June 29, 1965 R. A. STEARN 3,191,787

PIPE GRAPPLE

Filed July 2, 1962 3 Sheets-Sheet 1

Fig. 2

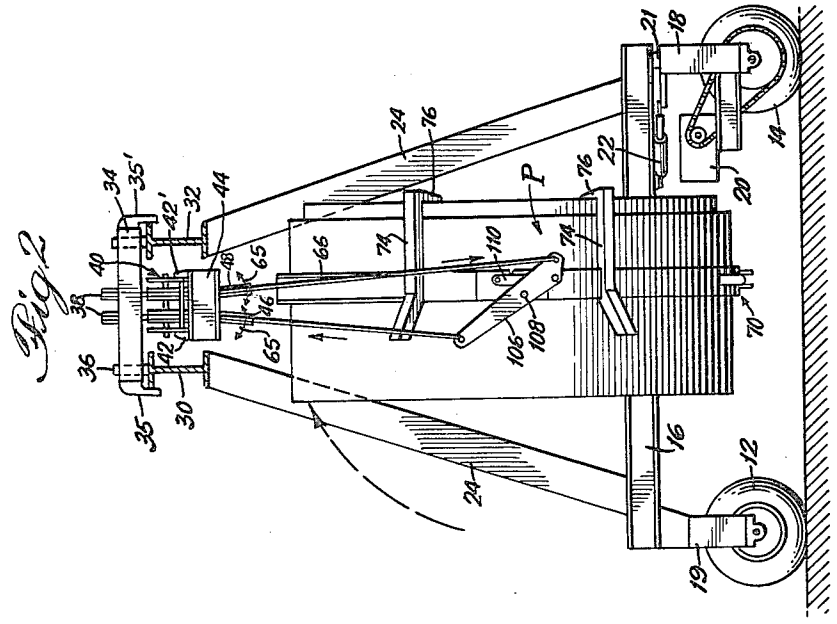
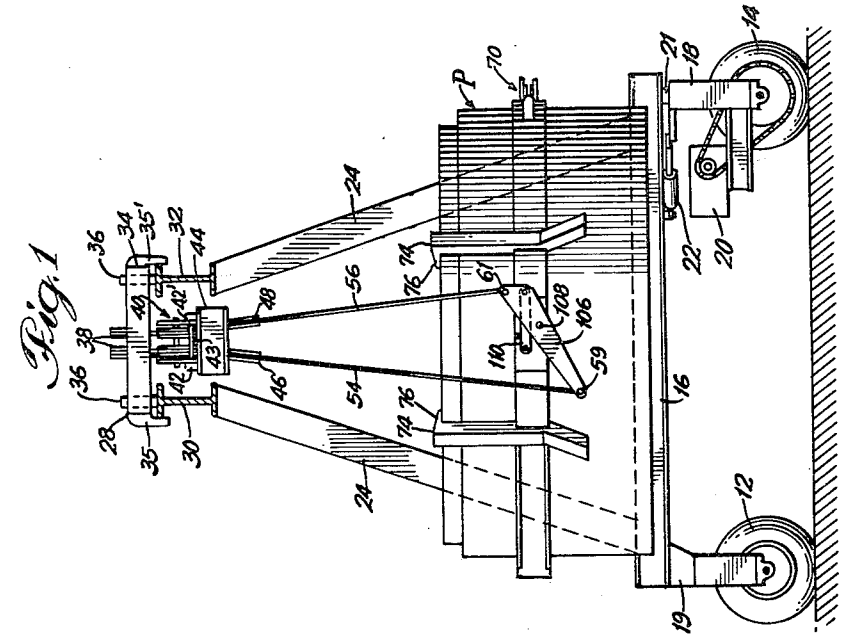


Fig. 1



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Filed July 2, 1962 3 Sheets-Sheet 2

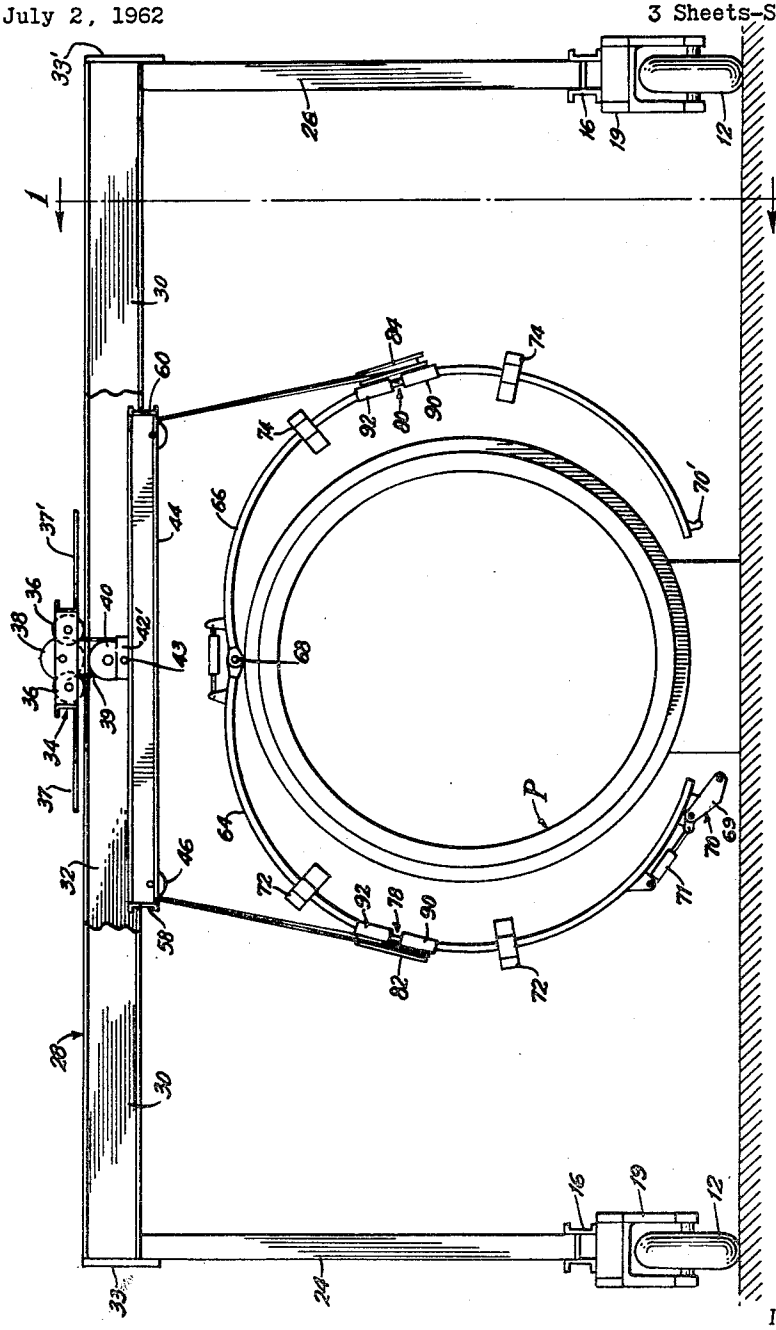


Fig. 3

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June 29, 1965 R. A. STEARN 3,191,787

PIPE GRAPPLE

Filed July 2, 1962 3 Sheets-Sheet 3

Fig. 4

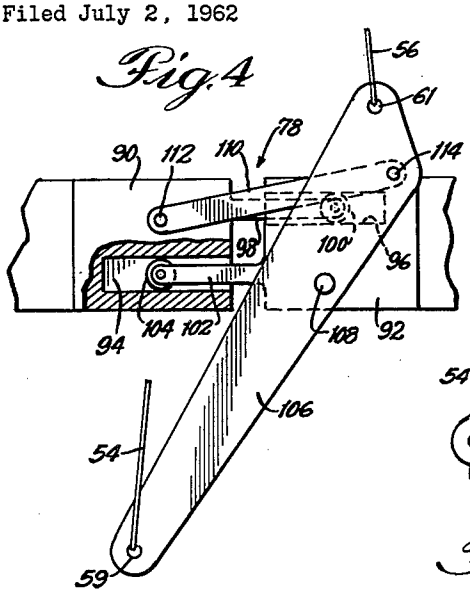


Fig. 5

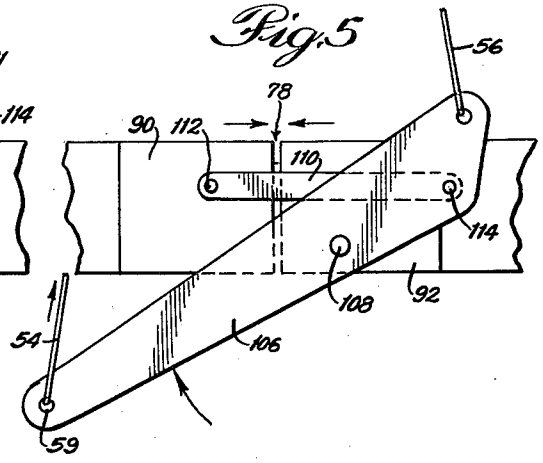


Fig. 6

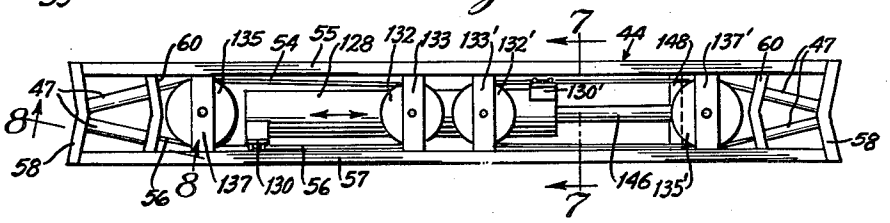


Fig. 7

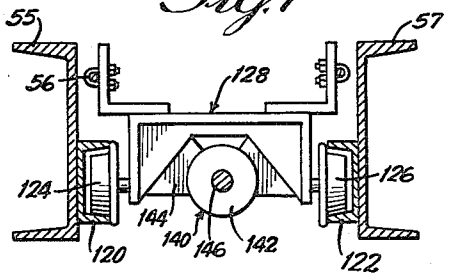
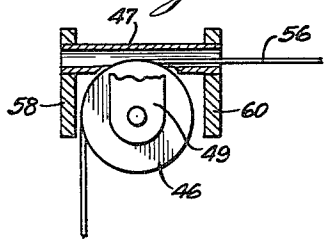


Fig. 8



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United States Patent Office 3,191,787 Patented June 29, 1965

3,191,787
PIPE GRAPPLE

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Filed July 2, 1962, Ser. No. 206,774
6 Claims. (Cl. 214—394)

This invention relates to apparatus for handling heavy, cylindrical members, and particularly relates to an apparatus for handling heavy concrete pipe sections of large dimensions.

In the process of building large sewage trunk lines, and in irrigation projects, the fluids are conveniently transferred by way of large diameter, continuous strips of concrete conduit. Such conduits are assembled from short length sections which are capable of being handled individually by article handling equipment. Such sections are normally stored at various designated depots along the proposed conduit line, and used as required. A primary objective of this invention is to provide a new machine which can effectively, and efficiently handle such conduit sections in order that such sections may be transferred from the depot storage area to the trunk line.

A further objective of this invention is to provide an apparatus which can straddle a trench, and including means to raise a section of pipe laying adjacent the trench and lower it into the trench.

Another important objective of this invention is to provide an apparatus for moving sections of concrete pipe from a storage depot, where it is normally stored with its conduit axis vertical, to a position in the trench, on its side, with the conduit axis parallel to the ground.

A still further objective of the invention is to provide an apparatus of the type described wherein a split band encircles a conduit section and grapples the section by way of a novel strap tightening device.

A still further objective of the invention is to provide grappling bands for apparatus of the type described wherein there are positioning guide and stop members which automatically and accurately position the pipe within the grapple assembly.

A still further objective of the invention is to provide a straddle-lift piece of equipment wherein a grapple assembly holds and grips a section of concrete pipe, and is of a sufficient size that the concrete pipe may move laterally an appreciable distance between the upright members of the straddle-lift.

Another important objective of this invention is to provide a means to move a section of concrete pipe from a position wherein its axis is normal to the ground to a position wherein the axis is parallel to the ground, and said means being used to initially grip the pipe prior to its function of changing the attitude of the axis. Conversely, it is an objective of this invention to provide means whereby when said pipe is lowered, with its axis parallel to the ground, the grappling means is initially released subsequent to axis positioning.

These and other important objectives and advantages of the invention will be apparent from the following description, wherein reference is made to the accompanying drawings illustrating a presently preferred embodiment of the invention, and wherein:

FIG. 1 is a side elevation view of the apparatus showing a concrete pipe carried with its axis vertical to the ground;

FIG. 2 is a similar view showing the apparatus holding the concrete pipe with its axis parallel to the ground;

FIG. 3 is an end view of the apparatus showing a grappling assembly in its opening position;

FIG. 4 is a partial view of the toggle elements in their open position;

FIG. 5 is a view similar to FIG. 4 with the toggle elements in their closed position;

FIG. 6 is a plan view of the cable carriage;

FIG. 7 is a cross-sectional view along the line 7—7 of FIG. 6; and

FIG. 8 is a partial section on the line 8—8 of FIG. 6.

Referring now in more detail to the drawings, wherein like numerals indicate like elements, the straddle-lift is supported by a pair of front wheels **12** and rear wheels **14**. Extending between the front and rear wheels are a pair of side rails **16**, from which wheel forks **18** and **19** depend. The front forks **18** are pivotally secured to the rails at **21** so that the machine may be steered. The front wheels are powered hydraulically by way of an engine **20**, and are power steered by way of hydraulic cylinders **22**. The power transmission and steering apparatus may be of the type disclosed in the Baudhuin et al. U.S. Patent 2,909,298, issued on October 20, 1959.

A pair of A-frames **24** and **26** extend vertically upwards from the side rails respectively and provide the supporting framework for the apparatus hereinafter described. A cross-beam assembly **28** extends between the apices of the A-frames, and is comprised basically of spaced, parallel I-beams **30** and **32**, and a pair of end weld plates **33** and **33'**. Supported along the upper surfaces of the I-beams, is a trolley **34** which rides on anti-friction rollers **36**. The trolley is guided along the beams by flanges **35** and **35'**, and is caused to move in either direction by cables **37** and **37'**. The apparatus for inducing motion in these last mentioned cables is conventional, and is not disclosed, for any suitable winch and sheave arrangement may be utilized.

Supported within the trolley is a cable reel **38** having an associated cable **39**, from which a hoisting sheave assembly **40** depends. A housing **44**, having two upwardly extending lugs **42** and **42'** is pivotally secured to the sheave assembly by way of shaft **43**. The housing **44** includes the operating cables and associated structure for operating and rotating the pipe grappling mechanism. The cable reel **38** may be actuated in any desired manner, preferably through power means on the trolley to raise and lower the housing **44** and the grappling means carried thereby. The grapple assembly is comprised basically of a pair of arcuate straps **64** and **66** which are expansible and contractible to grip a pipe section. Although not essential for all purposes, the straps are preferably detachably connected to open and move around a pipe section with its axis horizontal. As shown, the straps are pivotally secured together at one side by a pin **68**. At their other ends, the straps are provided with a latch mechanism **70**. The latch assembly is comprised of an eyelet member **69** pivotally mounted to strap **64** and adapted to receive a lug **70'** fixedly secured to strap **66**. The member **69** can be conveniently operated by a hydraulic jack **71**. Circumferentially spaced about strap **64** are a plurality of positioning arms **72**, and spaced about strap **66** are a plurality of positioning arms **74**. Each of the positioning arms is provided with an inwardly directed lug **76** at one end to engage the end of a pipe section and position the straps centrally thereon and is bent outward at its other end to guide the grapple over a pipe section. When the latch assembly is secured, the interior circumference of the straps is approximately equal to, but slightly larger, than the outside diameter of a concrete pipe P, and the arms **72** and **74** are parallel to the center axis thereof.

In order to separate to receive the pipe and then contract to grip the pipe securely, the members **64** and **66** are respectively split at points **78** and **80**. A toggle assembly **82** bridges split section **78**, and a similar toggle assembly **84** bridges split **80**. Only toggle assembly **82** will be described in detail, it being understood that the

toggle assembly 84 is the mirror image thereof, and is operationally identical.

Split 78 of the arm 64 is defined by two opposing sections 90 and 92. Section 90 is provided with a recess 94, and section 92 is provided with a recess 96. Extending longitudinally outwardly from section 90 is an arm 98 terminated in a guide roller 100, and extending longitudinally outwardly from section 92 is an arm 102, terminated in a guide roller 104. As seen best in FIG. 4, recess 94 receives the arm 102 and recess 96 receives the arm 98. Bridging the split 78 is a toggle member 106 which is pivotally secured to section 92 by way of pin 108. A linkage arm 110 is pivotally secured to section 90 by pin 112 and is pivotally secured to toggle member 106 by way of pin 114. Since pin 112 and pin 114 are at a fixed distance apart, it can be seen (FIGS. 4 and 5) that sections 90 and 92 will move toward and away from each other as toggle arm 106 is pivoted about pin 108. The path of movement will be determined by rollers 100 and 104, as they follow recesses 94 and 96.

The toggle arms 106 are each operated by cables 54 and 56 connected respectively to opposite ends of each toggle arm at points 59 and 61. The cables 54 and 56 run over sheaves 46 and 48 which are supported at the ends of the housing 44 and which are tiltably mounted to maintain the sheaves in alignment with the cables as the cables swing during turning of the toggle arms 106. As shown in FIGS. 6 and 7 the housing is formed by side plates 55 and 57 connected at their ends by V shaped end plates 58 and by plates 60 spaced from the plates 58. Each sheave is mounted as shown in FIG. 8 in a hollow trunnion 47 journaled at its ends in the plates 58 and 60 and carrying side flanges 49 between which the sheave 46 or 48 is journaled. The cables 54 or 56, as the case may be, extend upward around the sheave 46 or 48 and through the hollow trunnion 47 to a guide sheave 135 pivoted on a vertical axis on a cross piece 137 on the housing 44. With this construction the sheaves can swing about an axis in line with the cable so that the downward runs of cable will always be aligned with the sheaves.

In its open position, as seen in FIG. 4, the gap 78 is largest, and toggle 106 is at a counter-clockwise limit. As cable 54 is drawn upwardly and cable 56 is extended, the toggle 106 moves clockwise to a position shown in FIG. 5, causing the sections 90 and 92 to approach each other. The means for cable operation will be described hereinafter.

When sections 90 and 92 have moved toward each other the amount permitted by the outer circumference of the pipe P, the pipe is securely gripped and any further shortening of cable 54 and extension of cable 56 causes the pipe to rotate (about an axis through pin 108) to the position shown in FIG. 2. Therefore, it can be seen that the original cable operation grips the pipe and further cable operation causes a rotational movement in the pipe itself. The pipe may be transported in either the FIG. 1 or FIG. 2 positions. After the pipe has been moved to the desired location, the cables (54 and 56) are moved in directions opposite to that previously described, and the first movement thereof will cause toggle 106 to move counter-clockwise. Splits 78 and 80 will increase to the distance shown in FIG. 4. The pipe can then be released to a block or the like, as shown in FIG. 3.

In the event it is desired to transport the pipe with its axis vertical, the cable is merely operated to an extent where the pipe is gripped, but not so far as to rotate the pipe.

One advantage of the clamping construction as shown and described is that the clamping action is always proportional to the weight of the pipe. Thus adequate clamping pressure will be developed securely to grip heavy thick-walled pipe and lighter thin-walled pipe will be gripped without producing damaging crushing forces.

In the clamping position the tension in cables 54 and 56 must be substantially identical or the pipe will be turned. However, the lever arm from pivot 108 to the point of attachment 59 of cable 54 is longer than the lever arm from pivot 108 to the point of attachment 61 of cable 56. Therefore, with equal tension on the cables the turning force on the lever 106 will be proportional to the ratio of these lever arms and the gripping force on the pipe will be proportional to this ratio times the weight of the pipe. Thus the grapple of the present invention will lift any pipe within its capacity without producing excessive gripping force on any pipe.

The mechanism for retracting and paying out cables 54 and 56 can best be seen by a reference to FIGS. 6 and 7. The side members 55 and 57 of the cable housing are respectively equipped with inwardly directed channel-shaped rails 120 and 122 which receive rollers 124 and 126 of a carriage 128. The cable 56, from its point of attachment on toggle 106, travels over sheave 46 and guide sheave 135 to a locking lug 130 where it is fixedly secured to carriage 128. The cable 56 continues about a horizontally disposed idling pulley 132 which is rotatably secured to a cross member 133 of the housing 44. From there the cable folds back over the guide sheave 135 and sheave 48 and has its other end 54 affixed to toggle 106. In effect, the lengths 54 and 56 are a continuous cable, and since the idling pulley 132 is stationary with respect to the cable housing 44, as the carriage moves to the right (FIG. 6), cable 56 is retracted while cable 54 is extended.

A cable arrangement, identical in operation and structure to that described, is provided to effect movement of the toggle assembly associated with split 80. Prime marks have been added to numerals, signifying elements of this last mentioned assembly, which correspond to like elements of the arrangement for toggle 84. By inspection, it can be seen that a movement of carriage 128 activates each of the cable systems.

The carriage 128 is reciprocated along the length of housing 44 by a hydraulic jack 140. The jack has its cylinder 142 affixed to carriage 128, by the spider flange 144, and has its piston rod 146 affixed to the housing 44 at cross bar 148. Therefore, carriage 128 is moved in response to the expansion and contraction of jack 140, and the carriage movement causes the operation of the toggle cables.

The hydraulic fluid lines for connecting pump 20 to the various hydraulic operators described, have been omitted in the interests of simplicity. Such conduits are of conventional design and present no problem to those skilled in the art.

In general manner, while there has been disclosed in the above description, what is deemed to be the most practical and efficient embodiment of the invention, it should be well understood that the invention is not limited to such an embodiment as there might be changes made in the arrangement, disposition, and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

I claim:

1. A device for transporting cylindrical articles, including grappling means comprised of first and second substantially semi-circular straps having their concave surfaces in opposed face-to-face relationship, means pivotally connecting the first ends of the straps, latch means for removably securing the other ends of the straps together, means to lower said mechanism over a cylindrical article having its cylindrical axis vertical, and contraction means intermediate the lengths of each of said straps to vary the circumference of the circle formed by said straps and thereby grip said article, said contraction means including a pair of tension elements connected to the grappling mechanism at spaced points and means simultaneously to shorten one and lengthen the other

tension element to change said axis to the horizontal, after said article has been gripped.

2. A device for transporting cylindrical articles comprising a housing, means for supporting the housing above an article to be transported, an expansible and contractible ring, the ring being split at horizontally spaced, diagonally opposite points, toggle mechanism including a toggle lever pivoted to the ring on a horizontal axis adjacent to each of said points for expanding and contracting the ring, an operating cable for each of the toggle levers having its ends connected to the ends of the toggle lever respectively, a pair of sheaves on the housing over which the central portions of the respective cables are trained, a slide on the housing to which the cables are connected, and power means on the housing for moving the slide.

3. A mobile device for handling cylindrical articles including grappling means comprised of first and second substantially semi-circular straps having their concave surfaces in opposed face-to-face relationship, a pivotal connection between first ends of the straps, a latch arm pivoted to the second end of one of the straps and swingable into and out of engagement with a latch lug on the second end of the other strap for removably securing second ends of the straps together, a hydraulic motor controllable from a remote point carried by said one of the straps and connected to the latch arm to swing it, each of said straps being split laterally intermediate its ends and forming a gap therein, slidable guide means spanning the gap in each strap to guide the sections of the strap circumferentially relative to each other, and expansion and contraction means connected across each of the gaps to vary the circumference of the circle formed by the straps after the latch bar has engaged the latch lug.

4. A mobile device for handling cylindrical articles, comprising grappling means including first and second substantially semi-circular straps having their concave surfaces in opposed face-to-face relationship, a pivotal connection between the first ends of each strap, a latch for removably securing second ends of the straps together,

each of said straps being split laterally intermediate its length and forming a gap therein, first and second adjacent ends defining each of said gaps, a toggle pivotally mounted to each of said first ends on a horizontal axis, a linkage arm pivotally connected to said toggle and to said second end, a pair of tension elements connected to opposite ends of each of said toggles, and means simultaneously to shorten one and lengthen the other tension element whereby said toggle and linkage arms will vary the distance between said adjacent ends and whereby the grappling means and a pipe held thereby can be turned about the horizontal axes of the toggles.

5. A device for transporting cylindrical articles comprising a grapple including an expansible and contractible ring, means carried by the ring to expand it so that it can be slipped over an article and to contract it to grip the article, said means including a pair of toggle levers pivoted on the ring on aligned horizontal axes, cables connected to opposite ends of the levers, and actuating means connected to the cables simultaneously to lengthen one cable and shorten the other cable connected to each lever thereby to turn the toggle lever in one direction or the other to expand or contract the ring and to turn the ring about said horizontal axes.

6. The device of claim 5 including axially extending positioning arms carried by the ring having inturned stop projections at one end to engage the end of the article to limit axial movement of the ring thereover.

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