This invention relates to mounting devices and more particularly to such devices as are used in mounting vibrators and like mechanisms to various types of supporting structures.

In the field of commercial vibrators for augmenting the handling, flow, treatment etc. of materials, one good example of which is shown in my U.S. Patent No. 3,076,346, it is found that portability of the vibrator mechanism is highly desirable. This enables the use of a few vibrators on various structures to be vibrated. This is especially true in the unloading of a string of hopper cars on a railroad, and for this purpose it is common to provide hopper cars with mounting ribs or flanges to which the vibrators or vibrators may be temporarily attached. Nonetheless, regardless of the temporary attachment, the mounting must be such that the vibrator in effect becomes an integral part of the car during the materials handling operation. This is also true in other aspects of the field, because an accidentally detached vibrator can cause serious damage. For this reason, although vibrators themselves are relatively successful, at least as to certain types, efficient use thereof cannot be exploited without efficient mountings. The alternative is to temporarily weld the vibrator in place but this of course has obvious disadvantages.

According to the present invention, an improved mounting is provided which adds to the portability of the vibrator and in effect makes almost any type of vibrator a more useful tool. The improved mounting also eliminates considerable expense in the provision of the types of mounting or receiving elements on hopper cars, tanks, etc., since, in view of the nature of the mounting, the receiving elements may be simply constructed as ribs or flanges, and expensive types of interlocks, wedges, welding, etc. can be eliminated. It is therefore one of the principal objects of the invention to provide an improved mounting means, particularly in the field noted.

It is another principal object of the invention to provide a mounting having clamping means including opposed force-exerting devices, at least one of which includes energy-storing means to augment the clamping force as the clamping force tends to deteriorate in use. It is a further object of the invention to provide the energy-storing means of several types. A still further object resides in a novel type of tubular insert having an improved form of engaging portion for engaging the receiving element on the structure or object to be vibrated. A still further object resides in improved means for cleaning the element-engaging portion of accumulated paints, tar and other materials that interfere with efficiency in the area of engagement. Still another object resides in indicator means for enabling the user to ascertain whether an adequate clamping force is being achieved.

The foregoing and other important objects and desirable features of the invention will become apparent as preferred embodiments are disclosed in the ensuing description and accompanying sheet of drawings, the figures of which are described below.

FIG. 1 is a perspective, on a reduced scale, of a typical vibrator equipped with the improved mounting means and shown as being mounted on a receiving element.

FIG. 2 is a somewhat enlarged view, partly in section, illustrating the interior of the vibrator and portions of the improved mounting means.

FIG. 3 is an enlarged "exploded" view showing one form of insert device, and illustrating its basic components.

FIG. 4 is an assembled view of the device in FIG. 3, illustrating the condition it occupies when initially assembled.

FIG. 5 is a similar view, but illustrating the device in use as initially installed.

FIG. 6 is a similar view showing the device in use after its element-engaging portion has cut into the receiving element.

FIG. 7 is an end view of the assembled device of FIGS. 4 through 6.

FIG. 8 is an end view of the energy-storing pack of FIGS. 3 through 6.

FIG. 9 is an enlarged fragmentary view showing the design of the element-engaging portion of the device.

FIG. 10 is a view similar to FIG. 5 but showing a modified form of device with a different type of energy-storing means.

FIG. 11 is a perspective view, on a reduced scale, illustrating the energy-storing means of FIG. 10.

FIG. 12 is a view similar to FIG. 10 but showing still another form of energy-storing means.

FIG. 13 is likewise similar to FIG. 10 but shows a still further form of energy-storing means.

The vibrator shown in FIGS. 1 and 2 may be similar to that in my U.S. patent as noted above. This vibrator comprises essentially a casing 28 which affords basic structure having a bottom to which are rigidly secured, as by welding at 22, two pairs of clamping portions or legs. Those visible at the forward or left hand end of the view will be referred to as first and second legs 24 and 26, respectively. One leg of the other pair is visible at 28. For purposes of the present description, the characteristics of the leg 28 will be assumed to be the same as those of the leg 26. Not visible is another leg in opposition to the leg 28 and this will have the characteristics of the leg 24.

By means to be presently described, the vibrator 20 is shown as mounted on a receiving element or rib 30, which may be taken as representative of a mounting element on a structure to be vibrated by the mechanism within the casing 20.

As shown in the U.S. patent referred to above, and as repeated somewhat generally here, the casing 28 supports interiorly thereof a hollow rotatable shaft 32 which rotates on an axis transverse to the median plane of the vibrator. It will be noted also that the rib or element 30 lies generally in this median plane. In other words, the axis of rotation of the vibrator shaft 32 is transverse to the rib 30 and is spaced thereabove. In this respect, it should be noted that such expressions as "above" etc. are used in the interests of brevity, because other geographical characteristics can exist. For example, it is not uncommon to mount the vibrator in a depending position or in a position with its axis vertical or otherwise disposed. Consequently, the description in this respect should be regarded as representative and not limiting.

The shaft 32 is appropriately journaled in bearings 34 and carries for rotation therewith a weight 36, the mass of which is of course eccentric with respect to the axis of the shaft 32. As the weight 36 rotates, it creates vibratory forces which in turn are translated to the object or structure to which the vibrator is attached. Any suitable means may be utilized for driving the shaft 32, that shown here comprising an air motor 38 having a drive shaft 40 keyed or otherwise connected to the vibrator shaft 32.

In the particular field under concern here, it is import-
ant, for reasons already expressed, that the vibrator be come in effect an integral part of the structure being vib-
trated. This is accomplished in one aspect by the pro-
vision of the two pairs of spaced legs, these being spaced laterally (with the body of the unit) for exerting a ade-
quate spacing so as to secure proper engagement with the rib 30. It will be understood, of course, that the rib 30 is part of a hopper, tank, etc., the handling of the contents of which are to be facilitated by use of vibration.

The means carried by the legs 24 and 26 (and of course by the leg 23 and its partner) for exerting a adequate force on opposite sides of the rib or element 50 include first and second devices, indicated generally and respecti-
vely by the numerals 42 and 44. For purposes of identi-
fication, the device visible in FIG. 1 for the leg 25 will also be designated by the numeral 44.

In this particular case, the leg 26 has an inner face 46 and an outer face 48. The leg 24 is equipped with inner and outer faces 50 and 52 respectively. The inner faces 46 and 50 are spaced apart to afford a space or gap 54 which enables the legs 24 and 26 to straddle the element 30. The leg 26 is provided with an internally threaded through opening 56, here in the nature of a conventional plug tap, and receives an internally threaded insert 58 which in turn receives an externally threaded clamping screw 60, the inner end of which may be hardened and shaped with a contacting portion for en-
gaging the associated side of the rib 30. As will be seen, tightening the screw 60 will exert an inward force, which is opposed by the other device 42, the details of which will now be described.

The leg 24, like the leg 26, has a through opening, in-
ternally threaded at 62 to receive an externally threaded cup-like tubular member 64, the interior of which is es-
entially in the form of a cylindrical bore or chamber 66. The member 64 is the plug 74 that is not threaded may be of hexagonal or other wrench-receiving shape, as shown in FIG. 7. The bore 66 opens at the inner face 50 of the leg 24 when the member or insert is screwed into place, and the opposite or outer end of the member is formed with a radial outer end wall 68, preferably pro-
vided with a central aperture 70 which is exteriorly 

Within the inner end portion of the chamber or bore 66 is carried a plug 74. The axial dimension of the plug 74 is of course less than that of the bore 66, so as to affo-
d a space between the interior of the member end wall 68 and the outer or left hand end of the plug 74 for receipt of energy-storing means, denoted in its enu-
irely by the numeral 76. In that form of the invention shown primarily in FIGS. 3 through 9, the means 76 takes the form of a pack of Belleville spring washers 78.

The plug 74 is provided at its inner end—the end ex-
posed at the inner face 50 of the leg 24—with an element-
engaging portion in the form of a circle 80 formed by the intersection of a pair of conical surfaces 82 and 84 generated about the axis of the plug. The surface 82 is of a cone that converges inwardly, or has its apex to the right as seen in FIG. 9, whereas the conical surface 84 is of a cone having its apex to the left as seen in that figure. The plug 74 has an internal bore or aperture 86, so that the conical surface portion 84 forms therewith at the element-engaging end of the plug an interior recess. Therefore, the surface 84 may be regarded as an internal surface whereas the surface 82 is an external surface. It is significant that these surfaces are arranged at such angles relative to the axis as to improve the engagement of the plug with the associated side of the rib or element 30. As best shown in FIG. 9, the angle of the surface 84 to the axis of the plug (or to a line parallel to that axis) is represented by angle $a$, which is preferably in the order of 25°—35°. The angle between the surface 82 and the axis of the plug (or a line parallel to that axis), denoted by the letter $b$ is in the order of 40°—50°. An arrangement of this character adequately

accommodates the components of forces exerted as the plug is caused to bite into the rib 30, thus avoiding de-
forming or other types of crushing of the plug. Basically, this end portion of the plug will be hardened to a re-
quise bar for and at adequate strength, and is preferably extended or indicator member 88, here of cylindrical tubular form and provided at its outer end with a flared head 90, the flare on which provides a stop part that matches the countersink 72 about the opening 70 in the end wall 68 of the member 64. Inasmuch as the plugs 74 are relatively loosely received in surrounding relationship to the member 88. The plug 74 is next assembled from the right hand end of the member 64, as is the means 76, but in this case the bore 86 in the plug is so dimensioned as to have a press fit with the outside diameter of the member 88. The member 64 is preferably assembled in an appropriate press, such as a hydraulic press, hardened jaws of which are indicated by way of representation at 92 and 94 in FIG. 4 as engaging head of tube 88 and end of plug 74. It is preferred that axial pressure applied to the assembled components is such that the spring pack 76 is flattened and the flared head 90 on the member 68 is partly received in the countersink 72. Upon removal of the assembled unit from the jaws 92 and 94, the pres-
sure exerted by the means 76 as the spring expands forces the plug 74 axially to the right, or inwardly, and the flared head of the tube seats at 92. Pressures developed by the spring pack 76, on the basis of the dimensional characteristics illustrated here in which the drawings are substantially one-half of full size, are in the order of twelve thousand pounds. This of course can be varied ac-
cording to circumstances and the figure given is represen-
tative.

After assembly of the unit 42, with the spring force causing the flared head 90 of the tube 88 to seat in the countersink 72, the head end of the tube may be ground off flush with the outer radial face of the wall 68. This status of the unit may best be regarded by assuming that there is a condition intermediate that of FIGS. 4 and 5, as where the unit 42 has not yet been tightened for receipt of energy-storing means, denoted in its en-
irety by the numeral 76. In that form of the invention shown primarily in FIGS. 3 through 9, the means 76 takes the form of a pack of Belleville spring washers 78.

The plug 74 is provided at its inner end—the end ex-
posed at the inner face 50 of the leg 24—with an element-
engaging portion in the form of a circle 80 formed by the intersection of a pair of conical surfaces 82 and 84 generated about the axis of the plug. The surface 82 is of a cone that converges inwardly, or has its apex to the right as seen in FIG. 9, whereas the conical surface 84 is of a cone having its apex to the left as seen in that figure. The plug 74 has an internal bore or aperture 86, so that the conical surface portion 84 forms therewith at the element-engaging end of the plug an interior recess. Therefore, the surface 84 may be regarded as an internal surface whereas the surface 82 is an external surface. It is significant that these surfaces are arranged at such angles relative to the axis as to improve the engagement of the plug with the associated side of the rib or element 30. As best shown in FIG. 9, the angle of the surface 84 to the axis of the plug (or to a line parallel to that axis) is represented by angle $a$, which is preferably in the order of 25°—35°. The angle between the surface 82 and the axis of the plug (or a line parallel to that axis), denoted by the letter $b$ is in the order of 40°—50°. An arrangement of this character adequately
his fingers, and can therefore take corrective measures, such as tightening the device 44 or even removing the whole to correct the situation in which the point of contact is accessible. In other instances, the operator can fully torque the screws 56. These are other problems overcome by the present invention.

Another feature of the invention is the use of the tube 58 rather than a solid member. It will be noted that by virtue of the tubular nature of this member it is in axial compression which the rubber or timing end 80 of the plug 74. It is commonplace in the use of mounting devices with the character referred to herein that the recessed end of a member comparable to the screw 60 or plug 74—except that they are not hollow—accumulates considerable material in the form of paint, tar, etc., making it difficult to engage its particular true in those instances in which hopper cars and the like pick up, either accidentally or deliberately, various forms of coatings as they are used, maintained, etc. These accumulations are known to become excessively hard and ultimately build up to the point where their axial thickness exceeds the depth of the recesses, thus destroying the effectiveness of a material-energizing circle such as that shown at 80 here. Therefore, these elements must be removed from time to time and cleaned, which itself is a relatively time-consuming task. However, according to the present invention, once the device is removed, a tool may be inserted from left to right through the tubular member 88 and the accumulated build-up is easily poked out.

Substantially the same structural and functional characteristics of the device just described may be achieved by that utilizing the design of FIGS. 10 and 11, wherein the reference numeral 42a is used to designate the devices as a whole. The components thereof as shown at 64a, 74c, 76a, 70a, 72a, 66a and 68a correspond to those previously employed. However, in this case, the energy-storing means 76a is in the form of a relatively hard solid rubber body having a central aperture 76c corresponding to the aperture through the spring pack 76, which accommodates the tubular member 88b. In addition, the rubber body has additional through openings 76g to give the body the characteristic of compressibility and expansibility. It will be understood that assembly of the device 42a follows that of FIG. 4, with the rubber body being compressed in that status just as the spring pack 76, and the said aperture will perform the functions of the spring pack 76.

The embodiment of FIG. 12, in which comparable reference numerals are used, supplemented by the exponent “b,” follows that of those previously described, except that in this case the energy-storing means 76b is a body of sponge mounted on the circumstances. Nothing more than a central aperture need be provided for accommodating the tubular member 88b, since the cellular nature of the sponge-rubber eliminates the needs for additional holes such as those at 76g in FIG. 11.

A still further form of the invention is shown in FIG. 14, the device itself being denoted by the reference character 42c, employing the energy-storing means a coiled compression spring 76c. Other components corresponding to those previously used are designated by reference characters suffixed by the exponent “c.” In all cases, plain reference numerals are used on the leg 24 and its components, as well as on the rib 30, since these are not altered by the change in design of the devices 42, 42a, 42b and 42c. In FIGS. 10, 12 and 13, the plug structures of FIG. 9 of course is used.

The structural and functional characteristics as well as the operational use of the devices have been covered above and need not be repeated. This is true likewise of the features of the invention. Other features and characteristics enumerated to this point will naturally occur to those versed in the art, as will numerous modifications and alterations in the preferred embodiments disclosed, all of which may be achieved without departure from the spirit and scope of the invention.

What is claimed is:

1. A clamp device, comprising: a generally cup-shaped member having an outer end provided with a radial wall and further having an axially open inner end adapted to be threadedly engaged with a clamp portion, said member having an axial chamber therein opening at said inner end and said wall having a coaxial through aperture of smaller radial dimension than the chamber; a plug relatively axially shiftable in and axially shorter than the chamber and having a work-engageable end projecting axially beyond the inner end of the member; centrally-apertured energy-storing means within the chamber and axially compressible between the plug and the radial wall upon forcible relative inward movement, end projecting and axially expansible to move the plug relatively outwardly; a coaxial extension having one end proximate to the plug and extending relatively loosely through the energy-storing means to an opposite indicator end projecting through the wall aperture, said indicator end having a stop part thereon engageable with the exterior of the wall upon relative axial movement of said extension toward the inner end of the member; and means connecting the extension at said one end to the plug for axially movement of the plug and extension in unison so as to project said indicator end stop part outwardly away from the wall upon forcible compression of the energy-storing means and to cause said stop portion to engage the wall after predetermined expansion of said energy-storing means, characterized in that the aperture is enlarged in at least a portion thereof at the exterior face of said radial wall to provide a recess in said wall, and the stop part has a radially projecting portion receivable in said recess and so constructed that, when said projecting portion is received in said recess upon said predetermined expansion of the energy-storing means, the outer radial end of said extension is substantially flush with said exterior face of said wall.

2. The invention defined in claim 1, in which: said aperture is countersunk at the said exterior face to provide said recess and said stop part is an annular flared head providing said projecting portion and receivable in said countersunk portion of said aperture.

3. A clamp device, comprising: a generally cup-shaped member having an outer end provided with a radial wall and further having an axially open inner end adapted to be threadedly engaged with a clamp portion, said member having an axial chamber therein opening at said inner end and said wall having a coaxial through aperture of smaller radial dimension than the chamber; a plug relatively axially shiftable in and axially shorter than the chamber and having a work-engageable end projecting axially beyond the inner end of the member; centrally-apertured energy-storing means within the chamber and axially compressible between the plug and the radial wall upon forcible relative inward movement of the plug and axially expansible to move the plug relatively outwardly; a coaxial extension having one end proximate to the plug and extending relatively loosely through the energy-storing means to an opposite indicator end projecting through the wall aperture, said indicator end having a stop part thereon engageable with the exterior of the wall upon relative axial movement of said extension toward the inner end of the member; and means connecting the extension at said one end to the plug for axial movement of the plug and extension in unison so as to project said indicator end stop part outwardly away from the wall upon forcible compression of the energy-storing means and to cause said stop portion to engage.
the wall after predetermined expansion of said energy-storing means, characterized in that the means connecting the plug and the plug extension comprises an axial friction fit enabling assembly of the device by insertion of the extension through the wall aperture toward the open end of the member and through the energy-storing means and into engagement with the plug.

4. The invention defined in claim 3, in which: said friction fit is established by an axial recess in the plug opening toward the radial wall and said end of the extension is tightly received in said recess.

5. A clamp device, comprising: a generally cup-shaped member having an outer end provided with a radial wall and further having an axially open inner end adapted to be threadedly engaged with a clamp portion, said member having an axial chamber therein opening at said inner end and said wall having a coaxial through aperture of smaller radial dimension than the chamber; a plug relatively axially shiftable in and axially shorter than the chamber and having a work-engageable end projecting axially beyond the inner end of the member; centrally-apertured energy-storing means within the chamber and axially between the plug and the radial wall upon forcible relative inward movement of the plug and axially expansible to move the plug relatively outwardly; a coaxial extension having one end proximate to the plug and extending relatively loosely through the energy-storing means to an opposite indicator end projecting through the wall aperture, said indicator end having a stop part thereon engageable with the exterior of the wall upon relative axial movement ofsaid extension toward the inner end of the member; and means connecting the extension at said end to the plug for axial movement of the plug and extension in unison so as to project said indicator end stop part outwardly away from the wall upon forcible compression of the energy-storing means and to cause said stop portion to engage the wall after predetermined expansion of said energy-storing means, characterized in that the work-engaging end of the plug is of concave configuration about the axis of the plug, the plug has an axial through opening therein, and the extension is tubular to provide an axial passage from the indicator end of the extension to said concave configuration of the work-engaging end of the plug.

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