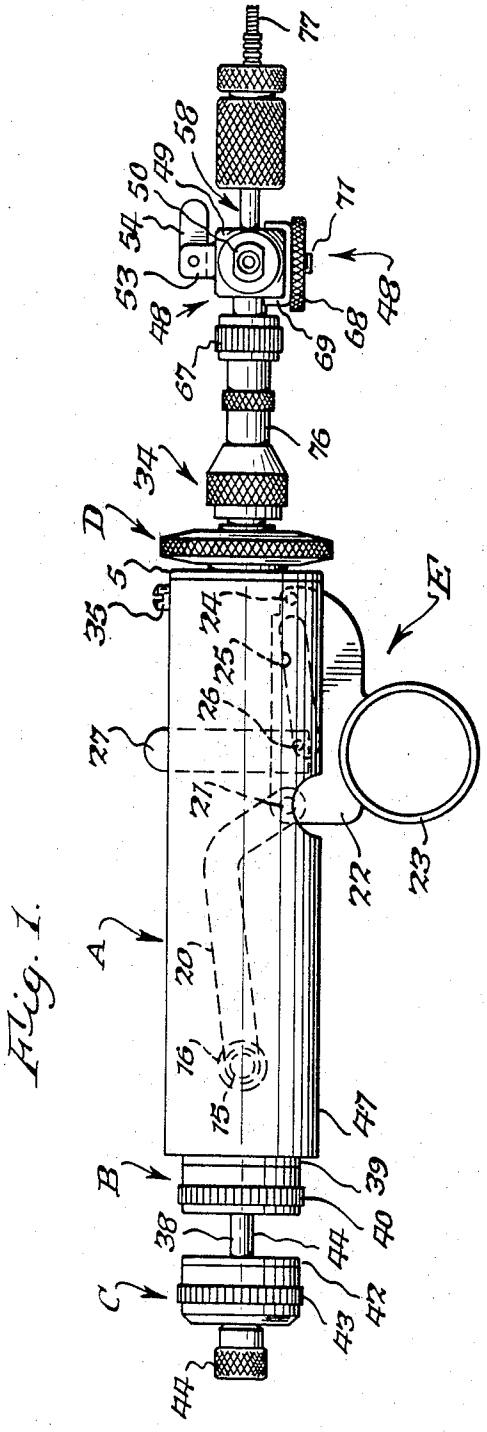

Fig. 1.

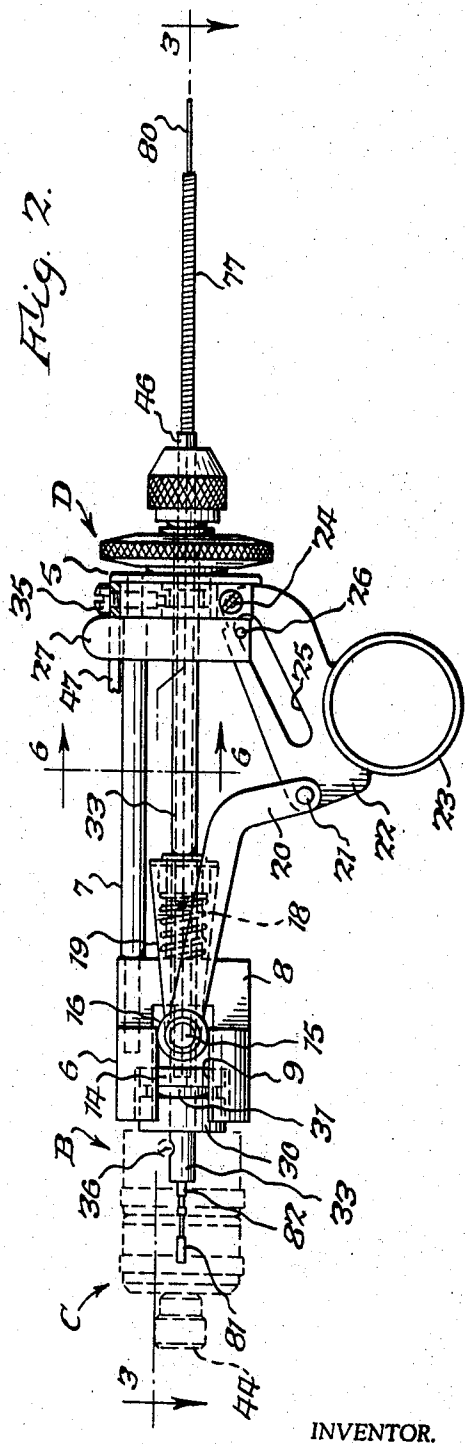

Fig. 2.

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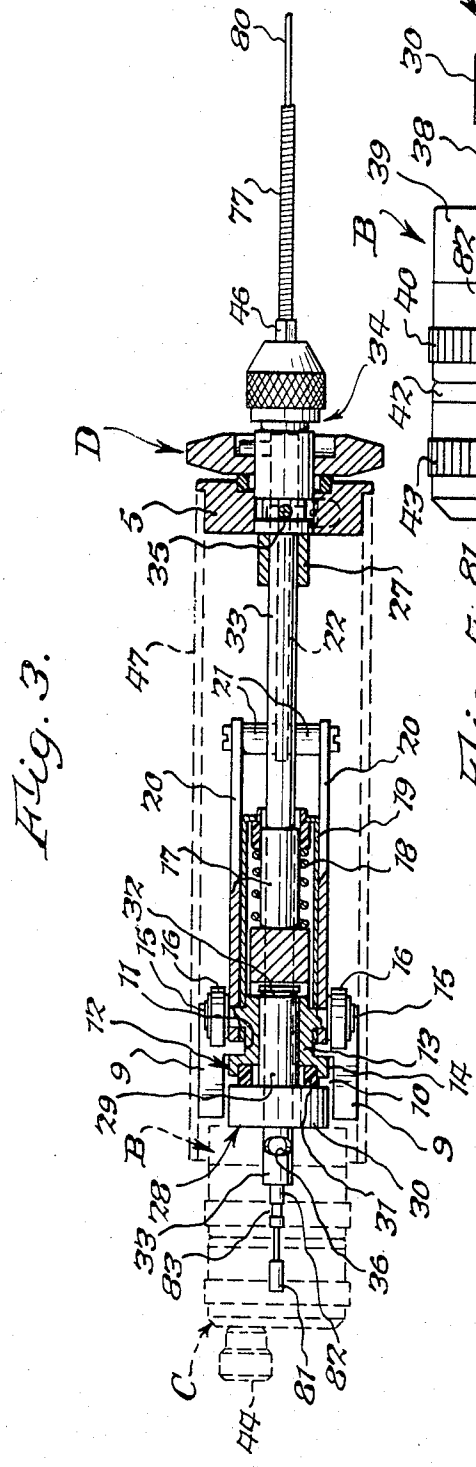

Fig. 3.

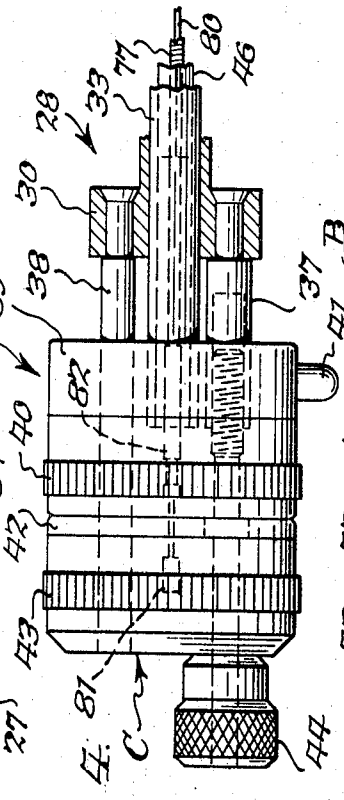

Fig. 4.

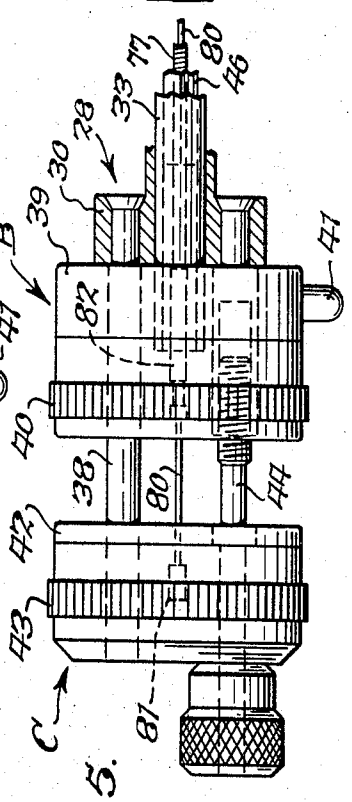

Fig. 5.

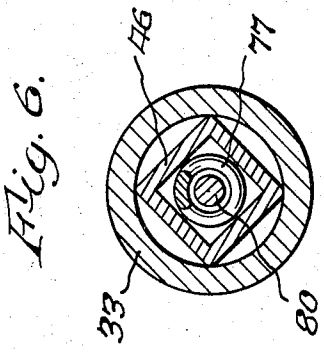

Fig. 6.

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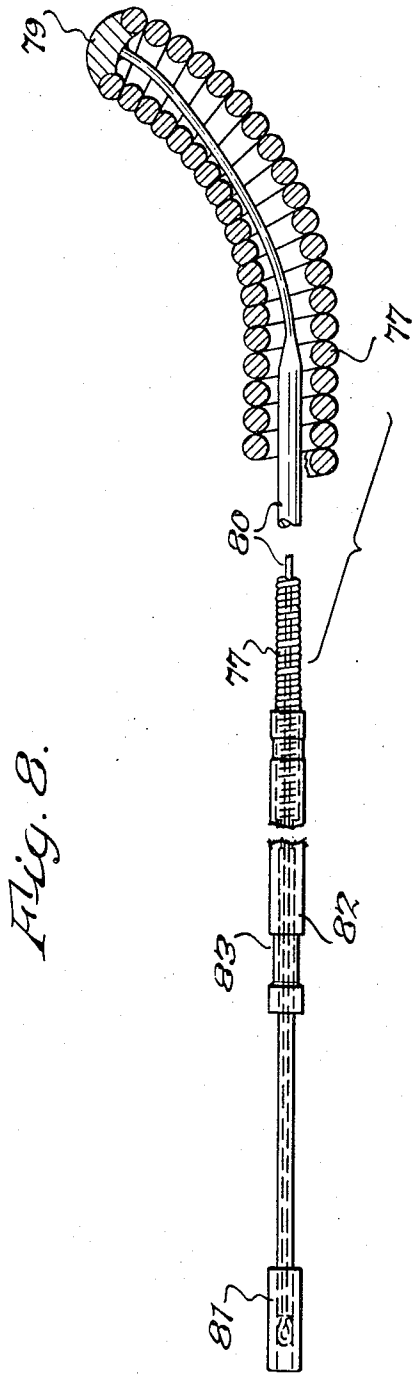

Fig. 8.

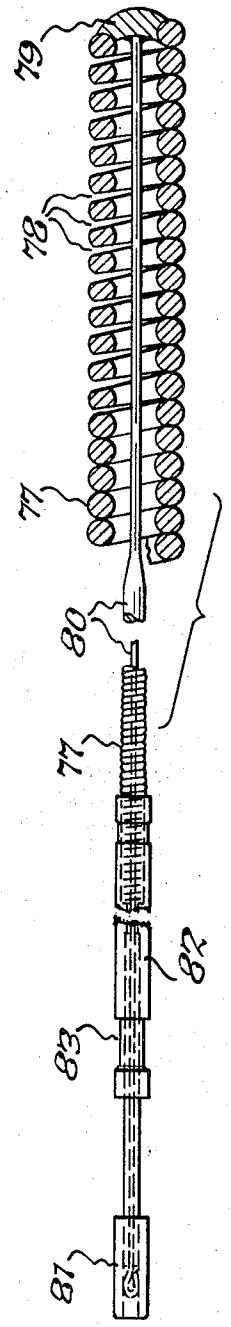

Fig. 7.

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Fig. 11.

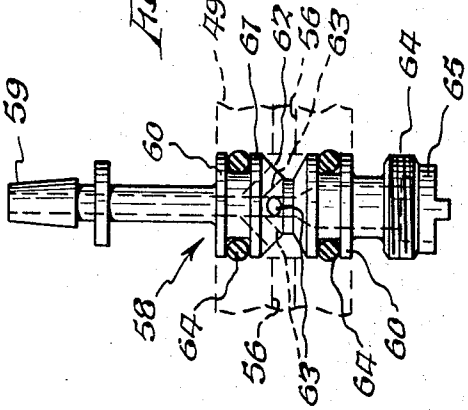


Fig. 9.

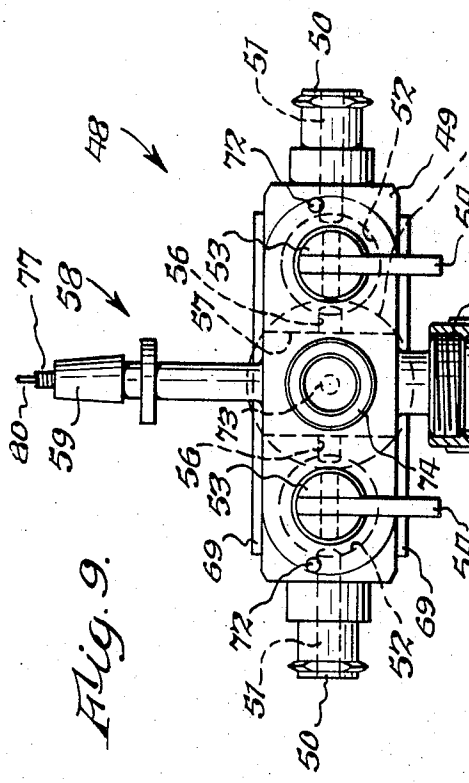
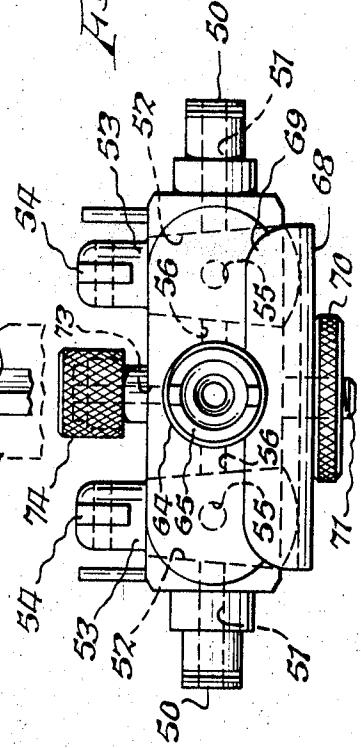


Fig. 10.



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United States Patent Office 3,452,740 Patented July 1, 1969

3,452,740

SPRING GUIDE MANIPULATOR

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Filed May 31, 1966, Ser. No. 553,850
Int. Cl. A61b 5/00, 17/00; A61m 25/00
U.S. Cl. 128—2 10 Claims

ABSTRACT OF THE DISCLOSURE

This invention is directed to a handle for attachment to, and manipulation of, spring guides that are used primarily as internal vascular probes to guide catheters to specific locations within the circulatory system. This handle remains in the hands of the doctor or surgeon outside of the patient's body but permits manipulation of the spring guide and catheter within the patient's body. The handle includes a pair of chucks for securely holding at the proximal ends both the spring guide coils and the spring guide tension wire with a linkage therebetween.

This invention relates to new and useful improvements in manipulative handles in general and particularly seeks to provide a novel handle for the manipulation of spring guides used primarily in internal vascular probes.

The marked advances in cardiac and vascular surgery in the past few years and other medical problems that require diagnostic study of the vascular beds and systems has led to the extensive use of cardiac or vascular catheters, particularly for retrograde aortography and angiocardiography, and less often to take blood samples, determine oxygen content, infuse medicaments, etc. at internal sites and various other uses that require the insertion of a relatively long catheter to an internal site that requires movement of the catheter into branch vessels at sharp angles relative to the feeding direction of the catheter.

The most common method for insertion of such catheters is the percutaneous technique described in 1953 by Sven Ivar Seldinger. In this procedure a local anesthesia is administered and a skin puncture made at a small angle to the vessel (e.g. femoral in the leg or brachial in the arm) with an obturator positioned within a cannula. Once the unit has been properly located in the vessel, the obturator is removed and the flexible spring guide then inserted through the cannula into the vessel for a short distance. Pressure is then applied to hold the spring guide in place while the cannula is withdrawn. The spring guide is then fed into the vessel generally under the fluoroscope until the desired point is reached which may or may not require considerable manipulation if there are branched vessels or curves concerned. Thereafter the catheter is passed over the flexible spring guide and fed into the desired position and the spring guide then withdrawn from the catheter unless both are needed for cooperative manipulation purposes.

A particularly useful spring guide for these purposes is disclosed and claimed in my co-pending application for U.S. Letters Patent Ser. No. 512,143, filed Dec. 7, 1965, now abandoned in favor of Ser. No. 563,927, filed June 29, 1966. In that form of spring guide its distal end may be straightened or curved by manipulation of an inner tension wire from its proximal end outside the patient and it may also be curved after a catheter is placed thereover to cause the catheter to curve.

The handle of this invention is particularly useful for manipulating spring guides of the abovementioned type.

Therefore, an object of this invention is to provide a manipulative handle attachable to the proximal end of a

spring guide containing an inner tensioning wire and having devices for controllably applying tension to or releasing tension from the inner wire.

Another object of this invetnion is to provide a handle of the character stated in which the tensioning devices may be locked in their tension-applying position to maintain the distal end of the attached spring guide in its curved condition.

Another object of this invention is to provide a handle of the character stated which includes means for rotating the attached spring guide and its contained tensioning wire relative to the handle.

Another object of this invetnion is to proivde a handle of the character stated that includes a two-valve manifold to permit the injection of liquids into a connected catheter while the spring guide is retained therein.

A further object of this invention is to provide a handle of the character stated that can be effectively used to progressively advance a catheter after it has been threaded over the spring guide.

A further object of this invetnion is to provide a handle of the character stated which is expressly designed for one-hand use.

A further object of this invention is to probide a handle of the character stated which is simple in design, rugged in construction and economical to manufacture.

With these and other objects which will be more apparent, the invention will be more fully understood by reference to the drawings, the accompanying detailed description and the appended claims.

In the drawings:

FIG. 1 is a side elevation of a manipulative handle constructed in accordance with this invention;

FIG. 2 is a view similar to FIG. 1 but with the cover tube removed;

FIG. 3 is a top plan view, partly in section, taken along line 3—3 of FIG. 2;

FIG. 4 is a fragmentary side elevation showing the relation between the chucks and swivel when the spring guide is in its normal, non-tensioned, condition;

FIG. 5 is a view similar to FIG. 4 but showing the relation between the chucks and swivel when tension has been applied to the tension wire of the spring guide;

FIG. 6 is an enlarged detail transverse section taken along line 6—6 of FIG. 2;

FIG. 7 is an enlarged sectionalized view of the end portions of a spring guide of the type with which the handle of this invention is particularly useful, and shows the spring guide in its normal non-tensioned conditioned corresponding to the parts relation shown in FIG. 4;

FIG. 8 is a view similar to FIG. 7 but showing the spring guide in its tensioned condition corresponding to the parts relation shown in FIG. 5;

FIG. 9 is a top plan view of a two-valve manifold operably attached to the telescoping tube of the handle;

FIG. 10 is a front elevation thereof; and

FIG. 11 is a top plan view of the rotary spindle therefor.

Referring to the drawings in detail, the invention as illustrated is embodied in a manipulative handle including a cylindrical body portion generally indicated A, a front chuck generally indicated B for securely holding the proximal end coils of a spring guide, a back chuck generally indicated C for securely holding the proximal end of the spring guide tension wire and being axially movable with respect to the front chuck, a wheel generally indicated D for rotating both chucks relative to the body portion, A and a linkage assembly generally indicated E for effecting axial movement of the back chuck C toward or away from the front chuck B.

The body portion A includes a front end closure flange **5** rigidly connected to an axially spaced mounting block **6** by a spacer rod **7**.

The mounting block **6** is preferably fabricated from a single piece of rod stock and machined to define a forwardly projecting vertical rib **8** and a pair of longitudinally extending horizontal slideways **9**, **9**, the bases of which are coplanar with the lateral faces of the rib **8**. The rear of the mounting block is provided with a relatively deep large diameter bore **10** and a smaller diameter bore **11** which connects with a still smaller bore (not shown) extending through the rib **8** for the passage of a torque tube as will be hereinafter more fully described.

A slide piece generally indicated **12** is mounted for reciprocatory movement in block **6** and includes a hollow cylindrical stem **13** which fits into the bore **11** and a disk end **14** which fits into the bore **10**. A pair of oppositely disposed stub axles **15**, **15** which are secured to the stem **13** and extend into the slideways **9**, **9** are provided at their outer ends with rollers **16** engaged in the slideways **9**.

A longitudinally extending tubular stud **17** is secured to the body rib **8** and carries a coil compression spring **18**. A bifurcated spring yoke **19** is fitted over the end of the stud **17** and has its arm pivotally attached to the axles **15**, thus maintaining the spring **18** under compression and constantly urging slide **12** toward the right as viewed in FIGS. 2 and 3 of the drawings.

The slide **12** and its associated elements is adapted to be reciprocated by the linkage assembly E which includes a pair of spaced parallel downwardly extending levers **20**, **20** pivotally connected at one end to the axles **15** and at their other end to a spacer pivot **21**. A lever plate **22**, provided with a finger ring **23**, has one pivotally connected to the spacer pivot **21** and its other end pivotally connected within a radial slot as at **24** in the closure flange **5**. The levers **20** and **22** thus form a toggle which can be moved into its "open" position by moving the finger ring **23** toward the body of the handle and thus moving the slide **12** to the left against the pressure of the coil spring **18**. Release of the finger ring permits the spring **18** to force the slide **12** to the right and to move the toggle levers back to their initial positions.

The lever plate **22** is provided with a slot **25** generally parallel with its upper edge which receives the pin **26** of a vertical locking bar **27** slidably mounted on the spacer rod **7**. Its normal position is indicated in full lines in FIG. 2 of the drawings and can be moved to the left as shown in FIG. 1 when the toggle defined by the levers **20** and **22** is in its open position to hold it in that position and maintain the slide **12** at its left end limit of movement.

A swivel generally indicated **28** includes a hollow stem **29** rotatably carried within the stem **13** of the slide **12** and a relatively thick disk end **30** which fits into the bore **10**. A thrust washer **31**, formed from nylon or other suitable material, is secured within an annular recess formed in the outer face of the slide disk **14** and serves as a slide seat for the disk **30** of the swivel **28**. The end of the swivel stem **29** extends slightly beyond the end of the slide stem **13** and is provided with an annular retaining groove **32** engageable with the pin end of a retaining screw (not shown) which extends radially through the mounting block **6**. Thus rotation of the swivel is permitted while axial movement thereof is prevented.

A rotatable torque tube **33** is affixed at one end to the cylindrical body portion of a pin vise generally indicated **34** rotatably mounted in the closure flange **5** and restrained from axial movement with respect thereto by a pin screw **35** extending radially therethrough and having its pin end engaged within an annular groove formed adjacent the end of the vise body portion. Incidentially, the pin screw **35** also secures the handle cover or shell in place as may be seen in FIG. 2.

The torque tube **33** extends axially from the closure flange **5** through the locking bar **27**, the tubular stud **17**, the rib **8** of the mounting block **6** and the stem and disk of the swivel **28** to a position somewhat beyond the swivel. One side of the torque tube **33** is notched as at **36** for connection with the front chuck B.

A radially offset, longitudinally extending, internally threaded tension post **37** is secured to the disk **30** of the swivel **28** and has a length approximately equal to that of the projecting end of the torque tube **33**. A slide rod or stud **38**, having a length substantially greater than that of tension post **37**, is also secured to the disk **30** in spaced parallel relation to the tension post.

The front chuck B includes a body **39** containing a cam-actuated clamp (not shown), a knurled clamp-actuating sleeve **40** and a spring-biased pin **41** for locking the chuck onto the projecting end of the torque tube **33**. The chuck B is provided with an axial duct passing through the internal clamp for receiving and retaining the proximal end of the spring guide coil while permitting the tensioning wire thereof to project therethrough for engagement by the back chuck C and for permitting the chuck to be attached to the end of the torque tube. When the front chuck B is attached to the torque tube the tension post **37** and slide stud **38** pass freely through longitudinal passages suitably provided therein so that relative sliding motion can take place between the chuck and the tension post and slide stud and permit relative axial motion to take place between the chuck and the swivel **28**.

The back chuck C includes a body **42** containing a cam-actuated detent (not shown), a knurled detent-actuting sleeve **43** and knobbed tension screw **44**. The chuck C is provided with an axial duct passing through the internal detent for receiving and retaining the proximal end of the spring guide tensioning wire. The back chuck C is slidably mounted on the stud **38** and is connected to the swivel **28** by engagement between the tension screw **44** and the tension post **37**. The tension screw **44** is freely rotatable with respect to the back chuck C but is restrained against axial movement by suitable means (shown in dotted lines) so that the tension screw is not only used to connect the back chuck with the swivel but may also be used to vary the spacing therebetween and thus correspondingly vary the total tension to be applied to the tensioning wire of the attached spring guide.

The torque tube **33** may be rotated in either direction relative to the handle body A by the knurled wheel D which is pin connected to the cylindrical body of the pin vise **34**. Since the front chuck B is firmly attached to the torque tube any rotation thereof will be transmitted through the chuck to the swivel **28** via the tension post **37** and stud **38** as well as to the attached back chuck C. Thus the torque tube, the two chucks and the swivel all rotate as a unit.

Axial movement of the slide **12** and its associated swivel **28** which results from manipulation of the linkage assembly E effects a corresponding axial movement of the rear chuck C and a relative movement of the rear chuck C with respect to the front chuck B. It is this relative movement between the chucks that applies and releases tension to and from the tensioning wire of the attached spring guide. FIG. 4 shows the relative positions of the chucks and swivel under normal or nontension conditions, while FIG. 5 shows their relative positions when tension has been applied. No axial motion of the front chuck B takes place because it is attached to the torque tube **33** that has no axial movement at any time, only rotary.

A telescoping tube **46** of square-section is carried within the torque tube **33** and projects beyond the end of the pin vise **34** for connection to a two-valve manifold as will be hereinafter more fully described.

A tubular shell or cover **47**, suitably slotted to permit the linkage assembly E and the top of the locking bar **27** to project therebeyond, fits snugly over the mounting block **6** and closure flange **5** and is retained in position by the pin screw **35** as mentioned before.

A two-valve manifold (see FIGS. 9–11) generally indicated 48 is operably connected to the outer projecting end of the telescoping tube 46 and includes a transversely extending stainless steel body 49 provided at each end with a female Luer fitting 50. Each of the fittings 50 connects with a horizontal duct 51 which communicates with a vertical tappered bore 52 containing a rotatable plug valve 53 provided at its projecting upper end with an actuating handle 54 pivotally connected thereto. Each valve 53 is provided with a single tranverse duct 55 horizontally aligned with its associated duct 51 and with an inner horizontal duct 56 extending into communication with a relatively large diameter bore 57 disposed in axial alignment with the telescoping tube 46.

A hollow rotary spindle generally indicated 58 fits snugly within the bore 57 and is provided at its forward end with a catheter connecting fittings 59. The spindle 58 is provided intermediate its ends with a pair of of flanges 60, 60 having an outer face spacing equal to the length of the bore 57. A second pair of flanges 61, 61, having conical interfaces 62, are symetrically positioned intermediate the flanges 60 so that the zone defined by their conical interfaces is aligned with the ducts 56. The conical face of the forward flange 61 is provided with four radial ducts 63 extending into communication with the axial bore of the spindle. A rubber O-ring 64 is fitted into each annulus defined by each pair of flanges 60 and 61.

The inner end of the spindle 58 is provided with an externally threaded boss 64 and the male half 65 of a toothed coupling or clutch, the female half 66 of which is affixed to the end of the telescoping tube 46. An internally threaded locking cap 67 is carried by the tube 46 for the engagement with the boss 64 to secure the two halves of the coupling together.

A U-channel pressure cap 68 having front and rear upwardly extending flanges 69, 69 spans the bottom of the manifold body 49 and is of sufficient length that its center web presses against the bottoms of the tapered plug valves 53 to retain them in place while permitting their rotation. The cap 68 is secured by a knurled disk nut 70 threadably engaged with a stud 71 affixed to the manifold body 49 and projecting downwardly through a hole in the web of the cap. The cap flanges 69 are just sufficiently high to engage the lower edge portions of the outer faces of the flanges 60 and thus restrain the spindle 58 against axial movement while permitting its rotation.

Proper alignment of the valve ducts 55 with the ducts 51 and 56 when the plug valves are turned to the open positions is assured through the use of upwardly projecting stop pegs 72 against which the handles or levers 54 are adapted to abut.

If desired the manifold body 49 may be provided with a vertical duct 73 extending into communication with the bore 57 for connection with external injection fitting 74 provided with a self-sealing rubber disk (shown in FIG. 9 in plan) for use when supplemental or flashing solutions are to be introduced by a hypodermic needle.

An externally threaded collar 75 (see FIG. 9) is affixed to the telescoping tube 46 adjacent to the coupling element 66 and carries an external sleeve 76 threadably engaged therewith. The sleeve 76 serves as an adjustable abutment engageable against the end of the pin vise 34 for accurately setting the initial or retracted position of a catheter connected to the fitting 59 with respect to the spring guide secured to the chucks B and C. In this way the distal ends of both the spring guide and catheter may be brought into exact registry prior to the time that the catheter is payed out or advanced relative to the spring guide during probing manipulations.

FIGS. 7 and 8 of the drawings show a preferred form of spring guide for use with the handle of this invention and formed from a continuous wire coil 77, the helices of which are individually tapered at the distal end to define a series of generally wedge-shaped spaces 78 therebetween.

The distal end of the spring guide is closed by a cap or plug 79 connected to one end of an internally extending tensioning wire 80, the other end of which projects beyond the proximal end of the spring guide and is provided with an enlarged pellet 81.

The proximal end of the spring guide is stiffened by an external stainless steel tube 82 rolled into tight contact therewith and provided with an annular groove 83 engageable by the clamp of the front chuck B to additionally restrain the spring guide against axial movement relative to the handle to avoid inadvertent flexing or relaxing of its distal end. The length of the stiffening tube 82 is such that the distal end thereof will extend through the body 49 of the manifold 48 when the spring guide is attached to the handle.

When the handle and spring guide are connected the spring guide is led through the telescoping tube 46 so that the pellet 81 is retained within the back chuck C and the proximal end of the wire coil 77 and stiffening tube 82 is clamped within the front chuck B. As the back chuck C is moved axially away from the front chuck B through operation of the linkage assembly E, tension is applied to the wire 80 and it is axially displaced to flex the distal end of the spring guide to the position shown in FIG. 8 by closing up the wedge-shaped spaces 78.

The total length of axial displacement of the tension wire 80 may be adjusted by varying the position of the tension screw 44 in the tension post 37 thus changing the axial spacing between the back chuck C and the swivel 28.

During connection of the spring guide to the handle, its unflexed distal end is passed through the spindle 58 of the manifold 48 and the manifold is then drawn along the spring guide toward its proximal end until the coupling halves 65 and 66 become engaged and the cap 67 can be secured on the boss 64 to complete the connection. The boss 64 carries a "no-bleed" plastic fitment (not shown) through which the spring guide passes and which serves to prevent back-flow leakage of liquid from the manifold around the spring guide.

When these connections have thus been completed a suitable catheter can be drawn over the spring guide from its distal end and connected to the fitting 59 on the manifold 48. It should be noted that whenever the manifold is to be used for the injection of liquids when the spring guide is still retained within the catheter, the outside diameter of the spring guide must be sufficiently less than the inside diameter of the catheter to permit free passage of liquid along the void therebetween.

It is believed that this invention, for the first time in medical and surgical technology, provides means for simultaneously manipulating a spring-guided catheter and injecting liquids therethrough.

When the manifold 48 is being used, the connections between the female Luer fittings 50 and the injection liquid supply sources prevent the manifold from rotating bodily although the spring guide and attached catheter may be rotated with respect thereto through use of the wheel D and its connected elements.

In the event that the manifold 48 is not to be used, it and the telescoping tube 46 are removed from the handle by releasing the pin vise 34 and replaced by a similar telescoping tube (not shown) having a catheter connecting fitting identical with the fitting 59 in place of the coupling half 66.

It is, of course, to be understood that variations in arrangements and proportions of parts may be made within the scope of the appended claims.

I claim:

1. A manipulative handle to be used while inserting spring guides in and through animal passages comprising a body portion including a longitudinally reciprocable slide and a swivel carried by said slide for rotation about

its longitudinal axis, a front chuck for securely holding the proximal end coils of said spring guide, and a back chuck for securely holding the proximal end of a spring guide tensioning wire, said swivel being operably connected to both of said chucks to effect bodily rotation thereof while permitting said back chuck to be moved axially with respect to said front chuck.

2. The handle of claim 1 in which said body portion includes an axially extending rotatable torque tube restrained against axial movement, said front chuck being secured to an end of said torque tube, said swivel being also operably connected to rotate with said torque tube.

3. The handle of claim 1 in which means are provided for locking said back chuck in its position farthest away from said front chuck.

4. The handle of claim 2 in which means are provided for locking said back chuck in its position farthest away from said front chuck.

5. The handle of claim 1 in which means are provided for adjusting the amount of axial movement said back chuck may make, and in which means are provided for locking said back chuck in its position farthest away from said front chuck.

6. The handle of claim 2 in which means are provided for adjusting the amount of axial movement said back chuck may make, and in which means are provided for locking said back chuck in its position farthest away from said front chuck.

7. The handle of claim 1 in which a liquid-injecting valve manifold is operably connected to said chuck rotating means.

8. The handle of claim 2 in which a liquid-injecting valve manifold is operably connected to said chuck rotating means.

9. The handle of claim 2 which includes a tube telescopically and adjustably retained within said torque tube for rotation therewith, means for clamping said telescoping tube in any desired position within said torque tube with one end projecting beyond that end of said torque tube opposite said chucks, a coupling having one end secured to the projecting end of said telescoping tube, and a liquid-injecting valve manifold having a rotary hollow spindle connected to the other end of said coupling, the free end of said spindle being provided with a catheter-connecting fitting.

10. The handle of claim 2 which includes a catheter-connecting tube telescopically and adjustably retained within said torque tube for rotation therewith, means for clamping said telescoping tube in any desired position within said torque tube with one end projecting beyond that end of said torque tube opposite said chucks, and a catheter-connecting fitting affixed to the projecting end of said telescoping tube.

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