Oct. 1, 1963 F. T. NESSLINGER ETAL 3,105,572

FOLDING SCAFFOLD

Filed March 9, 1961 2 Sheets-Sheet 1

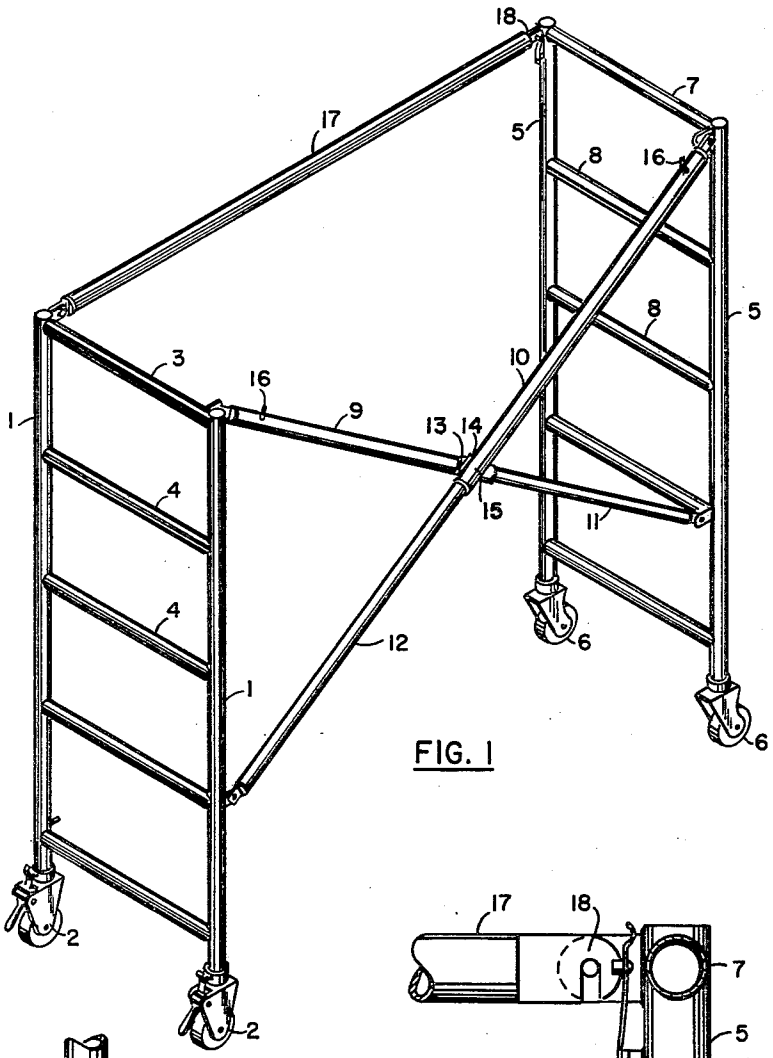


FIG. 1

FIG. 6

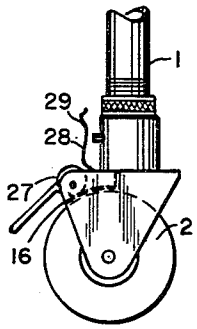


FIG. 5

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Filed March 9, 1961 2 Sheets-Sheet 2

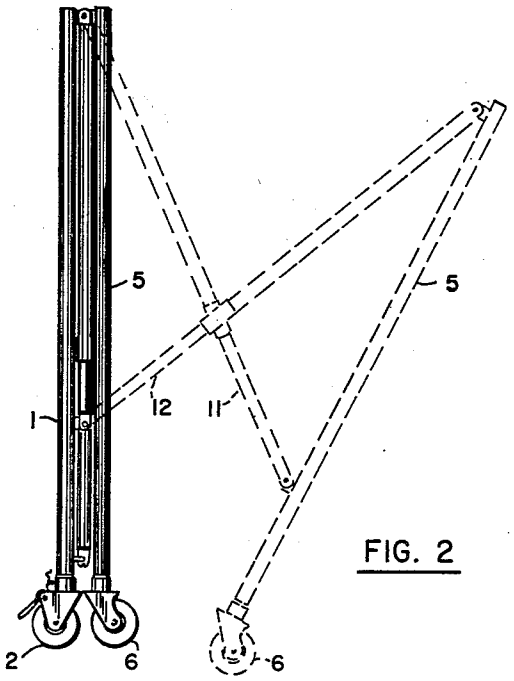


FIG. 2

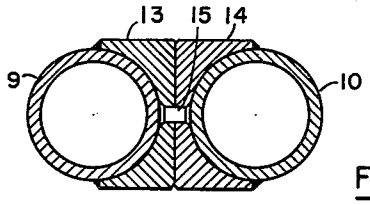


FIG. 4

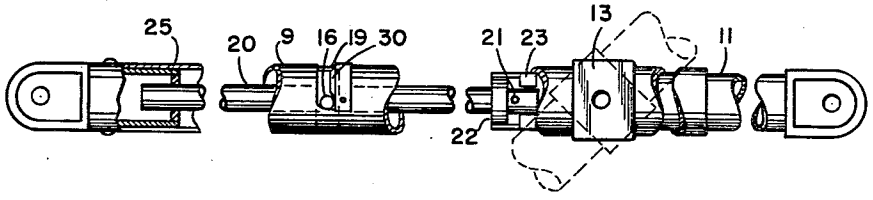


FIG. 3

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FOLDING SCAFFOLD

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This invention relates to an improved scaffold or scaffold support.

Movable scaffolding for use inside buildings or on outside walls for painting, window-washing and other purposes is usually made of metal tubing and may be considered when erected as four uprights with end rungs or braces, side top members and cross diagonal braces on the side, thus producing a strong and comparatively light structure with its own platform or on which planks or other walkways may be placed for use of workmen.

For many years such scaffolds have been made with bolted joints, so that they can be dismantled. However, the dismantling and erection take considerable time, and in general required the services of at least two men. When scaffolding was erected for a job which lasted some time, and which was not often recurrent, the time and man power factor presented no economic problem. Where, however, scaffolding was to be erected for a short time only, for example for window-washing or servicing high illuminating fixtures in buildings, the time and labor required for erecting represented a serious cost.

In recent years an attempt was made to eliminate at least part of the disadvantages. This attempt resulted in collapsible scaffolds in which the two end pieces were the conventional pair of uprights with rungs connecting them between the top and the bottom. Each upright had the bottom provided with a large caster.

A pair of such end members were connected together at one face with articulated V-shaped cross bars, and with a single straight bar at the top. Both of the V-shaped cross bars were provided with toggle joints at their center, and locking means to hold them against collapse which means, however, are only effective when the cross bars are fully extended. In this position there is also provided means for locking the two joints together. The straight tube bar at the rear was made with a joint in its middle and a locking sleeve to hold against collapse, but again only when the joint is fully extended. When the two end pieces were brought together by releasing the several locking means and folding at the toggle joints, they formed a compact unit higher than the end uprights and of a width corresponding to the end members and thickness a little more than four times the diameter of the tubing used.

This compact unit could be rolled into place on its casters, passing through doors which need only to be a little higher than the length of the upright, and was erected by locking the casters of one end piece and then pushing apart the two end pieces until the adjacent V-joints can be locked and the straight top bar was straightened out and locked by its sleeve. The toggle braces then were provided with other locks which could be engaged to hold the V-joints together.

The scaffolding described above presented a number of advantages over what was available hitherto and has come into commercial use. However, it has disadvantages which will be enumerated below.

Among the disadvantages of the collapsible scaffolding described are: First, the toggle joints in the V-braces present a serious hazard. If the user is not careful to keep his hands out of proximity while the scaffolding is being erected painful injury can result. A second disadvantage is that until the scaffolding is completely erected and the V-braces have been locked to each other

there is no bracing against movement at right angles to the plane of the diagonal braces. This is true whether they are in the fully collapsed position, or partially extended. Any blow from rough handling can easily bend the braces, and when then they are erected the lock which fastens them together may no longer register, or may require very strenuous efforts to force the braces into locking position, with further possibility of hand injury. A third disadvantage is that since each of the diagonal braces and the collapsed top member are jointed the two end pieces can tip toward or away from each other. As a result in order to erect, it is necessary to grasp both end pieces at the same time and to push them apart, because until the braces have almost locked there is otherwise no assurance that the end pieces will not tip. In a comparatively small scaffolding this disadvantage may be tolerable, but if the scaffolding is larger only a man with a very long reach is capable of erecting it at all, or else two men are needed to pull the end pieces apart, greatly decreasing the labor-saving advantage of the collapsible structure.

The present invention solves all of the problems presented by the above serious disadvantages and produces a scaffolding which when collapsed is thinner. There is no part protruding above the uprights and, therefore, the scaffolding can be rolled through lower door openings. The cross braces give effective bracing in a plane at right angles to the plane of the diagonal cross braces at all times, both when collapsed or during the erection, and the rigidity of the diagonal cross bracing members is at a maximum when they are collapsed. It is in the collapsed position when the scaffolding is stored that the likelihood of side blows, e.g., by dropping the scaffolding or tipping it over, is most serious.

Another important advantage of the present invention is that in erecting it is only necessary to lock one or both casters on one end and then pull the other end away. It is not necessary for the operator to grasp both ends. As the scaffold is erected the uprights tilt slightly, first in one direction, and then back to the vertical. However, their tipping is controlled by the geometry and they cannot collapse.

The serious danger of injury in the toggle hinges of the prior scaffolding is completely eliminated by the present invention, as the cross braces have no hinges and it is impossible to catch a hand in a closing toggle joint. Moreover there are no precision joints to be fitted together. The cross braces used in this invention remain connected. At the same time scaffolding in the present invention is light, is stronger than the collapsible scaffolding hitherto used even when erected, and does not have any disadvantages. This is an unusual situation.

Generally one mechanical design which is solving a serious problem or danger has some offsetting, even though less serious, disadvantage. In the present case problems presented by the serious disadvantages of former collapsing devices are solved without such offsetting disadvantages.

Essentially, in the present invention the cross braces are connected at their center at all times with a connection which permits turning about an axis so that the cross braces can be folded, but prevents any motion in any other direction. Cross braces are formed of telescoping tubes, the center connection being fastened to the largest tubing which will normally be the top portion, although it is perfectly possible to reverse the design of the cross bracing. As the cross braces are collapsed there is more and more telescoping, and the stiffness of the cross braces increases so that they are at their most rigid when completely collapsed, instead of being in a weak position as in the case of the hinged braces used before. It is precisely in the collapsed position in which the scaffolding is moved or is stored that the danger of

bending of the braces is at a maximum, and it is at this point that the braces of the present invention are at their strongest.

Since the permanent connection at the center of the braces prevents tipping over of the end pieces with respect to each other erection is very simple. It is only necessary to lock one set of casters and pull out the other end. This is a one man job even with scaffolding which may be considerably longer than the span of the extended arms of even a tall man. In the collapsible scaffolding used before, this required cooperation of two men, and the present invention in the case of these long scaffolds therefore is capable of performing the erecting function with half the amount of labor.

While the advantages set forth above are most important the present invention has other advantages. When fully erected the lock is very simple and much stronger than hitherto. It is only necessary to lock the telescoping tubes against movement in one direction. This can be an internal lock, and in a preferred embodiment may involve an internal rod which still further strengthens the braces in their folded position. The lock is far stronger than anything possible with the toggle hinges hitherto used which have to be locked against twisting and bending forces in a number of directions. This produces a much stronger and stiffer structure and completely obviates the risk of the joints becoming unlocked in use, which could result in a scaffolding collapse or partial collapse. This additional safety factor is obtained in the present invention without mechanical complication. The lock is quite simple, rugged and reliable.

While the provision of brakes on the casters of one end piece is not a new thing in the present invention, in a more specific modification the invention includes an improved form of brake which simultaneously applies a brake-shoe to the caster and locks the caster against turning. This is an added safety feature.

A horizontal top bar in the present invention can be made in a simpler form than the articulated bar described above, and can simply be pivoted and swung down in one piece, with a suitable conventional snap lock when the scaffold is erected. This eliminates another toggle joint, another possibility for injury, and results in a stronger top bar. It was not practical to use such a simple rugged and reliable construction before because in erecting with the joints of the cross braces free to turn some further protection against tipping and other movement was necessary during erection and this was provided by the hinged top member. The present invention makes such a provision unnecessary and eliminates one more hazard. It should be understood, of course, that the basic cross bracing advantage of the present invention can be used with a jointed top member if desired, but it is preferred to use a one piece member as there is no need, and hence no advantage in a jointed one.

In many cases the collapsible scaffolding of the present invention requires cross braces on only one side, a single top member being sufficient on the other side. However, the present invention is not limited to such a construction and there is advantage in a symmetrical structure, which provides still greater bracing. For example in very long scaffolding, it is perfectly possible to have the telescoping cross bracing of the present invention on both sides.

The largest single use of scaffolding of the collapsible type is for a single level. However, if still higher scaffolding is needed the uprights may be provided with sockets so that successive units of such scaffolding can be mounted on one another. In this respect the present invention does not present any marked advantages in ease of erection, but where higher scaffolding is needed the greater rigidity and increased strength of the cross bracing of the present invention makes for a stronger and safer whole.

The invention will be described in greater detail in conjunction with the drawings which illustrate a typical and desirable construction, and in which:

FIG. 1 is an isometric view of an assembled scaffold in condition for use;

FIG. 2 is an elevation of a fully collapsed or folded scaffold in condition for moving and showing it in partially open form in dashed lines;

FIG. 3 is an elevation of a telescoping tubular brace, partly broken away; and with parts of the locking devices in the relative positions occupied when the telescoping brace tubes are in extended condition but with the locking pin in non-locking position.

FIG. 4 is a transverse section through the pivotal connection between the contact plates carried by the tubular braces;

FIG. 5 is a detailed view of the caster brake and lock, and

FIG. 6 is a detail of the rear bar lock.

FIG. 1 shows the scaffold erected. It consists of two end pieces or frames, one formed of uprights or posts, **1** with casters, **2**, a top member **3**, and rungs **4**, and the other with uprights or posts **5**, casters **6**, top member **7** and rungs **8**. The cross braces are formed of two large tubes **9** and **10** pivoted at the top of one of the uprights **1** and one of the uprights **5** respectively. Within said larger tubes **9** and **10** are telescoped the end portions of smaller tubes **11** and **12**. These smaller tubes are secured at substantially lower points on the uprights **1** and **5**, respectively.

The larger tubes **9** and **10** are fastened, for example by welding, to a yoke composed of plano-convex members **13** and **14** having their plane faces in contact and joined together by a pivot pin **15**, as shown most clearly in FIGURE 4. It will be seen that this permits the braces to be swung about the pin **15**, but does not permit other relative movement between the tubes **9** and **10**, thus providing a maximum of rigidity for the structure when extended in condition for use.

FIG. 3 shows in more detail the construction of one brace. The smaller tube **11** is provided at its upper end with a bushing **22** which forms an end wall for tube **11** and provides a bearing and passage for the rod **20** in its center opening. Stop lugs **23** are provided on the inside of tube **11** near, but spaced from the bushing **22**. These lugs are spaced apart diametrically, leaving an opening at the center loosely fitting the rod **20** and a diametrically oriented space between adapted to receive the projecting ends of pin **21**.

The locking rod **20** is mounted axially in the telescoped tubes, being secured in this position at one end by the bushing **25** (shown at the left hand end of FIGURE 3) and at the other end by the bushing **22** and lugs **23**.

The locking rod **20** is provided with an operating lever **16**, the free end of which is capable of limited movement within an arcuate slot **19** in the tube **9**. When the brace is fully extended, as in FIGURE 1, the bushing **22** abuts against the pin **21** extending radially from the rod **20**. This limits further endwise extension of the brace and keeps the tubes **9** and **11** telescoped sufficiently for structural strength during use. When the rod **20** in this position is rotated by means of lever **16**, the pin **21** moves to locking position between lugs **23** and bushing **22** and thus holds the brace extended and against endwise or telescoping of the tube **11** into the tube **9**.

The lever **16** is held in this latter locking position by a spring latch **30** which yieldingly engages the lever **16**, as shown in FIGURE 3.

When the scaffolding is fully erected with one end of the single cross brace **17** fastened to the top of post **5** of one end piece and its other end releasably connected to a bracket at the top of post **1** of the other end piece, e.g. by means of hook **18** and a suitable keeper, as shown in FIGURE 6. The cross braces are strongly held and quite stiff, and a construction of maximum strength is

provided. Where the scaffold is no longer than an end upright the construction shown in FIG. 1 is simple and adequate. When the scaffold is to be much longer than the height of an upright it is preferably to provide both sides with cross braces, although even here it is possible to use a single member **17** which can snap on at both ends. However, this makes for an additional piece of tubing which has to be transported, and is at less desirable modification.

FIG. 5 shows a detail of an improved caster brake, the brake shoe **36** being brought into contact with the caster wheel or roller **2** by lifting the free end of the eccentric lever **27** and swinging it toward the upright **1**, which at the same time forces a spring **28** against said upright. The spring has an opening **29** which fits over a pin on the upright, thus locking the caster against turning as well as applying the brake.

FIG. 2 shows that the width of the scaffold in collapsed or folded form is barely more than three times the width of the uprights. To erect, the brakes are applied to the caster wheels of one ladder-shaped end frame and then the other is grasped and pulled out. The position partway unfolded, is shown in dashed lines in FIG. 2. When the scaffold is fully extended the levers **16** are thrown over, i.e. to the position shown in FIG. 3, thus locking the braces against endwise relative movement of the small tube, as **11**, and the large tube, as **9**, and the free end of the side bar **17** is swung up and hook **18** is snapped onto the top end of upright **5** of the other end frame. If the modification for a long scaffolding with cross braces on both sides is used, of course, the final operation is to throw the locking levers on the other set of cross braces.

It will be seen in FIG. 2 that the distance along the uprights from pivot connection to pivot connection therewith of the braces is quite substantially longer than the distance along the braces from the upper pivot points or connections on the two uprights to the pivot pin **15**. The only limitation on how far apart the uprights may be moved is the practical limitation that if this is too great in comparison to the distance between pivot points on an upright, so flat an angle between the two cross braces will be made at the pin **15** that friction may rise to an excessive degree so that it is no longer practical for one man to erect the scaffolding. For scaffolds which are to be erected by one man this angle should ordinarily not become significantly less than 80° so that there remains a substantial component of force in a direction to telescope the tubes and to swing down the position of the pin **15**.

When the scaffolding is erected there is sometimes the need for slight leveling as a floor may not be absolutely level. Accordingly the bottoms of the uprights are capable of limited telescoping and can be locked in any position by the knurled locking rings. Because of the necessity for leveling the opening **29** in the spring **28** is in the form of a slot.

It has been stated that for practical purposes the angle between the two cross-braces in the fully erected position should not be less than 80° (a slope of 40° with the horizontal). This is a practical limitation. Theoretically the angle might be 60°, if thicknesses of materials are disregarded, but if it were attempted to approach too closely the theoretical minimum angle smooth telescoping cannot be effected because of high friction. For best results an angle approximately 90° is preferred.

There is one other limitation, namely the relative distance on the uprights between the lower pivot points and the bottom of the casters. If the uprights are in the same plane, which is preferred, the length must not be so long that the casters strike each other before the uprights have reached the position where they begin to swing together. If the uprights are in offset planes so that the casters may slide past each other this requirement need not be met and such constructions are included, although the preferred modification is where the uprights are in the same plane.

We claim:

1. A collapsible mobile scaffold wherein end frames including uprights each provided with a supporting caster are connected by extensible braces which, in collapsed or inoperative condition of the scaffold, are brought into substantially parallel relation with each other and with said uprights and, in operative condition of the scaffold, extend in cross relation between an upright of one of said end frames and an upright of the other of said end frames on the same side of the scaffold, each of said braces comprising a larger tube of relatively large inside diameter, open at its lower end, and a smaller tube having an outside diameter less than said inside diameter of the larger tube, each of said larger tubes being assembled in telescoping relation with one of said smaller tubes and having its upper end pivotally connected to an upper end of one of said uprights and being pivotally connected adjacent its lower end to a lower end portion of said other larger tube, and each of said smaller tubes having its lower end pivotally connected to a lower intermediate portion of one of said uprights and having its upper end extending into the open lower end of one of said larger tubes, said upper end of said smaller tube having a perforated transverse wall providing a bearing, and said upper end portion of said larger tube having a perforated transverse wall providing a bearing coaxial with the tubes and with said other bearing, a reinforcing and locking rod mounted in said larger tube with its upper end portion supported in said bearing of the larger tube and its lower end portion slidably and rotatably supported in said bearing of the smaller tube, a transverse slot in the wall of said larger tube, a lever projecting radially from said rod through said slot to retain said rod in relatively fixed position longitudinally in said larger tube and providing means accessible outside said larger tube for rotating said rod on its axis in said bearings to and from locking engagement with said smaller tube, said rod having adjacent its lower end a radially extending locking and stop pin positioned to be engaged by said transverse wall of said smaller tube to limit the extent of movement of said smaller tube in relation to said larger tube, and said smaller tube having angularly spaced inwardly extending lugs spaced downwardly from said bearing wall of the smaller tube and positioned to be passed by said locking and stop pin when the larger and the smaller tube are moving into and out of extended position and to be engaged by said pin when said locking rod is rotated to locking position.

2. A foldable and extensible brace assembly for scaffolds comprising in combination a pair of pivotally connected tubular brace members, each including a smaller diameter tube having an end portion in telescoping engagement with a large diameter tube, each of said larger tubes being provided with a contact plate having a flat surface arranged and adapted to bear against and ride on the flat surface of said other contact plate and a pivot connection between said plates, said larger and smaller tubes having means at their outer ends arranged and adapted to be secured to spaced portions of a scaffold frame, and said assembly including a rod mounted coaxially and rotatably in the larger tube, detent means arranged in spaced relation in the smaller tube and adapted to provide a stop to limit outward endwise movement of the smaller tube and a stop spaced therefrom to prevent inward endwise movement of said smaller tube, and a pin extending radially from said rod in position to be engaged by said outward movement limiting stop when the brace assembly is in operative extended condition, and means for rotating said rod to bring said pin thereon into and out of operative locking relation to said inward movement preventing stop.

3. An expansible brace comprising in combination a large diameter tube, a smaller diameter tube having an

inner end portion telescopically engaged within said large tube, said large tube having a first bearing arranged coaxially therein, said small tube having a transverse stop wall which provides a second bearing coaxial with said tubes and with said first bearing, a rod having its opposite end portions rotatably mounted respectively in said bearings, and a pin extending radially from said rod in position to be engaged by said stop wall to limit the extent of differential endwise outward movement of one of said tubes in relation to the other, and wherein a lug extends inwardly from an interior lateral wall portion of said small tube in longitudinal spaced relation to said transverse wall, said rod and said pin being rotatable to and from locking position between said lug and said transverse wall and a rod actuating lever extending radially from said rod and having a free end accessible for manual operation outside of said large tube.

4. A collapsible scaffold comprising two end frames each provided with two laterally spaced upper pivot connections and two laterally spaced lower pivot connections, brace means connecting said frames and including a pair of relatively large diameter tubes and a pair of relatively small diameter tubes, said large tubes being pivotally interconnected near their inner ends, the opposite ends thereof each being pivotally secured to one of said end frame pivot connections at a height substantially removed from that of said pivotal interconnection whereby, when the end frames are pulled apart, the large tubes tend to be pulled toward a straight line between their pivotal connections with the end frames and to be pushed toward parallelism with the end frames when said frames are pushed one toward the other, said small tubes each having an outer end pivotally connected to one of said end frame pivot connections at a level removed from the level of pivot connections of the large tubes by a distance greater than the length of the large tubes measured from their pivot connections to their inner ends beyond the intersection, the other ends of said small tubes being telescoped into the inner ends of the large tubes, the length of each said small tube being less than the distance between said upper and lower pivot connections on its said end frame and substantially greater than the distance between its lower pivot connection on said end frame and said interconnection when swung against said end frame, means operatively interposed between each large tube and the small tube telescoped therewith and including parts mounted within said tubes for limiting the extent of endwise relative extending movement between said tubes, thereby to automatically position said braces and end frames in predetermined operative extended relation when said end frames are moved apart to fully extended position, and means for locking said tubes in said extended relation including a rod mounted axially and longitudinally, but rotatably to a limited extent, in one of said tubes and slidably engaging a bushing fixed in the other tube and through which an end of said rod extends, a locking pin having end portions extending radially from said rod, stop lugs on the inside of said smaller tube spaced axially from said bushing to provide a transverse channel for angular movement of said locking pin and spaced circumferentially to provide a longitudinal channel for said pin, and means for rotating said rod to move the pin angularly in one direction into said transverse channel between the bushing and said lugs for preventing relative endwise movement between said tubes and angularly in the opposite direction into alignment with said longitudinal channel to permit endwise relative telescoping movement between said tubes.

5. An expansible tubular brace for scaffolds comprising a relatively large diameter tube, a relatively small diameter tube having an inner end portion telescopically engaged within an inner end portion of said large tube, means at the outer ends of said telescoped tubes for pivotally connecting them to scaffold parts, each of said tubes having a bushing arranged coaxially therein, the bushing in the larger tube providing an axial bearing and the bushing in the smaller tube providing a transverse stop wall therein and a bearing longitudinally spaced from and coaxial with said bearing in the larger tube, said small tube having an inwardly extending stop projection spaced longitudinally from said transverse stop wall, a locking rod having spaced portions rotatably mounted in said bearings, means arranged and adapted to rotate and to retain said rod against longitudinal movement in relation to said larger tube, said means comprising a stop pin extending radially from said rod in position to be engaged by said stop wall to limit the extent of relative endwise inward movement between said tubes, said pin being rotatable with said rod in one direction to an end position between said wall and said projection to lock said tubes against any relative endwise movement and in the opposite direction to an end position in substantially the same plane to permit relative endwise inward telescoping movement between said tubes, and yielding means cooperating with said rod and operatively interposed between the rod and said large tube to prevent rotation of said rod and thus releasably retain said pin in said end position.

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