

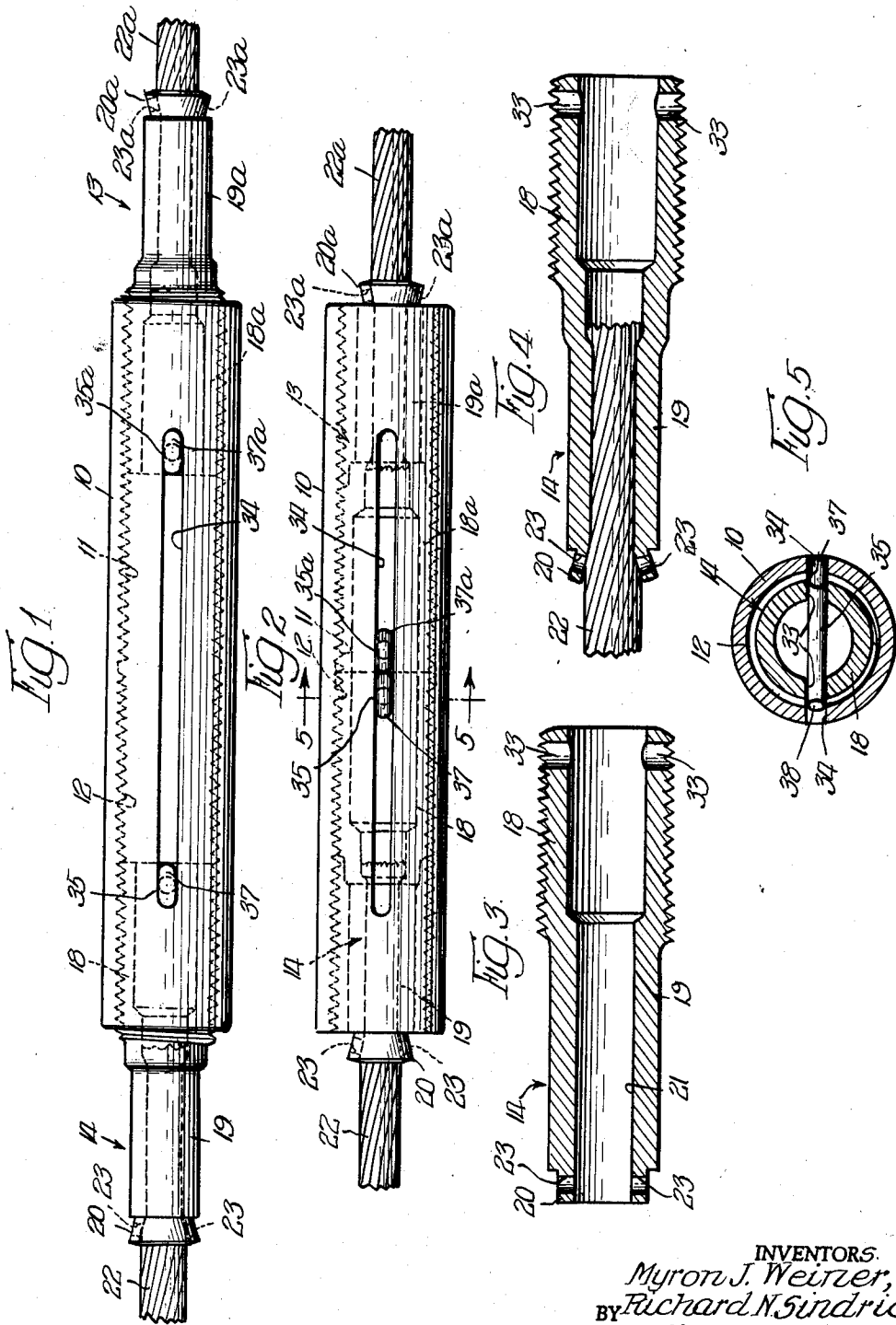
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M. J. WEINER ETAL
TURNBUCKLE

3,081,116

Filed April 11, 1960

2 Sheets-Sheet 1



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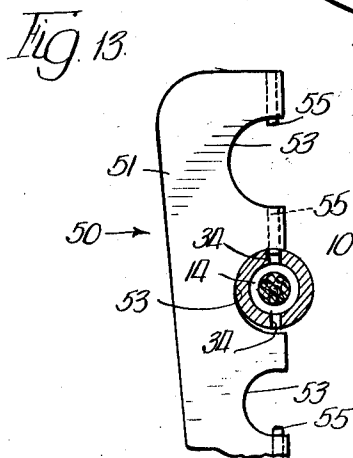
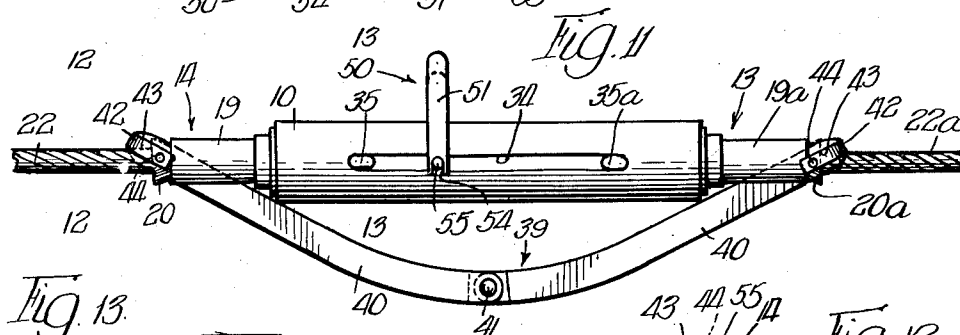
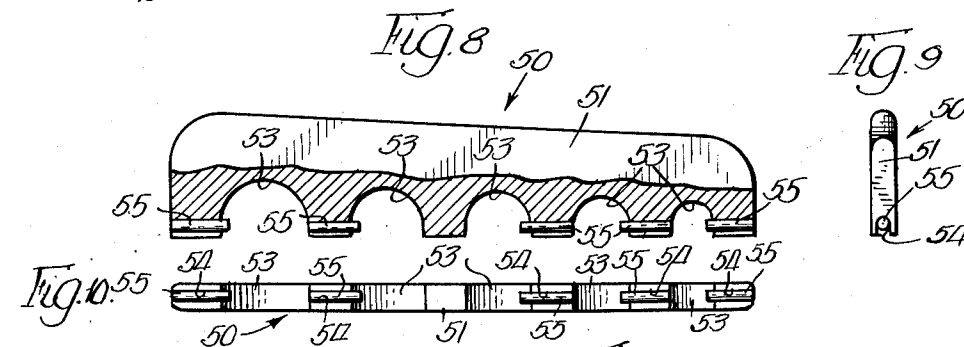
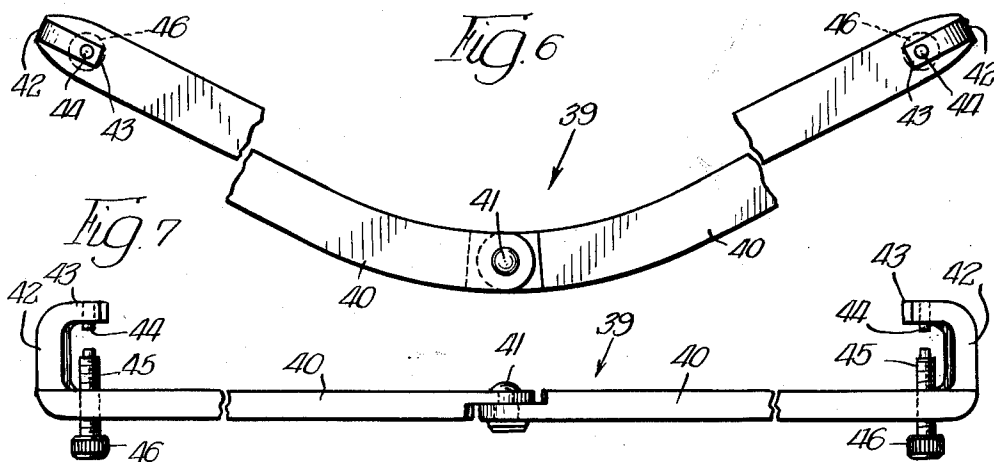
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TURNBUCKLE

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4 Claims. (Cl. 287—60)

This invention relates to turnbuckles and particularly to turnbuckles adapted for use in the structure of airplanes and similar uses where lightness in weight, compactness, strength efficiency and positive locking against any relative movement, are important requirements.

It is the general object of this invention to provide a new and improved turnbuckle particularly adapted for use in installations, e.g. airplane control cables, requiring a turnbuckle which is lightweight, has high strength to weight and bulk efficiency, has a minimum over-all length when in a "closed" condition, and may be positively locked in an adjusted position.

Another object of the invention is to provide a new and improved turnbuckle having a hollow or tubular barrel portion the ends of which are internally threaded in opposite directions, and a tubular terminal member for each end of the barrel with each terminal member having an exteriorly threaded end portion, an integral, intermediate portion adapted to be swaged onto the end of a cable disposed therein, and an integral, relatively short, wrench engageable end portion.

Another object of the invention is to provide a new and improved turnbuckle of the character described wherein the intermediate, swaged portion of each terminal member has a lesser outside diameter than the minor diameter of the threaded end portion so that when the turnbuckle is in a fully "closed" condition the threaded end portions of the two terminal members will abut each other adjacent the center of the barrel and the swaged portions are drawn wholly within the barrel, exposing only the relatively short, wrench engageable end portions, thereby limiting the overall length of the device.

Still another object of the invention is to provide a new and improved turnbuckle of the character described wherein the cable extends through only the wrench engageable end portion and the intermediate swaging portion of the terminals, the extra weight of a length of cable within the threaded end portion being neither required nor desired, thus providing a light terminal member.

Another object of the invention is to provide a new and improved turnbuckle of the character described wherein the tubular terminal member swaged onto the end of a cable can easily be visually inspected to see that the cable has been correctly located and swaged in place by looking into the open threaded end of the terminal member and noting if the individual wires in the cable are flared out to verify that the cable has passed fully through the swaged portion and the swaging operation has been properly performed.

Another object of the invention is to provide a new and improved turnbuckle of the character described wherein the wrench engageable end portion is provided with a lesser outside diameter than the intermediate portion so that as a result of the intermediate portion being swaged onto the cable, the wrench engageable end portion will flare out radially, thus providing a gradual relief of the clamping stresses present in the cable at the end of the swaged portion and also providing an inclined seat for a spanner or other type wrench.

Another object of this invention is to provide a new and improved turnbuckle of the character described having means for positively locking the terminal members against rotation relative to the barrel from an adjusted position and wherein there is no protrusion of any part

2

of the locking mechanism beyond the outer surface of the barrel when the device is in a locked condition.

A more detailed object of the invention is to provide a turnbuckle of the character described wherein the locking means includes a radial bore formed in the threaded end portion of each terminal member, a pair of elongated, diametrically opposite slots formed in the barrel, and a locking member, such as a cotter pin, adapted to be passed therethrough with the ends of the locking member being disposed wholly within the slots in the barrel so as not to protrude beyond the outer surface of the barrel when assembled, the slots being substantially the same width as the locking member so as to prevent any "play" therebetween.

Still another object of this invention is to provide a new and improved turnbuckle of the character described wherein the locking means is so arranged or proportioned that the turnbuckle may not be locked unless substantially all of the threads of the threaded end portions of the terminal members are engaged with the corresponding threads in the barrel so as to utilize the full strength of the device.

Another object of the invention is to provide in combination a new and improved turnbuckle and operating wrenches therefor having relatively few components which are economical and easy to make on high speed machines from standard stock and materials and which are very readily assemblable.

It is a further object of the invention to provide in combination a new and improved turnbuckle of the character described, a novel form of a freely expansible terminal wrench having a pair of end portions adjustably engageable with the wrench engageable end portions of the terminal members, and a novel form of a spanner engageable with one of the elongated slots formed in the barrel, the terminal wrench and the spanner permitting convenient adjustment of the turnbuckle.

Certain other objects of the invention will, in part, be obvious, and will in part appear hereinafter. For a more complete understanding of the nature and scope of the invention reference may now be had to the accompanying drawings wherein:

FIG. 1 is a side elevational view of a preferred embodiment of the invention locked in the "open" condition;

FIG. 2 is a side elevational view of the embodiment shown in FIG. 1, but locked in a "closed" condition;

FIG. 3 is an enlarged longitudinal sectional view of one of the terminal members shown in FIGS. 1 and 2 before the end of a cable has been clamped therein;

FIG. 4 is an enlarged longitudinal sectional view of the terminal member shown in FIG. 3 after the end of a cable has been inserted therein and the intermediate portion of the terminal member has been swaged to securely clamp the end of the cable therein;

FIG. 5 is an enlarged sectional view taken on line 5—5 of FIG. 2 and showing the means for locking the turnbuckle in an adjusted position;

FIG. 6 is a broken top plan view of a terminal wrench especially adapted to be used in adjusting the turnbuckle, the wrench being shown in an expanded condition;

FIG. 7 is a broken front elevational view of the wrench tool shown in FIG. 6;

FIG. 8 is a partially sectioned, side elevational view of a barrel spanner especially adapted to be used in combination with the terminal wrench of FIGS. 6 and 7 in adjusting the turnbuckle;

FIG. 9 is a right end elevational view of the spanner shown in FIG. 8;

FIG. 10 is a bottom plan view of the spanner shown in FIG. 8;

FIG. 11 is a reduced in size view of the turnbuckle shown in FIG. 1 with the terminal wrench of FIGS. 6

and 7 and the spanner of FIGS. 8, 9 and 10 in operable engagement with the turnbuckle, as during adjustment thereof;

FIG. 12 is a vertical sectional view taken generally on the line 12—12 of FIG. 11; and

FIG. 13 is a vertical sectional view taken generally on the line 13—13 of FIG. 11 with the lower portion of the spanner broken away.

As shown in FIG. 1 the turnbuckle includes an elongated hollow member or barrel 10 internally threaded at opposite ends with right and left-hand threads 11 and 12, respectively, for receiving the correspondingly threaded terminal members 13 and 14, each of which has a length equal approximately to one-half the length of the barrel 10.

The terminal members 13 and 14 are identical except that the terminal member 13 is provided with a right-hand thread while the terminal member 14 is provided with a left-hand thread so that the two terminal members may be received within the right and left-hand ends of the barrel 10, respectively. Inasmuch as the two terminal members 13 and 14 are substantially identical, only the terminal member 14 will be described in detail, as best shown in FIGS. 3 and 4. Corresponding elements of the terminal member 13 will be identified by the same reference numbers with the suffix "a."

The terminal member 14 has three integral portions including an exteriorly threaded end portion 18 extending for approximately half the length of the terminal member, an intermediate swageable portion 19 having a length approximately equal to the length of the threaded end portion 18 and having an outer diameter which is less than the minor diameter of the threaded portion 18 for purposes that will be evident hereinafter, and a relatively short end wrenching portion 20 having an outer diameter which is less than the outer diameter of the intermediate portion 19. The end portions 20 and 20a may be radially drilled to provide bores 23 and 23a engageable by a wrench, to be fully described hereinafter, thus allowing the barrel 10 to be rotated by means of a spanner, also to be fully described, while the two terminal members 13 and 14 are held against rotation.

The bore 21 of the intermediate portion 19 of the tubular terminal member 14 is formed so as to have a diameter appropriate for the size of a cable 22 intended to be clamped or secured within the terminal member 14 by a swaging operation. After the end of the cable 22 has been inserted through the wrench engageable end portion 20 and into the intermediate portion 19 of the terminal member 14, the greater portion of the length of the intermediate portion 19 of the terminal member 14 is reduced in diameter, as by swaging, so as to securely clamp or anchor the end of the cable 22 therein. As shown in FIG. 4, the end of the cable 22 should extend slightly farther toward the threaded end 18 of the terminal member 14 than does the swaging of the intermediate portion 19 so that the ends of the individual wires of the cable 22 flare outwardly to permit visual inspection that the cable 22 is properly clamped within the terminal member 14.

The terminal construction disclosed herein provides a terminal member which is lightweight inasmuch as the cable does not extend the whole length of the terminal member, the extra weight of a length of cable within the threaded end portion being neither required nor desirable. Additionally, the structure disclosed herein provides a terminal member which can easily be visually inspected to see that the cable 22 has been correctly located and secured in place. This inspection can be accomplished by simply examining the exterior of the terminal member 14 and noting if the decrease in outside diameter due to swaging has proceeded for a sufficient length of the intermediate portion and by looking into the open threaded end of the terminal member 14 and noting if the individual wires in the cable end have flared

out to verify that the cable 22 has passed completely through the swaged portion.

As a result of the swaging operation, the reduced diameter end portion 20 tends to flare radially outward, as best shown in FIG. 4, thus providing a gradual relief of the clamping stresses present in the cable at the end of the swaged portion and also providing an inwardly inclined and more stable seat for a spanner or other type wrench.

Another important feature of the turnbuckle disclosed herein is the fact that it may be positively locked in a desired adjusted position. To provide such locking means, a radial bore 33 is formed adjacent the threaded end 18 of each terminal member and a pair of diametrically opposite, elongated slots 34 are formed in the barrel 10. When the barrel 10 and the terminal members 13 and 14 are adjusted in a desired position, a locking member, such as a cotter pin 35, is passed through the slots 34 in the barrel 10 and the bores 33 in the terminal members to positively lock the barrel 10 and the terminal members 13 and 14 against relative rotation. It is important that the slots 34 and the radial bores 33 be formed of a size or width just sufficient to accommodate the cotter pins 35 so that there will be substantially no "play" between the barrel 10 and the terminal members 13 and 14 when in a locked condition. As best shown in FIG. 5, the head or eye 37 of each cotter pin 35 is adapted to be disposed wholly within one of the slots 34 with split ends 38 thereof being wholly disposed within the opposite slot 34. Thus, when the turnbuckle has been positively and properly locked, there is no protrusion of any part of the locking member and no possibility of the locking member being weakened by contact with any part of the structure with which the turnbuckle is to be used or to become entangled therewith. Although cotter pins have been shown and described as a preferred locking member for the turnbuckle disclosed herein, it is obvious that other similar locking members could be utilized providing that the extremities thereof would be completely disposed within the slots 34 so that there would be no protrusion of any portion of the locking members beyond the outer surface of the barrel 10.

As shown in FIG. 1, the slots 34 terminate substantially short of the ends of the barrel 10, the distance being such as to require that the turnbuckle may not be locked unless substantially all of the threads on the terminal members 13 and 14 are cooperating or in engagement with corresponding threads in the barrel 10 so as to utilize the full strength of the device. That is, the threaded end portions 18 of the terminals must be screwed into the barrel 10 far enough to bring the holes 33 into register with the opposite ends of the slots 34 before the cotter pins 35 can be inserted.

After the terminal members 13 and 14 have been properly swaged on the ends of the desired cables 22 and 22a, the terminals 13 and 14 are initially assembled with the barrel 10 manually, as by screwing each terminal member a short distance into the proper end of the barrel. For most adjustments of the turnbuckle disclosed herein, when installed or in use, it will be necessary to utilize especially adapted tools to prevent relative rotation between the barrel 10 and the terminal members 13 and 14.

A novel form of terminal wrench 39 which is particularly well suited to be used with the turnbuckle disclosed herein is shown in FIGS. 6 and 7. The terminal wrench 39 comprises a pair of elongated, curved arm members 40 having interfitting end portions pivotally connected together by means of a bearing rivet 41. The free end of each of the arms 40 is provided with a reversely bent portion 42 which terminates in an end portion 43 overlying and extending generally parallel to the main body portion of the arm 40. A terminal engaging pin 44 is secured in each of the end portions 43 and extends toward the main body portion of the arm 40 in endwise alignment with a threaded terminal engaging pin 45 which ex-

5

tends through the main body portion of the arm 40. The pins 45 are provided with knurled head portions 46 so that they may be adjusted toward or away from the fixedly mounted pins 44. Each pair of pins 44 and 45 are adapted to be engageable in the diametrically opposed bores 23 formed in the wrench engageable portion 20 of each of the terminal members, as best shown in FIGS. 11 and 12. With the wrench 39 in engagement with the two terminal members 13 and 14, the turnbuckle may be adjusted to tighten or loosen the cable 22 by either rotating the end terminals by means of the wrench 39 while the barrel 10 is held against rotation or by holding the wrench 39 in one position while the barrel itself is rotated. The pivot connection at 41 permits continued engagement between the wrench 39 and the end terminals during adjustment of the turnbuckle between fully "closed" and maximum "open" positions.

To provide means for properly gripping the barrel 10 of the turnbuckle during adjustment thereof, a novel form of barrel spanner 50, shown in FIGS. 8, 9 and 10, is provided. The spanner 50 is formed with a relatively thin, rectangular body portion 51. Along one of the straight, longer edges of the body portion 51 are formed a series of semicircular recesses 53 of varying sizes and in spaced relation to each other. The particular spanner 50 shown in the drawings is provided with five recesses, the sizes of which correspond to the standard sizes of five cylindrical barrels that may be utilized in fabricating a turnbuckle of the character described herein. The straight edge portions of the "scalloped" edge of the spanner 50, intermediate the recesses 53, are provided with longitudinally extending slots or grooves 54 into each of which is secured, as by silver solder, a barrel slot engaging pin 55. One end of each of the pins 55 projects a short distance into the adjacent one of the recesses 53; at one end of the semi-circle thereof, so that said projecting end of the pin 55 may be engaged in one of the elongated slots 34 formed in the barrel 10 with approximately one-half of the cylindrical barrel fitting into the appropriate recess, as best shown in FIGS. 11 and 13, so as to provide an effective grip on the barrel.

In using the turnbuckle, the wrench tool 39, and the spanner tool 50 in combination, the terminal wrench 39 is engaged with the bores 23 formed in the wrench engageable portions 20 of the terminal members 13 and 14 and the spanner 50 is engaged with the barrel 10 as described herein after which either one of the tools is held in a stationary position while the other tool is rotated relative thereto to move the terminal members either toward or away from a fully "closed" position to respectively tighten or loosen the cable 22.

With the turnbuckle structure disclosed herein, wherein the intermediate portion 19 of each terminal member is formed so as to have a lesser diameter than the minor diameter of the threaded-end portion, it is seen that the barrel 10 may be rotated to draw the terminal members 13 and 14 substantially completely within the barrel 10 until the two threaded-end portions 18 and 18a of the terminal members 13 and 14 abut each other adjacent the center of the barrel 10. As shown in FIG. 2, with the turnbuckle in this fully "closed" condition only the relatively short wrenching end portions 20 and 20a extend beyond the ends of the barrel 10, thus substantially limiting the over-all length of the turnbuckle to that of the barrel 10.

The turnbuckle disclosed herein is particularly well adapted for use in connection with control cables for aircraft inasmuch as the turnbuckle while relatively strong is light in weight due to its generally tubular structure, has a minimum overall length, and may be positively locked in an adjusted position by a very simple locking mechanism which does not protrude from the turnbuckle barrel. Additionally, with the terminal-member structure disclosed herein, it is very simple to visually inspect the terminal members to insure proper clamping of a cable therein.

6

The relatively few components making up the turnbuckle disclosed herein are economical and easy to fabricate. The barrel 10 may be formed from tubular stock which is then appropriately internally threaded and slotted. The terminal members 13 and 14 may also be formed from tubular stock having an inner diameter appropriate for the diameter of the cable 22 onto which the terminal members are to be clamped. High speed machines may be utilized to form the wrench engageable ends, the swageable intermediate portions, and the appropriate, externally threaded and radially bored ends of the terminal members. Likewise, the terminal wrench and the barrel spanner are economical and easy to fabricate.

It will be understood that certain changes may be made in the construction or arrangement of the turnbuckle and wrench and spanner therefor disclosed herein without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. In a turnbuckle comprising, a barrel having a through bore the opposite ends of which are internally threaded in opposite directions inwardly to the longitudinal center of said barrel, and a terminal member for each end of said barrel, the improvement which comprises each terminal member being tubular with a continuous peripheral wall structure and approximately equal in length to one-half the length of said barrel, each of said tubular terminal members being characterized by an externally threaded inner end portion adjustably threaded in one end of said barrel and an adjacent, integral, non-threaded portion of lesser diameter than said threaded end portion swaged onto one end of a cable inserted through the outer end of said terminal member whereby said one end of said cable is securely clamped in the terminal member, said swaging terminating short of said externally threaded inner end portion of said tubular terminal member with said inner end thereof remaining open and short of the inserted inner end of the cable so that the inner ends of the individual elements making up the cable tend to flare outwardly with said tubular terminal member permitting visual inspection through the open inner end thereof for ascertaining whether or not the cable is properly clamped within said non-threaded portion as indicated by the flaring out of the ends of the individual elements making up the cable.

2. In a turnbuckle comprising, a barrel having a through bore the ends of which are internally threaded in opposite directions inwardly to the longitudinal center of the barrel, and a terminal member for each end of said barrel, the improvement which comprises each terminal member being tubular with a continuous peripheral wall structure and approximately equal in length to one-half the length of the barrel, each of said terminal members being provided with an externally threaded inner end portion adjustably threaded in one end of said barrel and an adjacent, integral, non-threaded portion of lesser diameter than said threaded end portion swaged onto one end of a cable inserted through the outer end of said tubular member whereby said one end of said cable is securely clamped in the terminal member, means defining a pair of elongated diametrically opposite slots in said barrel, means defining a radial through bore in the threaded end portion of each of said terminal members, said slots and said bores being arranged and positioned to permit initial registration therebetween only after substantially all of the threads on the terminal members have been engaged with the threads formed in the barrel whereby to permit positive locking of the turnbuckle in an adjusted condition only under maximum strength conditions, and a releasable locking member adapted to be inserted through the registered slots and bores for positively locking the barrel and each terminal member against relative rotation therebetween, said locking members having a width such that they are just accommodated by the width of the slots so as to prevent "play" therebetween with the op-

posite ends of the locking members being positionable wholly within said slots when in a locked condition so that there is no protrusion of the ends of said locking members externally of the barrel of the turnbuckle.

3. In a turnbuckle comprising, a barrel having a through bore one end of which is provided with an internal right-hand thread and the other end of which is provided with an internal left-hand thread, said right-hand and left-hand threads each extending inwardly to the longitudinal center of said barrel, a pair of tubular terminal members for said barrel each of which has a continuous peripheral wall structure and a length approximately equal to one-half the length of said barrel, each terminal member being characterized by an externally threaded inner end portion, one having a right-hand thread and the other having a left-hand thread, adapted to be adjustably received one in each end of said barrel, by an intermediate portion swaged upon the end of a cable disposed therein and having a lesser outer diameter than the minor diameter of said threaded end portion, and by a relatively short radially flared outer end portion adjacent said swaged portion for providing gradual relief of the clamping stresses on the cable, said tubular terminal members permitting visual inspection through the open inner ends thereof for ascertaining whether or not the cable is properly clamped within said intermediate swaged portion, means defining a transversely extending bore in the threaded end of each terminal member, and means defining a pair of diametrically opposed elongated slots formed in said barrel of a width just sufficient to accommodate a cotter pin, said bore means and said slot means permitting positive locking of said terminal members against rotation relative to said barrel, when adjusted as desired, by passing cotter pins therethrough with the heads of said pins being receivable wholly within one of said slots and the split ends of said pins being receivable wholly within the other slot, said slots terminating a sufficient distance from the opposite ends of said barrel to permit positive locking of said terminal members only when said threaded inner ends of said terminal members

are fully engaged with the threads of said barrel, the turnbuckle having a minimum over-all length when fully "closed" equal approximately to the length of said barrel inasmuch as said lesser outer diameter of said intermediate portions of said terminal members permits said portions to be fully drawn within said barrel with said threaded end portions abutting each other when the turnbuckle is fully "closed."

4. A cable terminal for use with a turnbuckle or the like comprising, a tubular member having a main body portion of substantial length with a bore substantially the same diameter as a cable inserted therein, and a relatively short reduced-outer-diameter end portion at the cable end of the terminal defining a right angular shoulder spaced a relatively short distance from the cable end of the terminal, the major length of said main body portion adjacent to and inwardly of said right angular shoulder being swaged upon the end of a cable inserted therein to securely clamp the cable therein, said swaging terminating short of the inner end of said cable whereby said inner cable end flares outwardly and said swaging causing said reduced-outer-diameter end portion of the terminal to flare radially outwardly so as to provide gradual relief of the clamping stresses on the cable at that point.

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