United States Patent

Hoffman et al.

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[54] UNIVERSAL FOLDING LADDER

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Feb. 14, 1970 Germany ..... P 20 06 846.6

[52] **U.S. Cl.** **182/163**
[51] **Int. Cl.** **E06c 1/383**
[58] **Field of Search** 182/24, 27, 163, 164

[56] **References Cited**

FOREIGN PATENTS OR APPLICATIONS

1,531,014 5/1968 France 182/27

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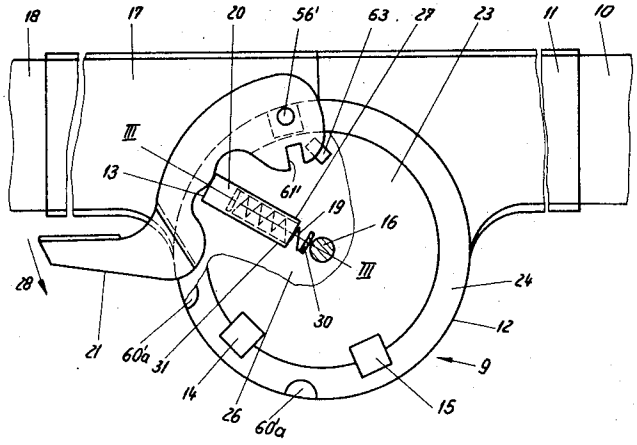
[57] **ABSTRACT**

A folding ladder is formed of several pairs of ladder sections connected by a joint. The joint includes on one section a circular locking disc concentric with the joint axis and with recesses about its periphery corresponding to the different positions of the ladder sections, and a stop member on the other section engageable in the recesses. A releasing lever is provided which lift the locking member out of the recesses. An arresting device associated with the releasing lever locks the releasing lever in its releasing position during movement of the ladder sections with respect to each other in one direction and disengages the releasing lever at the end of such movement.

10 Claims, 11 Drawing Figures



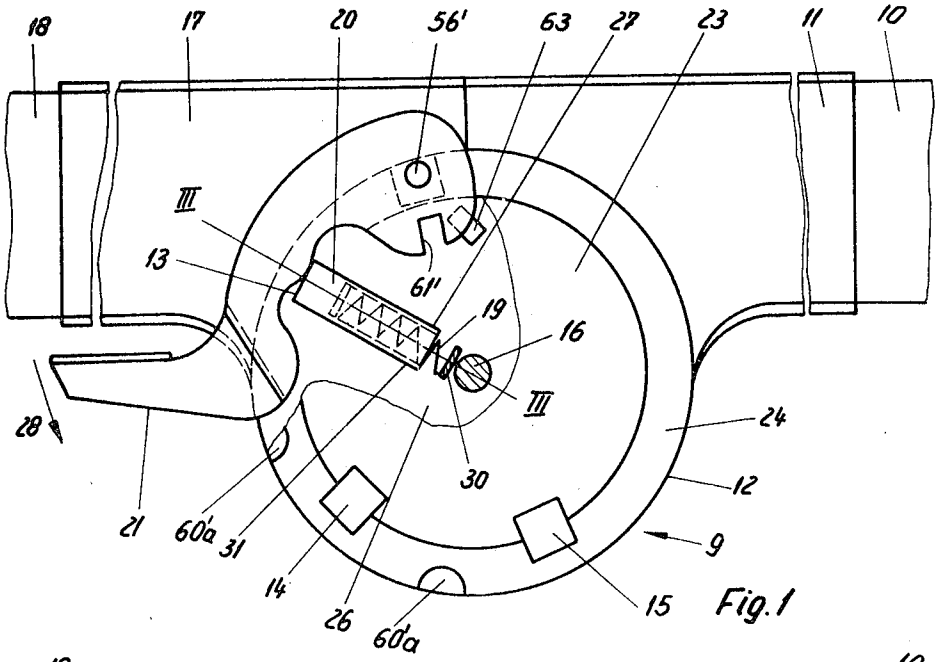


Fig. 1

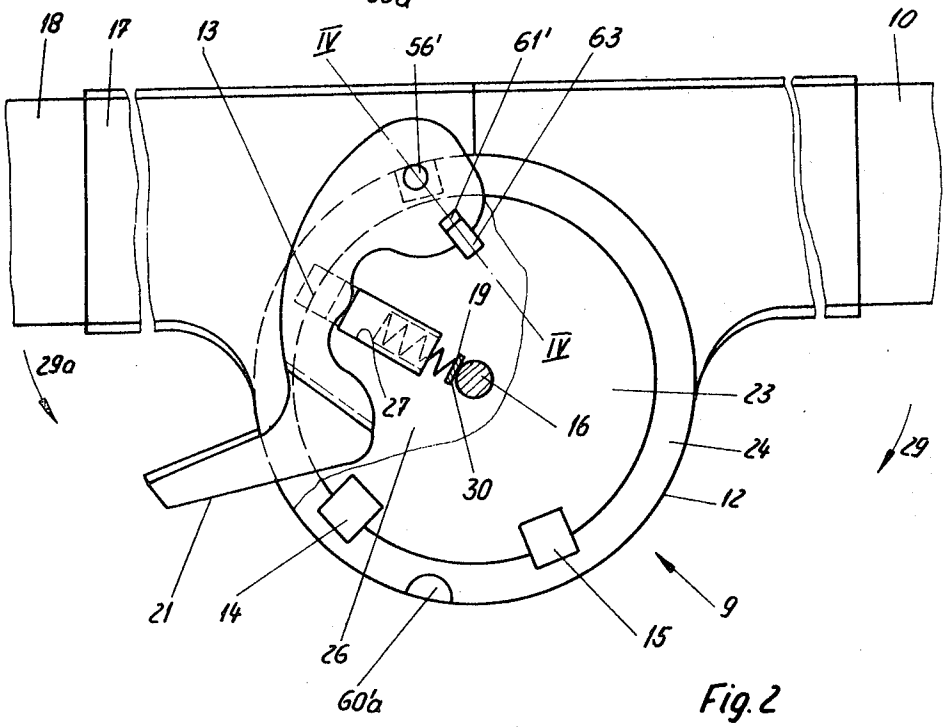


Fig. 2

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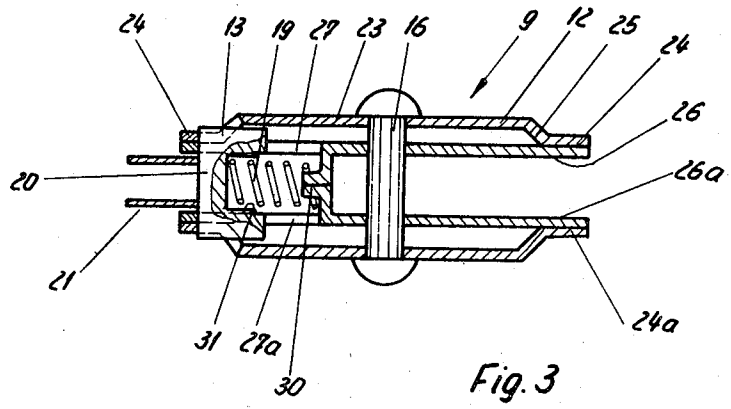

Fig. 3

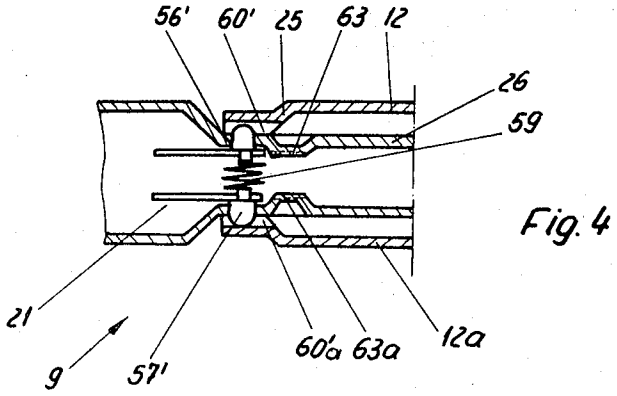

Fig. 4

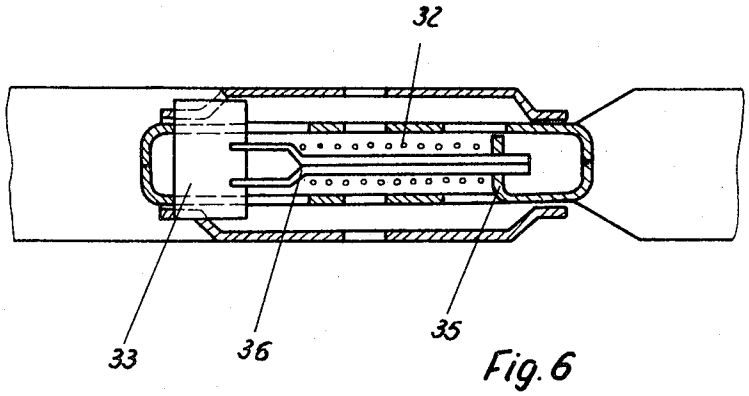

Fig. 6

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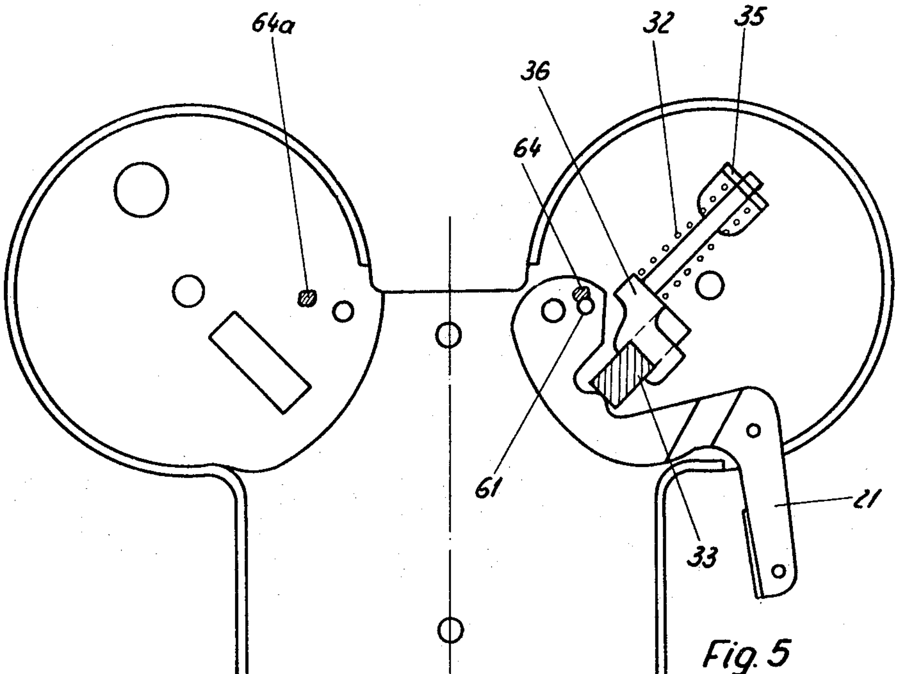

Fig. 5

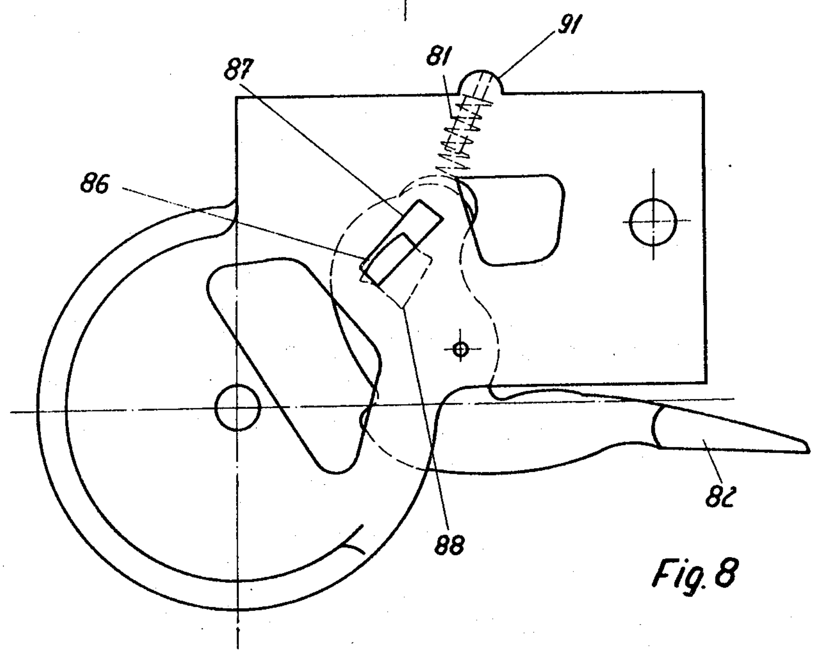

Fig. 8

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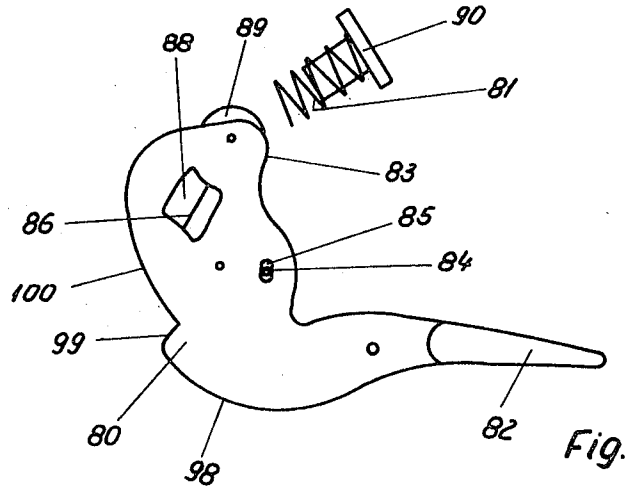

Fig. 7

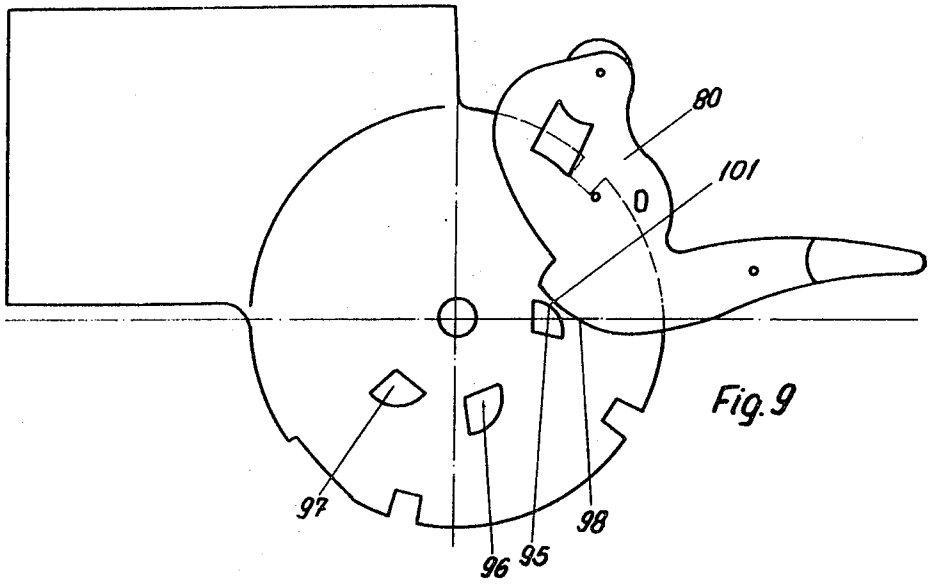

Fig. 9

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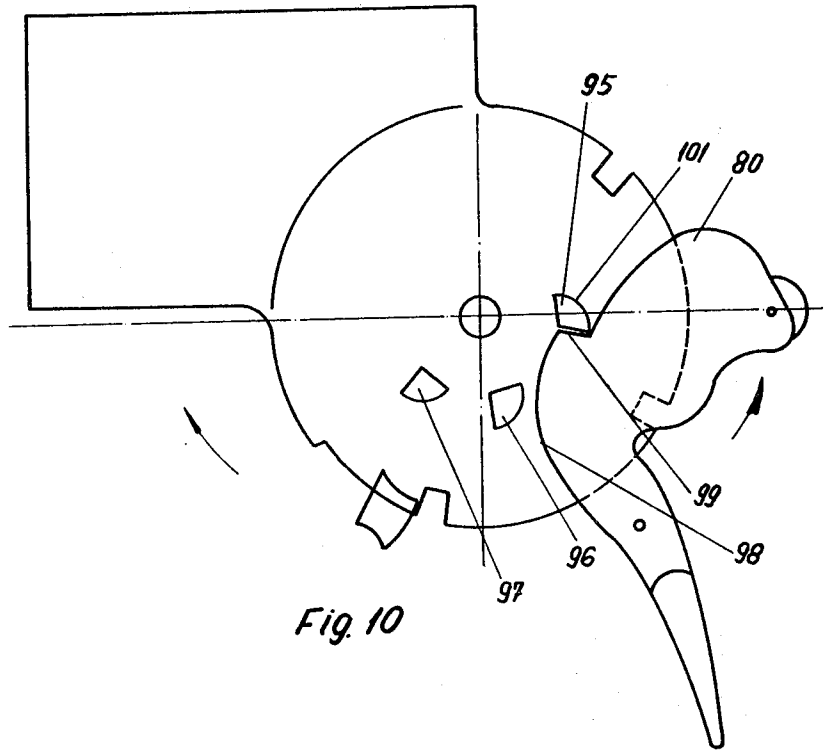

Fig. 10

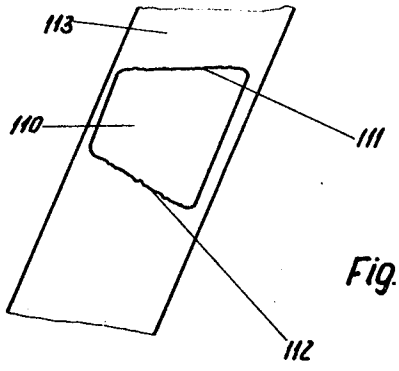

Fig. 11

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UNIVERSAL FOLDING LADDER

The present invention relates to a universal folding ladder serving for multiple use and more especially to a ladder comprising several pairs of ladder sections or beams or stringes which are interconnected by joints or fittings and which can be locked in the flat or straightly extended position and in at least one preferred service position, each of said joints connecting two ladder sections and comprising a first joint member connected to either of the said two ladder sections and having at least one circular locking disk arranged concentrically with the joints axis, with recesses provided preferably at equal distances about its periphery which are associated to the flat or straightly extended position and to the different preferred service positions, respectively, and further comprising an other joint member which is rigidly connected to the other one of the said two ladder sections and further connected with the locking disk of the said first joint member so as to be pivotable about a joint pin, a stop member being provided and guided on the said second joint member which snugly fits into the different individual recesses, respectively, when the said ladder sections are in any of the pre-determined positions and which is released from its engaged position and secured in its disengaged or unlocked position by a single releasing lever which is pivoted on the said second joint member and is to be operated from the outside and which can be pivoted to and fro at will between an engaged or locked and a disengaged or unlocked position and with the aid of which the stop member may be lifted off the recesses when in its engaged position.

According to the invention to the said releasing lever there is associated an arresting or locking device engaging with and, thus, locking, the releasing lever in its operative position and disengaging from, and releasing, the releasing lever again when the joint members perform a subsequent relative rotation.

The universal folding ladder with multiple use according to the invention, which may be employed for instance as working platform, single and double ladder and the like, offers the special advantage that the joints can be adjusted without any difficulty and with ease virtually with one hand, and that it warrants at the same time absolute service reliability. With this ladder, the joint parts can be locked — just as with ladders of the conventional type — in each of the preferred positions when the ladder is being unfolded, it being impossible to bring the joint parts into the next position unless the arresting device has been released first, while — contrary to most of the known arrangements — no locking of the ladder parts will place between the initial and the end position when folding the ladder together, so that it is not necessary to operate the releasing lever at any time during the folding process.

These and other object, features, and advantages of the present invention will become further apparent from the following detailed description thereof, particularly when the same is read with reference to the accompanying drawings.

FIG. 1 is a side elevation of a ladder joint or fitting according to the invention with the outer part of the one joint member partly removed, the joint being locked in one service position and the releasing lever being in one first position,

FIG. 2 is a side elevation of the joint or fitting according to FIG. 1 shown in the same position but with the joint unlocked and with the releasing lever in a second position allotted thereto,

FIG. 3 is a cross-section taken along the line III—III in FIG. 1,

FIG. 4 is a cross-section taken along the line IV—IV in FIG. 2,

FIG. 5 is a front elevation of a detail of another embodiment of the invention shown in an intermediate stage during the manufacture thereof,

FIG. 6 is a cross-section similar to that shown in FIG. 3 of the embodiment according to FIG. 5,

FIG. 7 is a side elevation of the releasing lever of another embodiment of the invention with the associated spring member,

FIG. 8 is a side elevation of the joint or fitting member associated with the releasing lever in its disengaged or inoperative position,

FIG. 9 is a side elevation of the joint or fitting member carrying the cams with the releasing lever in its disengaged or inoperative position,

FIG. 10 is also a side elevation of the arrangement according to FIG. 9, but with the releasing lever in its engaged or operative position, and

FIG. 11 is a diagrammatic side elevation of an embodiment of the ladder rungs to be used together with the novel joint or fitting.

The novel ladder comprises several pairs of ladder sections which are interconnected by joints or fittings **9** and which can be locked in the respective service position, each of the said fittings or joints comprising one first joint member **11** connected to one ladder stringer or beam or section **10** and comprising at least one circular locking disk **12** of cup-shaped cross-section with preferably rectangular, for instance square-shaped recesses distributed about its periphery in correspondence with or according to the different individual service positions of the ladder or, rather, ladder members. The number of such recesses may be for instance three (**13**, **14**, **15**) corresponding to a flat position, an obtuse-angled and an acute-angled position of the joint or fitting, i.e., to a service position of the ladder known as single ladder, double ladder or working platform, etc., or else there may be provided only two recesses. The locking disk **12** has a bottom surface **23** with bead-like or fin-type reinforcements forming the joint outside and a circular flange **24** forming the lateral extension of such bottom surface, with the radial recesses **13**, **14**, **15** being provided in the transition zone **25**. In order to enable the ladder to assume the above-mentioned different positions when the locking disk is provided with only two recesses, the locking disk of the middle joint **9** or fitting may have only recesses **13**, **15** spaced approximately by a central angle of 120°–140° in the direction opposite to the sense of rotation, while the locking disks of the two outer joints may have each recesses **13**, **14** spaced by approximately 60°–**80°**. Furthermore, the joint or fitting **9** comprises a second joint member **17** arranged essentially in parallel relation to the locking disk **12** and pivoted on the latter by means of a joint pin **16**, the said second joint member **17** being connected to the other ladder beam or section **18** and comprising a disk **26**, the said joint member **17** carrying a stop member **20** which snugly fits into the recesses **13**, **14** or **15** when the ladder assumes any of the individual service positions and which is loaded by a spring, for instance, a spiral spring **19** bearing with its one end against the bottom of the hole **31**. The said stop member has associated to it a releasing lever **21** pivoted on the second joint member **17** and to be operated from the outside, by means of which the stop member **20** is lifted off the recesses **13**, **14** or **15** when it is rotated in the direction indicated by the arrow **28**.

The disk **26** which rests against the circular flange **24** of the associated locking disk **12** may have the form of a single or or a double disk, its wall being provided, respectively with a guide slot **27**, **27*a*** within which the stop member **20** is held so as to be positively connected or to have a form fit in the circumferential direction and as to be slidable in the radial direction, said stop member being held between the locking disk **12** and the disk **26** of the second joint member **17**, the associated spring **19** arranged between the stop member **20** and the abutment **30**, pressing the said stop member outwardly in the radial direction and into the associated recess **13** or **13*a***, when the guide slot **27** comes into line or register with any of the recesses. In the embodiment shown in FIGS. **5** and **6**, the spring **32** surrounding the guide rod **31** is arranged not radially and concentrically, but excentrically and bears on the one hand against the stop **35** arranged essentially diametrically opposite the stop member **33** and forming essentially an integral part of the second joint part, and on the other hand indirectly against the stop member **33** over a shoe **36** fork-shaped, for in-

stance, which embraces two sides of the said stop member. Again, the spring **32** and the releasing lever **1 21** act against diametrically opposite points of the stop member **33**.

Each joint or fitting may consist of only one locking disk and only one disk of the other joint member co-operating therewith. However, the first joint member **11** may also comprise two parallel locking disks **12**, **12***a* interconnected in the form of a fork and connected to a ladder beam or section **10**, with their circular flanges **24**, **24***a* and recesses **13**, **14** and **15** arranged opposite to and in register with each other, while the second joint member **17** may comprise two circular disks **26**, **26***a* interconnected to form a drum-type box and connected to the other ladder beam or section, the said circular disks **26**, **26***a* being embraced by the locking disks **12**, **12***a* and pivoted on the latter by means of the central journal pin **16**. In this case, the drum-shaped box encases the stop member **20**, which is guided there-within to slide in the radial direction in the guide slots **27**, **27***a* of the circular disks **26**, **26***a* allotted to one another, and encases also the pivoting releasing lever **21** which consists of two symmetrical parts made essentially of spring steel which are rigidly interconnected on one side. The drum-enclosed portions of the releasing lever which bear against the stop member and which are resiliently interconnected by means of the spring **59** are provided in the region of their end zone with a journal pin **56'**, **57'** engaging a bore provided at the periphery of the associated disk of the second joint member. The movement of any drum-enclosed portion of the releasing lever **21** or the journal pin rigidly connected therewith, which movement is essentially rectangular in relation to the associated disk **26**, **26***a*, can be controlled by means of cams or recesses **60'**, **60'***a* provided in the circular flange **24**, **24***a* of the locking disk **12**, **12***a*, and acting upon the journal pins in dependence on the relative rotary movement of the two joint members. The drum-enclosed portions of the releasing lever are provided in the region of their journal pins with one recess **61'** each co-operating with an associated stop member consisting essentially of a cam **63**, **63***a* (FIGS. **1**, **2** and **4**) or a pin **64**, **64***a* (FIG. **5**) in such manner that the said stop member engages the associated recess **61'** of the releasing lever **21**, thus arresting the latter, when the releasing lever **21** is shifted in the direction indicated by the arrow **28**, while the journal pins and, accordingly, the inner portions of the releasing lever are caused by the recesses **60**, **60***a* of the locking disks to move away from the inner surfaces of the associated disk **26**, **26***a* and the recesses **61'** of the releasing lever **21** come out of engagement with the associated stop member in the case of any subsequent relative rotation of the joint in the direction indicated by the arrows **29** and **29***a*, so that the stop member **20** of the joint or fitting is released for another automatic engagement when the joint is further rotated in the direction indicated by the arrows **29**, **29***a*.

In the embodiment shown in FIGS. **7** and **8**, the releasing lever **80**, which is subjected to the action of the spring **81**, comprises two arms **82**, **83** arranged at an angle of approximately 90° to one another. It is rotatably connected at a point **84** situated approximately midway between its ends to the associated joint member, the arm **82** of the said angular lever, which constitutes the operating end thereof, taking a position approximately parallel to the longitudinal center axis of the joint member associated thereto when the angular lever is in the inoperative position, i.e., when the stop member is in the engaged or locked position. The bores **85** in the releasing lever which serve to receive the pin take the form of oblong holes arranged essentially at a right angle in relation to the longitudinal center axis of the associated joint member, so as to allow the releasing lever slight deflections or evasive motions in the radial direction during its rotating movement. The wedge-shaped stop member **86** passes through opposite recesses **88** in the releasing lever and **87** in the corresponding joint member and can be moved on the one hand along a straight line between the engaged or locked and the unlocked or disengaged position and, on the other hand, perform a relative movement in the direction of the lever movement between the stop member and the releasing lever when the latter is shifted between its two end positions. For this purpose, the recesses **87** have a length equalling essentially the sum of the height of the stop member and the path travelled by the stop member between the engaged or locked and the unlocked or disengaged position, while the recesses **88** have a width considerably greater than the width of the stop member.

The releasing lever carries at its end which faces the spring member a bearing support **89** for the spiral-type spring member, which bearing support can be rotated on the releasing lever about an axis parallel to the axis of rotation of the releasing lever and is provided with a hole whose bottom serves as an abutment for one end of the spring member, with the other end of the spring member acting against an intermediate member, which comprises a shaft guided within the spiral spring and which carries on its upper end a cross-bar **90** seated in a depression **91** provided in the wall opposite the operating end of the releasing lever and which can be pivoted about an axis approximately parallel to the axis of rotation of the releasing lever. Accordingly, the releasing lever and the spring member co-operate in the manner of a snap acting member, which means that the lever, once it is removed from its one end position and shifted beyond its dead-center position, will snap into its other end position, and vice versa.

The releasing lever can be moved only by hand into the position corresponding to the disengaged or unlocked position of the stop member, and against the action of the arresting or locking device. For shifting the lever into its disengaged or unlocked position corresponding to the engaged or locked position of the stop member, cams **95**, **96**, **97** are provided which are formed by projections on that side of the locking disk which faces the lever, each of said cams being associated to one of the stop notches. The said cams co-operate with a counterface **98** provided on that side of the releasing lever which faces away from the joint member, the shape and arrangement of the said cams being such that they will come into effect only when the ladder members are being unfolded, while they will remain ineffective during the folding process. When viewed from above or from the side, the cams have the shape of a quadrant with its arc **101** directed to the periphery of the disk. The cams may also be part of one cam plate. The counterface of the releasing lever, which co-operate with the cams **95**, **96**, **97**, is provided at about the center of its length with a tooth-shaped projection directed towards the cams and having, when viewed from the operating end towards the other end — one flank **98** uniformly and slightly curved right to the tooth tip and one flank **99** dropping abruptly from the tooth tip to the basis of the releasing lever, with the portion adjacent the spring member ending in a flat curve **100**. When the ladder members are folded, the releasing lever is not actuated by the cams, because when the associated right joint member is pivoted in the clockwise direction and the other joint member is pivoted in the counterclockwise direction — always viewed in the same direction as when regarding the drawings — the curved portion **98** of the releasing lever will travel along the arc-shaped portion **101** of the periphery of the cam. However, when unfolding the ladder into the flat or any of the preferred positions, the releasing lever is each time operated by the cam corresponding to the position in question in order to release the stop for engagement with the recess. If, thereafter, the ladder members are to be further unfolded beyond the already reached position in which the joint members are locked, the releasing lever must first be operated by hand and returned into its operative position in which in retains the stop member in its disengaged or unlocked position. FIGS. **9** and **10** show how the releasing member and the cams of the other joint part co-operate during the two movements described above.

In order to obtain the largest possible tread width without sensible increases of the ladder weight and the dimensions of the ladder beams or sections, one may — in accordance with a further development of the invention and with FIGS. **11** — give the rungs the cross-section of a polygon, for instance a trapezoid or, preferably equalsided, triangle with two sides

inclined in relation to each other, one **111** of which corresponding the respective tread surface and the other **112** corresponding to the opposite surface, the arrangement of the rungs in relation to the beams or sections **113** being such that the conveniently corrugated tread surface, which is comprised within one horizontal or essentially horizontal plane, forms a certain angle with the longitudinal edges of the mating beam or section and extends preferably over the entire width of the beam or section. In this manner, one obtains a horizontal tread surface even when the stringers or stringer parts are inclined, and due to the typical shape any desired surface may be used as tread surface.

Although our invention has been illustrated and described with reference to the preferred embodiments thereof, we wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed our invention, what we claim is:

1. A universal folding ladder comprising several pairs of ladder sections which are interconnected by joints and which can be locked in the straightly extended position and in at least one service position, each of said joints connecting two ladder sections and comprising a first joint member connected to either of the said two ladder sections and having at least one circular locking disk arranged concentrically with the joint axis, with recesses provided about its periphery which are associated to the straightly extended position and to different service positions, respectively, and further comprising another joint member which is rigidly connected to the other one of the said two ladder sections and further connected with the locking disk of the said first joint member so as to be pivotable about a joint pin, a stop member provided and guided on the said second joint member which snugly fits into the different individual recesses, respectively, when the said ladder sections are in any of the pre-determined positions and which is released from its engaged position and secured in its disengaged position by a single releasing lever which is pivoted on the said second joint member and is to be operated from the outside and which can be pivoted to and fro at will between an engaged position and a disengaged position and with the aid of which the stop may be lifted off the recesses when in its engaged position, wherein to the said releasing lever there is associated an arresting device engaging with, and locking, the releasing lever in its operative position during movement of the sections with respect to each other in one direction and disengaging from, and releasing, the releasing lever again when the joint members reach the end of such movement.

2. The universal folding ladder set forth in claim **1**, wherein the said arresting device retains the said releasing lever both in its operative and in its inoperative position, wherein, further, the releasing lever can be transferred into its operative position corresponding to the disengaged position of the stop member against the action of the arresting device only by hand and into its inoperative position corresponding to the engaged position of the stop member against the action of the arresting device only by cooperating with one of the cams associated with the different individual positions of the ladder sections, and wherein, further, the shape and arrangement of the cams and their coordination with the releasing lever are such that they will become effective only when the ladder sections are being unfolded while remaining ineffective when the ladder sections are being folded together.

3. The universal folding ladder set forth in claim **1**, wherein to the said releasing lever having the form of an angular lever there is associated a spring member which is movably connected with the said releasing lever and which retains and locks it both in its operative and in its inoperative position, the said spring member acting in the manner of a snap acting means so that the lever, once it has been removed from one end position and pivoted beyond its dead-center position, will snap into its other end position, and vice versa.

4. The universal folding ladder set forth in claim **3**, wherein the one end of the said releasing lever is the operating end and the other end thereof is loaded by the spring member, wherein, further, the releasing lever is movably supported in about the middle area between its ends by means of pins and oblong holes and wherein, finally, the counterface of the said releasing lever cooperating with the cams is provided on the lever side opposite the joint member.

5. The universal folding ladder set forth in claim **1**, wherein to the said recesses in the said locking disk there are associated guide slots provided in another disk connected coaxially to the said other joint member which hold and guide the stop member, the said stop member engaging the recesses in the radial direction from the periphery towards the center of the disk when the stop member is in its engaged position.

6. The universal folding ladder set forth in claim **1**, wherein the stop member passes through opposing recesses provided, on the one hand, in the releasing lever between the latter's support portion and the end associated with the spring member and, on the other hand, in the associated joint member, in such a manner that the stop member may be movable on the one hand along a straight line between its engaged position and its disengaged position and, may, on the other hand, perform a relative movement between the stop member and the releasing lever when the latter is pivoted, this being done by making the recesses in the associated joint member to have the form of oblong holes the length of which corresponds approximately to the height of the stop member plus the path travelled by the stop member between the engaged and the disengaged position, while the recesses in the releasing lever have the shape of rectangular holes with a width considerably greater than the width of the stop member.

7. The universal folding ladder set forth in claim **1**, wherein cams, which are provided at approximately equal intervals along the circumference consist each of a projection provided on that side of the locking disk carrying the recesses which faces the releasing lever, the said projections having when viewed from above, the form of a quadrant with the arc facing the periphery of the locking disk, while one of the two straight boundary lines are directed radially to the center of the locking disk and the other one of the straight boundary lines on the corresponding point extends parallely to the tangent to the circumference of the locking disk, the counterface of the releasing lever cooperating with the cams being, when viewed from the operating end, curved towards the cams and interrupted at about the middle of its length by a step facing the other side and ending towards the spring member in a flat curve.

8. The universal folding ladder set forth in claim **1**, wherein a spring acting on the stop member is arranged excentrically and bears on the one hand against an abutment arranged approximately diametrically opposite the said stop member and forming an integral part with the said second joint member, and on the other hand in directly against the side of the stop member facing away from the releasing lever.

9. The universal folding ladder set forth in claim **8**, wherein the releasing lever comprises two portions which can be flexibly moved towards and away from each other, while maintaining the rotatable support provided by the journal pin mounted to each of the portions, the said two portions of the said releasing lever having one recess each essentially in the region of the journal pin, the said recess cooperating with an associated stop member provided on the inner surface of the associated circular disk, such cooperation taking place in such a manner that rotating of the releasing lever and displacing of the stop member into the or disengaged position, when the stop member of the joint is engaged in any of the service positions, will cause the stop member of each circular disk to engage into the associated recess in the releasing lever and thereby arrest and lock the latter in this position, while in the case of any subsequent relative movement of the joint the journal pins will be moved away from the inner surface of the associated circular disk, through the recesses provided in the locking disk, so that the recess of the releasing lever will disengage from the associated stop member in a direction rectangu-

lar to the circular disk, thus releasing the stop member of the joint for another automatic engagement or locking movement when the joint is rotated into another service position.

10. The universal folding ladder set forth in claim 1, wherein the cross-section of the rungs has the shape of a polygon with two sides inclined in relation to each other, one of them corresponding to the opposite surface and wherein, further, the arrangement of the rungs in relation to the ladder beams is such that the tread surface, which is comprised in an approximately horizontal plane and which extends over substantially the whole stringer width, is inclined in relation to the longitudinal edges of the respective stringer.

* * * * *