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BAND CLAMP WITH SELECTIVE GIRTH ADJUSTMENT MEANS

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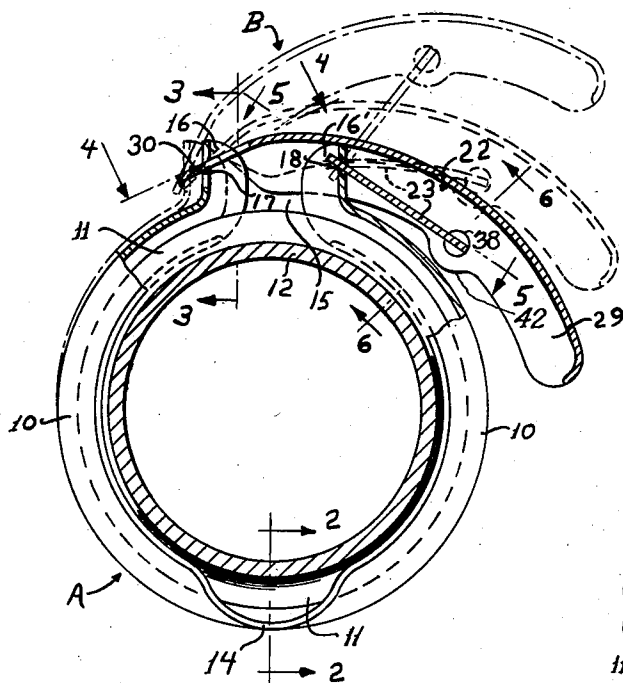


Fig. 1

Fig. 2

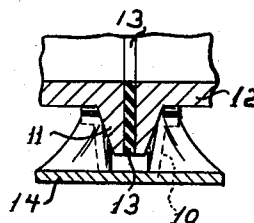


Fig. 3

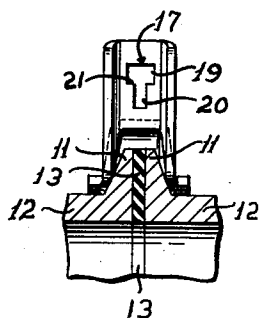


Fig. 4

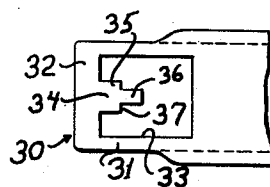


Fig. 6

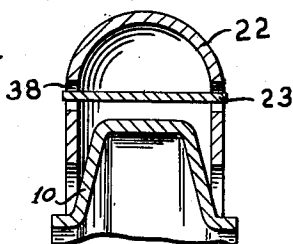
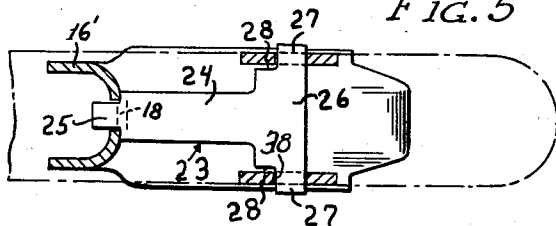


Fig. 5



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## BAND CLAMP WITH SELECTIVE GIRTH ADJUSTMENT MEANS

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This invention relates to band clamps of the type wherein a flexible clamping band, adapted to encircle an object for applying constricting pressure thereto or to encircle a pair of objects for attaching them together, has free end terminal portions joined by take-up connector mechanism that is adapted to draw the band tightly around the encircled object. The present invention is directed particularly to the take-up connector mechanism and has as its general object to provide an improved take-up mechanism of the toggle lever type.

Connectors utilizing the toggle lever with over-center action together with toggle linkage connecting the terminals of a band clamp, have been utilized and proposed in many different forms. The toggle type connectors have the particular advantage of being rapidly operable to draw the terminals of the band toward one another; in fact, the toggle connector has as its basic concept substantially instantaneous take-up operation. However, toggle connectors by their nature embody problems of manufacture and designing that are more difficult than the more common screw bolt take-up connector such as for example the conventional T-bolt, trunnion and nut construction. One of the objects of the present invention is to provide a band clamp embodying a toggle connector which is of relatively simple and inexpensive construction, such as can be fabricated by simple sheet metal stamping operation, and yet which is adequately strong, rugged and durable to withstand the rigors of usage to which a band clamp that is to be frequently coupled and uncoupled (the type of use for which a toggle type connector is especially directed) is commonly subjected.

In attaining this simplicity of construction, the invention utilizes as one of its features, a one-piece clamping band having adequate resiliency to open up the gap between its terminals to a sufficient extent to pass the band over the object to be encircled, and having integral terminals to which the constricting pressure of the toggle mechanism is applied. More particularly, the invention contemplates a band clamp that may embody a V-channel section throughout most of its circumference, for drawing together the terminal flanges of cylindrical objects such as tube sections or abutting shafts, and at the same time having an integral hinge portion diametrically opposed to the gap between its terminals. In such a clamp, wherein the respective channel portions of the band are relatively rigid and the resiliency is largely confined to the hinge portion, the problem of spreading the terminals of the band sufficiently to pass the object to be encircled, is magnified. To facilitate the handling of the band during this spreading operation, the invention has as a further object to provide a band clamp having a toggle connector mechanism that can readily be completely detached from the band terminals and as easily re-applied thereto after the band has been brought into encircling relation to the object to be clamped.

Another inherent problem in a toggle type connector, is an inherent lack of adaptation to adjustment for various

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extents of take-up action. It has previously been proposed to meet this problem by including in the toggle linkage an adjustable element having a threaded connection to one of the toggle parts. However, the use of a threading action for adjustment tends to revert the toggle mechanism back to the screw bolt type of take-up mechanism with its time consuming operation of rotating a screw for adjustment. Furthermore, the screw parts complicate construction and add to expense.

Consistent with the general object of attaining maximum simplicity and cheapness, the invention contemplates a toggle connector mechanism having means providing satisfactory range of take-up action without resorting to screw adjustment parts. More specifically, the invention contemplates an arrangement wherein some adjustment is attained by a spring action in the linkage, and the range of adjustment thus obtained is multiplied by means providing a step adjustment of substantial amplitude at another point in the linkage.

A common feature of a toggle connector is its utilization of an over-center action for locking it against opening up under the effect of vibrations or other conditions of operation. As the toggle linkage moves past "dead center" any further movement commences to relax the linkage and to loosen the clamp. It is therefore essential that stop means be provided for arresting the lever movement at a point just sufficiently past dead center to establish an adequate locking condition. One of the objects of the invention is to provide a simple arrangement providing a stop for arresting the toggle movement at the proper point.

One of the important objects of the invention, and a prime reason for obtaining maximum simplicity of construction, is to provide a band clamp of highly sanitary character. This involves attaining a construction wherein sharp corners and inaccessible recesses are avoided and wherein the parts can be separated for cleansing operation. Such band clamp is especially desirable in coupling and uncoupling the sections of tubing used in conveying milk, in the dairy industry, and is required to be uncoupled for cleansing of both the tubing and the clamp mechanism, at the end of each recurring period of operation of the milk processing apparatus.

Other objects will become apparent in the ensuing specifications and appended drawing in which:

Fig. 1 is a transverse sectional view through a line of tubing embodying end-abutted sections connected by a band clamp embodying my invention, a portion of the clamp being broken away and shown in section, and the remainder shown in end elevation;

Fig. 2 is a detail sectional view of such assembly taken through the hinge portion of the clamp as indicated by line 2-2 of Fig. 1;

Fig. 3 is a detail sectional view of the assembly taken through the connector portion of the clamp as indicated by line 3-3 of Fig. 1;

Fig. 4 is a detail sectional view of the connector mechanism taken on the line 4-4 of Fig. 1; and

Figs. 5 and 6 are detail sectional views of the connector mechanism taken respectively on the line 5-5 of Fig. 1 and on the line 6-6 of Fig. 1.

Referring now to the drawing in detail, I have shown as an example of one form in which the invention may be embodied, a band clamp utilizing a clamping band of the V-band type, wherein segments 10 of V-channel section (the shape of the section being indicated in dotted lines in Fig. 2) are adapted to be constricted around and in embracing relation to a pair of flanges 11 on the ends of tube sections 12. The flanges 11 may be of trapezoidal section as indicated in Figs. 2 and 3 in order to obtain the most satisfactory wedging action for draw-

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ing the tubing ends together as a resultant of the constricting action in the band clamp A. On one side clamp A embodies an integral hinge section 14 and, diametrically opposite hinge section 14, has a gap 15 defined between terminals 16, 16'. Toggle take-up mechanism B connects the terminals 16 to draw them toward one another and constrict the band A so as to draw the flanges 11 into sealing engagement with one another or with the gasket 13.

Hinge section 14 is a full width section of the ribbon stock from which band A is initially roll-formed to incorporate therein the channel shape of segments 10. Section 14 is attained in a post-forming operation in which the channel section is pressed back to its initial straight section condition at the center hinge axis of hinge section 14, as indicated in Fig. 2. Between the V-segments 10 and this hinge axis there is a gradual flaring transition from the full V-section to the completely straight section at the axis, as indicated in Figs. 1 and 2. By utilizing the full width of the ribbon stock (which is considerably wider than the channel section of segment 10, as shown in Fig. 2), adequate resiliency combined with maximum strength and durability in the hinge, is attained. This is quite important in a clamp wherein the hinge is subjected to the frequent flexings and the high degree of flexing imposed by the conditions of usage and the V-band structure of the particular type of band clamp to which the invention is directed. It is especially important where band A is fabricated from stainless steel, a material of less flexibility and endurance to repeated flexings than ordinary spring steel. The use of stainless steel is practically mandatory in a sanitary clamp of the type contemplated by the invention.

The terminals 16, 16' are of plain U-section for smooth nesting within the toggle lever hereinafter referred to, and are likewise fabricated in a post forming operation upon the ends of a suitable length of the rolled channel section material after such length has been severed from the rolled stock. In attaining the plain U-section, the reinforcing flanges of the V-segments 10 are ironed out or trimmed off, and the width of the U-section 16 is substantially the width between the base portions of the diverging sides of segments 10 where these sides merge with the marginal reinforcing flanges.

The terminal 16 has a T-slot lanced therein, and terminal 16' has a plain aperture 18 which may be circular although it is preferably rectangular as indicated in Fig. 5. T-slot 17 includes a head portion 19 and a relatively narrow stem portion 20, shoulders 21 being defined therebetween.

Toggle mechanism B includes simply a lever, indicated generally at 22 and a link 23, the marginal contour of which is shown in Fig. 5. Link 23 comprises a straight shank 24, a tip 25 of reduced width at one end thereof, and a cross-head 26 of increased width at the other end thereof. Cross-head 26 includes relatively narrow trunnions 27 at its ends, and shoulders 28 constituting the ends of wider portions of the cross-head 26 between trunnions 27 and shank 24. The entire link 23 is simply and inexpensively fabricated by a simple die blanking operation, from sheet metal stock of relatively high elasticity so as to have considerable spring action, a preferred material being spring steel, protected from corrosion by suitable plating.

Lever 22 is fabricated in a blank and form operation from sheet metal such as stainless steel. It is of U-section channel form, substantially uniformly from the handle portion 29 at the rear end of the lever to a terminal loop portion 30 at the forward end of the lever, but the side flanges of the U-section are cut away so that loop is flat throughout its width. Loop 30 includes side bars 31 and an end cross bar 32, and defines a rectangular aperture 33 of the proper width to freely but snugly receive the clamp terminal 16 therein. In the center of cross bar 32 and projecting into opening 33, in the plane of the loop

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30 is a fulcrum finger 34 which includes a relatively wide base portion 35 and a relatively narrow tip portion 36 projecting therefrom, with shoulders 37 defined between these portions. Base portion 35 is of a proper width to be receivable freely yet very snugly within head portion 19 of T-slot 17 and tip portion 36 is of the proper width to be similarly receivable in the stem portion 20 of the T-slot. As indicated in Fig. 4, the cross section of terminal 16, like terminal 16', includes a relatively flat central web portion against which the inner edge of cross bar 32 is adapted to bear when base element 35 is received in slot portion 19, shoulders 37 being adapted to bear against the outer face of this terminal web when tip 36 is received in stem portion 20 of the T-slot.

In the side flanges of lever 22 are laterally registering apertures 38 in which the trunnions 27 of cross head 26 of link 23 are pivotally mounted, thus permanently attaching link 23 to lever 22. The forward end of link 23 is pivotally connected to band terminal 16' by the insertion of tip 25 into aperture 18 of terminal 16', with shoulders 27 of the link bearing against the outer face of the terminal web.

It will now be apparent that the connector mechanism B provides a toggle arrangement in which lever 22, in tightening the clamp, is placed under tension between the axis A of pivotal engagement of fulcrum finger 34 against band terminal 16, the axis B of pivotal engagement of link 23 against band terminal 16', and the axis C of compressive engagement of trunnions 27 at the rear end of link 23 against the rear edges of apertures 38 in handle 29. In the closed position of the clamp shown in full lines, the clamp is fully tightened from flanges 11, with link 23 under compression between band terminal 16' and handle 29. The distance between axis A and C in this closed position is slightly less than the sum of the distances between axis A and B and the distance between axis B and C in the dead-center position of the parts along the dead-center axis indicated by broken lines 40. The differential between this sum and the distance A—C of the closed position could be accounted for by over-closing of the clamp at the dead center position and then allowing it to relax as it reaches the over-center position, in accordance with conventional practice. However, in preference to such practice, the present invention provides for accommodating this differential in a springing action of link 23 in which the distance between its ends is forested by the bowing of the link as indicated in dotted lines in the dead-center position illustrated in Fig. 1. The angle between the dead-center position and the closed position is kept at a minimum consistent with adequate locking of the clamp, depending upon the conditions of usage to be encountered. For most conditions, this angle may range between 5 degrees and 20 degrees, the substantially 20 degree angle shown in the drawing being somewhat exaggerated for the purpose of clarity in illustration.

The highly elastic characteristic of the spring material of link 23 provides for adequate bowing of link 23 at the dead-center position and the return of the link to a substantially straight condition at the closed position of the clamp while maintaining full compressive load between the axis B and C without requiring any over-closing of the clamp at the dead-center position. Also, as a result of the full compressive loading that is maintained down to the closed position, the locking efficiency of the clamp is maintained at a maximum. Actually, the compressive loading of the link 23 may increase as it straightens out from its bowed condition of the dead-center condition to its more straightened condition of the closed clamp condition.

The angle between the dead-center position and the fully opened position shown in dotted lines in the drawing, wherein the loading of link 23 is completely removed, is several times the angle between the dead-center and closed positions. The tangent of this larger angle along dead-center line may be as low as only one-half of the effective

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length of link 23, so as to allow a clamp opening range equal to half the length of the link, which is ample for any conditions encountered in the use of clamps.

The angle between the dead-center and closed positions is maintained sufficiently high to provide an automatic fine adjustment for small differences in the diameter that the clamp is to assume in its most effective fully closed position, depending upon slight variations in circumference of the pipe flanges and gasket thickness, etc. This range of fine adjustment extends between the limits determined by engagement of narrow tip 36 in stem portions 20 the T-slot on the one hand and engagement of the wider base portion 35 in the head 19 of the T-slot on the other hand. This automatic adjustment is provided for by a difference in the degree of bowing to which the link 23 is subjected in passing through the dead-center position.

This range of adjustment is doubled by the selective connection of loop 30 to band terminal 16 in either of the two positions described above, the change from engagement of the terminal web by shoulder terminals on the one hand and cross bar 32 on the other hand adding to the total effective length of the linkage by the distance between shoulders 37 and the inner edge of cross bar 32. This combination of fine and coarse adjustments provides a sufficient range of adjustment to cover all requirements for any specified size of clamp.

The U-section of lever 22 is of the proper proportions to receive the terminal 16' as the clamp is closed, and its depth and longitudinal contour are so related to dead center line and the height of terminal 16' that the web of the lever will engage terminal 16' to constitute the latter a stop to determine the limit of closing movement of the lever at the proper position beyond dead center to attain adequate locking. Side members of the lever 22 may have respective integral lugs 42 adapted to embrace the rightward V-band segment 10 with a piloting action for aligning the lever 22 with the band segment and securing it against rattling in the presence of vibration.

I claim:

1. In a band clamp: a band having at its respective ends, radial terminals each provided with an aperture; a lever having at one end a loop to receive one of said terminals, said loop having an end cross bar provided with an integral pilot to enter the aperture of said one terminal, with said cross bar bearing against said one terminal, said lever having a handle at its other end and including an intermediate body of channel section opening inwardly and adapted to receive the other terminal; and a toggle link having at one end a pilot engageable

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in the aperture of said other terminal and having, at the base of said link pilot, shoulders to bear against said other terminal, said link projecting away from said one terminal, and having at its other end a pivotal connection to said intermediate body on a transverse axis, said loop pilot being of stepped construction, including a relatively narrow tip and a relatively wide base portion, and the aperture of said one terminal being a T slot having a narrow stem portion receiving only the narrow portion of said stepped pilot and having a wider head portion in which said base portion of the stepped pilot is receivable.

2. A clamp as defined in claim 1, wherein said link is generally in the form of a flat bar of spring metal adapted to flex to a bowed condition in passing dead center, said lever being arranged to bottom on the outer end of said other terminal to constitute the latter a stop to limit the closing of the lever at a position just sufficiently past dead center to effectively lock the clamp against opening while maintaining substantially at a maximum the clamping tension developed in the clamp by the closing thereof.

3. A clamp for embracing an object and comprising a band having radially projecting terminals at each end thereof, one of said terminals having an aperture formed therein of T configuration with the stem portion of the T extending in a direction radially outwardly from the band, toggle means for moving said terminals toward each other to tighten the band around the object to be embraced, the toggle means being movable to a position past dead center to close the clamp, said toggle means comprising a lever having a loop at one end thereof to receive said one terminal, said loop having an end cross bar and an integral pilot of stepped construction, including a narrow tip adapted to enter the stem portion of said T aperture and a relatively wide base portion adapted to enter the cross arm portion of said T aperture, and a toggle link engageable at one end thereof with the other terminal and pivotally connected at its other end to said lever.

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