Jan. 28, 1969 M. M. KINLEY 3,424,244

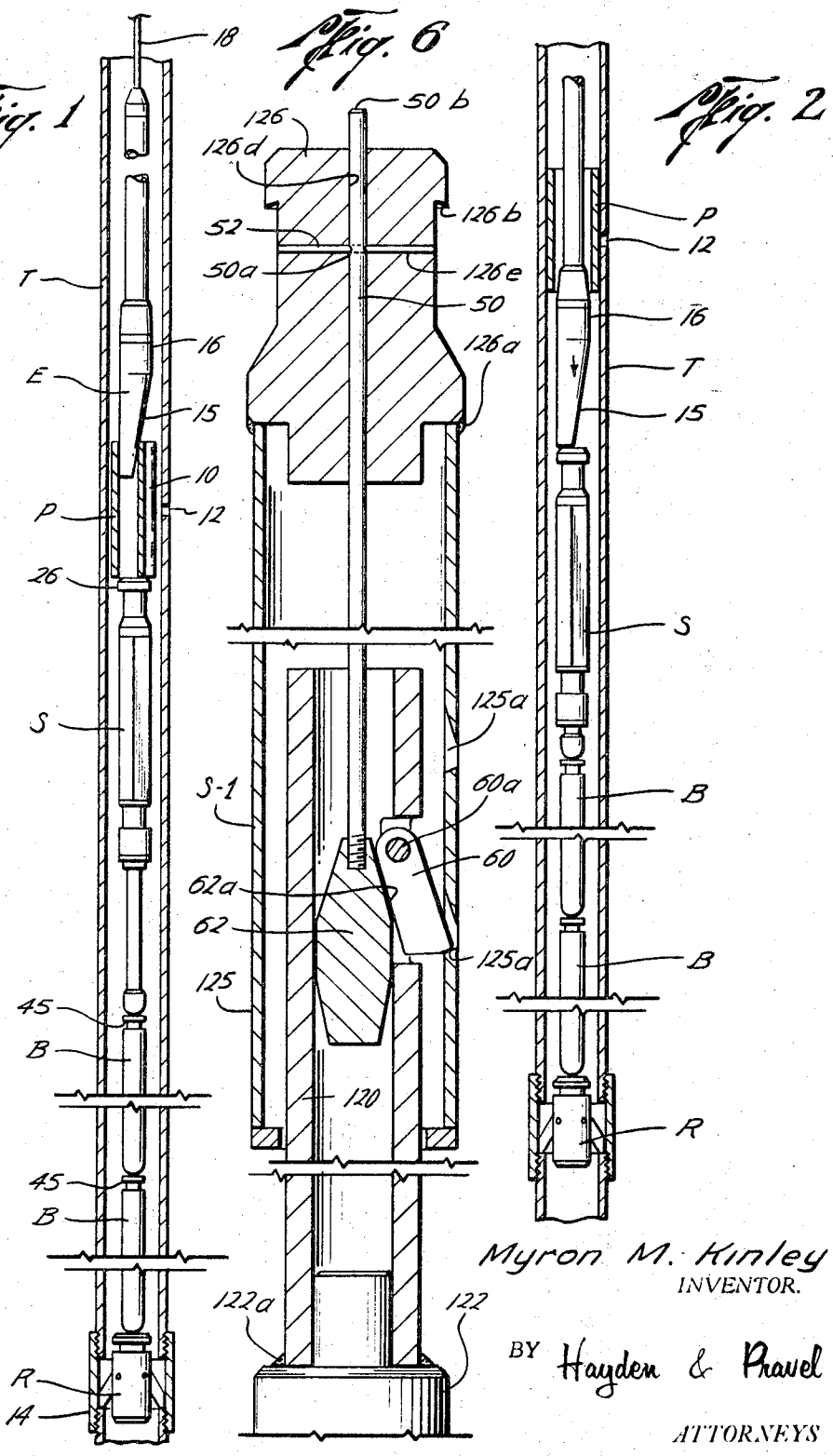
COLLAPSIBLE SUPPORT AND ASSEMBLY FOR CASING OR TUBING LINER OR PATCH

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Fig. 1

Fig. 6

Fig. 2



Myron M. Kinley
INVENTOR.

BY Hayden & Pravel
ATTORNEYS

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Fig. 3A

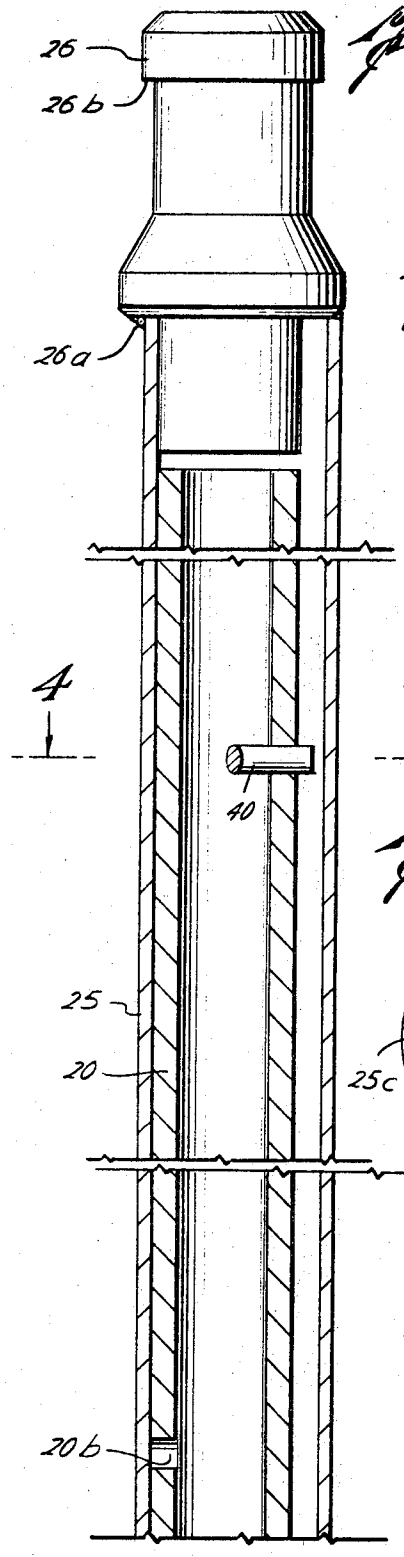


Fig. 3B

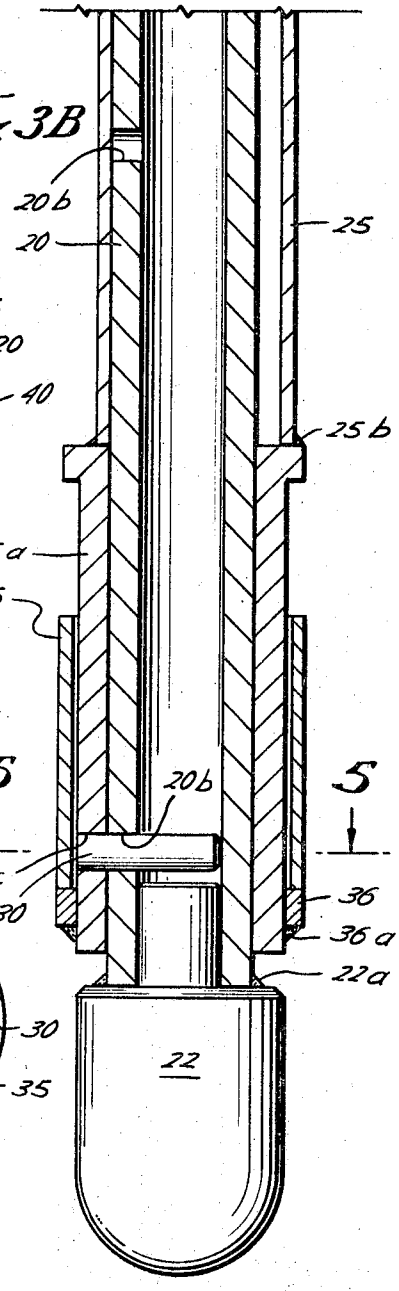


Fig. 4

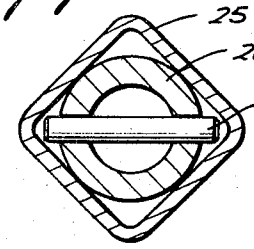
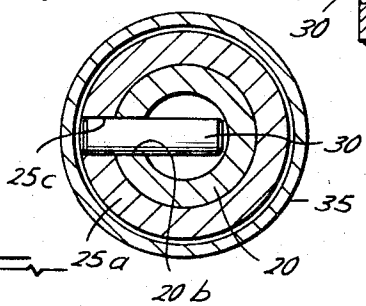


Fig. 5



Myron M. Kinley
INVENTOR.

BY Hayden & Pravel

ATTORNEYS

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COLLAPSIBLE SUPPORT AND ASSEMBLY FOR CASING OR TUBING LINER OR PATCH

Myron M. Kinley, Chickasha, Okla., assignor to J. C. Kinley Co., a corporation of Texas

Filed Sept. 14, 1967, Ser. No. 668,748
U.S. Cl. 166—114 11 Claims
Int. Cl. E21b 33/12, 43/10, 17/00

ABSTRACT OF THE DISCLOSURE

A collapsible support adapted to be used alone or in an assembly for supporting a tubular patch in casing or tubing prior to and during expansion of the patch into substantial conformity with the inside of the casing or tubing; said support being collapsible after expansion of the patch for obtaining a full expansion of the patch and for indicating to the operator that the patch has been expanded.

Background of the invention

The field of this invention is apparatus for positioning a tubular patch on the inside of a tubular member such as casing or tubing. In my prior copending U.S. patent application, Ser. No. 552,812, filed May 25, 1966, a tubular patch and apparatus for installing same in casing or tubing is disclosed. Also, my U.S. Patent No. 3,191,677 relates to a method and apparatus for setting liners in tubing and the like. In both of such prior inventions, removable tubing stops were employed for supporting the patch, which stops prevented the expanding tool from passing completely through the tubular patch until the stop was removed or displaced downwardly. This might require several expanding runs to obtain an initial expansion with a first tool such as shown in application Ser. No. 552,812 followed by a second tool of the type shown in Patent No. 3,191,667.

Summary of the invention

The present invention constitutes an improvement over the inventions of application Ser. No. 552,812 and Patent No. 3,191,677 in several respects. With the present invention, a single tool such as one of the tapered type shown herein may be used for fully expanding the patch in a single run. Additionally, with this invention, the patch or liner may be set at any predetermined elevation with positive support during the expanding thereof. When the patch has been expanded, the support means of the present invention releases and allows the expanding tool to pass downwardly completely through the patch so that the opetrator knows that the patch is fully expanded before removing the expanding tool from the casing or tubing.

Brief description of the drawing

FIG. 1 is an elevation, partly in section, of the releasable support assembly of the present invention as used in conjunction with a tubular patch or liner disposed inside of a tubular member such as a casting or tubing.

FIG. 2 is a view similar to FIG. 1, but illustrating the expander tool after it has passed through the tubular patch and has collapesd the collapsible support for such patch;

FIGS. 3A and 3B are detailed views, partly in elevation and partly in section, illustrating the preferred embodiment of the collapsible support of this invention with FIG. 3A showing the upper portion thereof and FIG. 3B showing the lower portion thereof;

FIG. 4 is a cross-sectional view taken on line 4—4 of FIG. 3A;

FIG. 5 is a cross-sectitonal view taken on line 5—5 of FIG. 3B; and

FIG 6 is a view, partly in elevation and partly in section, illustrating a modified form of the collapsible support of this invention.

Descrpition of the preferred embodiments

In the drawings, the letter P designates a tubular patch or liner which is preferably in the form of a cylinder with a single inside reverse bend designated by the numeral **10**, such patch P being specifically illustrated in said patent application Ser. No. 552,812. The patch P is adapted to be positioned in a tubular member such as a tubing or casing T adjacent a hole **12** or other defect in the tubular member T which it is desired to cover or patch from the inside thereof. The patch or liner P is supported at a predetermined elevation in the tubular member T adjacent to the defect **12** by a collapsible support S which is preferably disposed immediately below the patch P. The collapsible support S may be directly resting upon a removable stop R of conventional construction. The support S may be disposed upon one or more solid spacer bars B which rest upon a removable stop R and which may take any suitable form so long as they are capable of passing through the inside of the patch P after the patch P has been fully expanded to substantially conform to the inside surface of the tubular member T, as will be more fully explained. In some instances, a plurality of the collapsible supports S may be employed rather than, or in addition to, one or more of the solid spacer bars B. The number of the collapsible supports S and the spacer bars B will be determined by the distance from the removable stop R to the elevation at which the patch or liner P is to be disposed in the tubular member T. Preferably, the removable stop R is of the type which is adapted to be positioned in a collar or joint **14** of the tubing T and therefore the distance from suck joint **14** to the hole or other defect **12** may be readily determined in advance with conventional equipment. However, the stop R may be set in tubing which does not have an internal collar recess, in which case the stop R will usually be set by pounding down on it with weights until it does not move downwardly any further. Then, the distance to the defect **12** or other elevation can be readily measured so that the length of the support S and any suitable number of spacer bars B and other supports S may be selected to position the hatch or liner P at such predetermined elevation.

The patch P is expanded so as to conform, or substantially conform to the inside surface of the tubing T by any suitable expander tool such as the expander tool E illustrated in the drawings. Other forms of expander tools are illustrated in said application Ser. 552,812 and U.S. Patent No. 3,191,677. The expander tool E is of the tapered type which has a lowered tapered portion **15** and a substantially cylindrical portion **16** at its upper part. The tool E is preferably lowered on a wireline **18** and a suitable jar and weights (not shown) for use with a wireline are incorporated between the wireline **18** and the expander tool E. In some instances, the expander tool E may be lowered on support pipe or tubing rather than a wireline. The cylindrical portion **16** is prefarably of the diameter corresponding to the final inside diameter of the patch P when it is fully expanded into substantial conformity with the inside surface of the tubing or tubular member T, although it may be smaller than such inside diameter if it is desirable to perform the expansion of the patch P in more than one expanding operation.

The preferred embodiment of the collapsible support S illustrated in FIGS. 2 and 3A–5 includes an inner mandrel **20** which has a solid lower head **22** welded thereto as indicated at **22***a*, or otherwise suitably affixed thereto. The

mandrel **20** includes a plurality of lateral openings **20***b* which are spaced longitudinally with respect to each other for receiving a shear pin **30** as will be explained hereinafter. The number of such openings **20***b* and the distance therebetween as shown in the drawings is not to be construed as limiting since such number and distance may be varied as desired for varying the length of the support S as will be more evident hereinafter.

The support S also includes a sleeve **25** which is slidably disposed over the mandrel **20**. In the preferred embodiment, the sleeve **25** is of a square tubular cross-section (FIG. 4), although such sleeve **25** may be cylindrical or of other cross-section configuration, as will be more evident hereinafter. The sleeve **25** has a support and anvil head **26** secured to the upper end of the sleeve **25** by welding as indicated at **26***a* or by any other suitable securing means. The head **26** is adapted to engage the lower edge of the patch for supporting same as illustrated in FIG. 1, and it is also adapted to be contacted by the lower end of the expander tool E after it has passed downwardly to that point in the patch P at which it can contact such head **26**.

The lower end of the sleeve **25** is preferably formed with a cylindrical sleeve section **25***a* which is suitably secured thereto such as by an annular weld **25***b*, or any other suitable securing means. A lateral hole **25***c* is formed in the sleeve section **75***a*, and it is adapted to be aligned with any one of the lateral openings **20***b* in the mandrel **20**.

Shear pin **30** extends through the opening **25***c* and into one of the openings **20***b* as illustrated in FIGS. 3B and 5. A retainer cylinder **35** is disposed externally of the sleeve section **25***a* for retaining the shear pin **30** in position in the aligned openings **25***c* and **20***b*. The cylinder or retainer **35** is adapted to move longitudinally relative to the sleeve section **25***a* for exposing the shear pin **30** so that it can be inserted, removed, or replaced. Normally, the lower edge of the retainer cylinder **35** rests upon a stop ring **36** which is welded at **36***a* or is otherwise suitably secured to the special section **25***a*.

To prevent relative rotation between the mandrel **20** and the sleeve **25**, a guide pin **40** extends through the mandrel **20** laterally as illustrated in FIGS. 3A and 4 so that it projects into the angular corners of the sleeve **25**. Thus, the mandrel **20** and the sleeve **25** may move longitudinally relative to each other, assuming the shear pin **30** is not in position or has been sheared, but the mandrel **20** and the sleeve **25** cannot be rotated relative to each other. Instead of having a sleeve **25** of a square cross-section, the sleeve **25** may be in the form of a cylinder with suitable slots formed internally thereof for receiving the ends of the pin **40** in the same manner as the corners of the square sleeve **25** receive the ends of the pin **40**. Thus, the pin **40** in co-operation with the sleeve **25** prevents a rotation of the mandrel **20** with respect to the sleeve **25** so as to maintain the opening **25***c* always rotationally aligned with the openings **20***b*. Thus, the length of the support S may be changed by moving the sleeve longitudinally relative to the mandrel **20** and the desired length may be fixed by the insertion of the shear pin **20** into any one of the openings **20***b* and also into the aligned opening **25***c*.

In the operation or use of the apparatus shown in FIGS. 1–5 of this invention, the removable stop R is positioned in the collar or joint **14** in the conventional manner and then the collapsible support S is lowered into the tubing or other tubular member T so as to rest upon the removable stop R. If spacer bars B are to be employed, they are lowered into the tubing T in advance of the collapsible support S and are positioned as illustrated in FIG. 1. However, the apparatus of this invention may be employed without using any solid spacer bars B and instead, a single support S or a plurality of such supports S may be used; alternatively, a plurality of such collapsible supports S may be used in conjunction with one or more solid spacer bars B, all of which are supported by the removable stop R. The uppermost collapsible support S is extended prior to lowering it into the tubing T so that the shear pin **30** is in one of the openings **20***b* above the lowermost opening **20***b* so that there will be a downward movement or telescoping of the sleeve **25** relative to the inner mandrel **20** when the shear pin **30** is severed to collapse the support S. If several collapsible supports S are employed, each of them may be extended so that each of them will collapse by telescoping, preferably in succession, with the uppermost support S collapsing first and then with each succeeding support S therebelow collapsing thereafter by impact from the expander tool E.

The patch P is lowered into the tubular member or tubing T so that it is disposed on the upper head **26** of the uppermost collapsible support S as illustrated in FIG. 1. Thereafter, the expander tool E is lowered on a wireline **18** or other suitable support and is manipulated so that it jars downwardly through the patch P, expanding the reverse bend portion **10** outwardly so as to cause the patch P to assume a true cylindrical shape conforming to the inside surface of the tubular member or tubing T.

With the expander tool E illustrated in FIGS. 1 and 2, the wedge portion **15** may readily proceed downwardly through the patch P and it is followed by the cylindrical portion **16** which is of a diameter to fully expand the patch P to the cylindrical shape as illustrated in FIG. 2.

When the lower end of the expander tool E reaches the lower end of the patch P, it will contact the head **26**, and thereafter, impacts or jars from the expander tool E will be transmitted to such head **26** and will also thus be transmitted to sleeve **25** and the sleeve section **25***a*. Since the inner mandrel **20** is supported directly or indirectly on the removable stop R, the portion of the shear pin **30** which extends through one of the openings **20***b* is thus supported against downward movement while the outer sleeve **25***a* is acting on the pin **20** with each blow of the expander tool E to impart a shearing force to such pin **30**. Thus, the shear pin **30** is eventually sheared by the impact from the expander tool E on the head **26**, and when this occurs, the sleeve **25** will move downwardly relative to the mandrel **20** so as to telescope the sleeve **25** relative to the mandrel **20**, the extent of such telescoping depending upon the height of the particular hole **20***b* in which the pin **30** is positioned. Thus, the over-all length of the support S will be shortened a sufficient distance to at least permit the expander tool E to pass completely through the patch P as illustrated in FIG. 2 so that the cylindrical portion **16** can fully expand the entire length of the patch P.

Thereafter, the expander tool E is removed and then the collapsible tool S is removed from the tubing T through the bore of the patch P by a suitable fishing tool of conventional construction. It should be noted that the external diameter of the collapsible support S, including its fishing neck **26***b*, is sufficiently small so that it can pass upwardly through the internal bore of the patch P after it has been expanded to its expanded position shown in FIG. 2. Likewise, any spacer bars B are of a sufficiently small diameter so that they also can be removed upwardly through the bore of the patch P. The spacer bars B have fishing necks **45** so that they can be engaged and retrieved or lifted upwardly through the bore of the patch P with a suitable fishing tool. The removable stop R may, of course, also be removed upwardly through the bore of the patch P with any suitable fishing or recovery tool in a conventional manner. Thus, all of the apparatus of this invention may be removed from the tubing T leaving only the patch or liner P in position so that the tubing T may be subsequently used for performing various well operations.

A modified collapsible support S–1 is illustrated in FIG. 6, wherein an inner mandrel **120** is disposed internally of an external sleeve **125** which is slidable relative thereto in the same manner as explained heretofore in connection with the mandrel **20** and the sleeve **25** of FIGS. 3A and 3B. The lower end of the mandrel **120** has a lower

plug or head **122** secured thereto by a weld **122***a* or other suitable means. The upper end of the sleeve **125** has an upper head **126** secured thereto by an annular weld **126***a* or other suitable means. Also, a suitable fishing neck **126***b* is provided on the head **126**. The head **126** has a suitable longitudinal central opening **126***d* through which extends an actuating rod **50**, the purpose of which will be explained hereinafter. Such rod **50** is releasably held with respect to the upper head **126** by a very light shear pin **52** which extends through a lateral opening **126***e* in the head **126** and also through a lateral opening **50***a* in the actuating rod **50**. Such pin **52** is adapted to be sheared on a downward movement of the rod **50** relative to the head **126** and usually such shearing can be accomplished with a few blows of the expander E on the upper end **50***b* of the rod **50**.

The inner mandrel **120** is provided with one or more dogs **60**, each of which is pivotally mounted at **60***a* for swinging inwardly and outwardly relative to the mandrel **120**. Each dog **60** hangs substantially vertically so that its outer surface is retracted inwardly of the inner surface of the sleeve **125**, but a locking wedge **62** is adapted to be used for holding the dog **60** outwardly in the position shown in solid line in FIG. 6. Such locking wedge **62** has a tapered surface or surfaces **62***a* which is adapted to engage the inner surface of the dog **60** to urge it outwardly and hold same in one of the slots **125***a* formed in the wall of the sleeve **125**. The degree of extension of the sleeve **125** with respect to the inner mandrel **120** will determine which of the slots **125***a* receives the dog **60**. This can be predetermined in the same manner as explained heretofore in connection with the selecting of the length of the collapsible support S. Only two of the slots **125***a* are illustrated in FIG. 6, but it will be appreciated that such slots **125***a* may be positioned at various points so that the extended length may be selected for the collapsible support S–1 to facilitate the proper positioning of the patch or liner P in the same manner as heretofore described in connection with FIG. 1.

Thus, with the embodiment illustrated in FIG. 6, the predetermined length of the collapsible support S–1 is set by positioning the sleeve **125** with respect to the inner mandrel **120**, and then the rod **50** is pulled upwardly to hold the dog **60** in the slot **125***a* adjacent thereto. Such slot **50** is, of course, moved upwardly before inserting the shear pin **52**, but as soon as the dog **60** is in one of the slots **125***a*, the shear pin **52** is inserted through the openings **126***e* and **50***a*. Thereafter, the collapsible support S–1 is handled in the same manner as explained heretofore in connection with the collapsible support S. However, it is to be noted that a much smaller force is required to release the collapsible support S–1 than is required for releasing the support S since a smaller shear pin **52** is normally utilized as compared to the shear pin **30**. Thus, the shear pin **52** may be so small that a single blow on the upper end **50***b* with the lower end of the expander tool E is sufficient to shear the pin **52** and permit the locking dog **60** to swing downwardly and out of the slot **125***a* whereby the sleeve **125** telescopes downwardly by gravity until its lower end is in engagement with the head **122**. The presence of the locking dog **60** assures that the sleeve **125** and the mandrel **120** are maintained in the expanded or operating position until such time as a blow is imparted directly to the upper end of the rod **50** for shearing the pin **52**. Thus, no jarring force is really imparted to the pin **52** until the upper end of the rod **50** is jarred or hit by the expander E. For this reason, such pin **52** may be of a very light construction and made shearable with a single blow, if desired. Also, it is to be noted that the sleeve **125** may be a tube or cylinder, and the dog **60** may serve to prevent relative rotation of the sleeve **125** with respect to the mandrel **120** when the dog **60** is in one of the openings or slots **125***a*.

It should be noted that this invention is particularly suitable for installing a patch in a tubular member, but any type of liner or other internal cylinder may be installed in another tubular member with the present invention, whether it is for the purpose of patching or for some other purpose.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A collapsible support for a tubular linear in a tubular member adapted to be positioned on a removable stop, comprising:

(a) an inner mandrel having a lower end adapted to be prevented from moving downwardly in the tubular member by the removable stop;

(b) a sleeve disposed slidably over said mandrel for slidable movement relative thereto;

(c) an anvil head at the upper end of said sleeve for supporting engagement with the tubular liner and for receiving impacts imparted thereto during the expansion of said liner;

(d) releasable means securing said sleeve in a releasable position relative to said mandrel; and

(e) said releasable means being releasable by impact whereby said sleeve telescopes relative to said mandrel to release said sleeve from supporting engagement with said liner.

2. The structure set forth in claim **1**, including:

(a) adjustment means for said releasable means for permitting the positioning of said sleeve and said mandrel at different relative longitudinal positions whereby the over-all length of said sleeve and mandrel together may be predetermined for locating the liner at a predetermined elevation in a tubular member.

3. The structure set forth in claim **1**, wherein:

(a) said releasable means includes a shear pin adapted to extend through a lateral opening in said sleeve aligned with a lateral opening in said mandrel; and

(b) said sleeve having a plurality of lateral openings spaced from each other at longitudinal intervals, each of which is adapted to be aligned with a lateral opening in said sleeve for receiving said shear pin to releasably maintain said sleeve and mandrel at selected over-all lengths.

4. The structure set forth in claim **1**, including:

(a) adjustment means for said releasable means for permitting the positioning of said sleeve and said mandrel at different relative longitudinal positions whereby the over-all length of said sleeve and mandrel together may be predetermined for locating the tubular patch at a predetermined elevation in a tubular member; and

(b) means for preventing relative rotation between said mandrel and said sleeve during relative longitudinal movement of said sleeve said said mandrel.

5. The structure set forth in claim **1**, wherein:

(a) said releasable means is a shear pin adapted to extend through a lateral opening in said sleeve aligned with a lateral opening in said mandrel;

(b) said sleeve having a plurality of lateral openings spaced from each other at longitudinal intervals, each of which is adapted to be aligned with a lateral opening in said sleeve for receiving said shear pin to releasably maintain said sleeve and mandrel at selected over-all lengths; and

(c) a retainer slidably mounted on said sleeve for holding said shear pin in the aligned openings in said sleeve and said mandrel and adapted for movement to expose said shear pin for removal and for positioning of the shear pin in aligned opening of said mandrel and said sleeve in any selected relative position thereof.

6. The structure set forth in claim 1, wherein said releasable means includes:

(a) a locking dog adapted to releasably lock said inner mandrel to said sleeve;

(b) a longitudinally movable wedge for holding said locking dog in locking position; and

(c) means for releasing said wedge to thereby release said dog from its locking position for permitting said sleeve to telescope relative to said mandrel.

7. The structure set forth in claim 1, wherein said releasable means includes:

(a) a locking dog adapted to releasably lock said inner mandrel to said sleeve;

(b) a longitudinally movable wedge for holding said locking dog in locking position;

(c) an actuating rod connected to said wedge and having its upper end extending upwardly above said anvil head when said wedge is holding said locking dog in a locked position; and

(d) shear means adapted to be sheared by a few blows securing said actuating rod to said anvil head.

8. A collapsible support assembly for a liner which is adapted to be expanded to substantially conform to the inside surface of a tubular member, comprising:

(a) a removable stop adapted to be anchored in the tubular member at a predetermined elevation;

(b) a longitudinally telescoping support disposed above said removable stop and supported thereby for supporting the liner in the tubular member; and

(c) an expander tool for expanding the liner and for effecting a telescoping of said longitudinally telescoping support to release said support from its supporting position below the liner.

9. The structure set forth in claim 8, including:

(a) another longitudinal support disposed between said telescoping support and said removable stop for locating the liner a desired distance above said removable stop.

10. The structure set forth in claim 8, including:

(a) another longitudinally telescoping support disposed between said telescoping support and said removable stop for locating the liner a desired distance above said removable stop.

11. The structure set forth in claim 8, wherein said longitudinally telescoping support comprises:

(a) an inner mandrel having a lower end adapted to be prevented from moving downwardly in the tubular member by the removable stop;

(b) a sleeve disposed slidably over said mandrel for slidable movement relative thereto;

(c) an anvil head at the upper end of said sleeve for supporting engagement with the tubular patch and for receiving impacts imparted thereto during the expansion of such patch; and

(d) releasable means securing said sleeve in a releasable position relative to said mandrel.

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JAMES A. LEPPINK, *Primary Examiner.*

U.S. Cl. X.R.

166—207; 175—321

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,424,244 January 28, 1969

Myron M. Kinley

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

Column 6, line 12, "linear" should read -- liner --.

Signed and sealed this 24th day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents