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[54] **DEVICE TO CUT HOLES WITHIN THE WAVE TROUGHS OF A CORRUGATED TUBE, ESPECIALLY FOR DRAINAGE**

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[52] **U.S. Cl.** **83/326;** 83/194; 83/54; 83/227; 83/628; 83/660

[51] **Int. Cl.** **B26f 1/06;** B26d 5/22

[58] **Field of Search** ..... 83/54, 326, 226, 227, 183, 83/355, 660, 193, 194, 337, 420, 628, 926 R, 423, 278, 261

[56] **References Cited**

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Attorney, Agent, or Firm—Wolf, Greenfield & Sacks

[57] **ABSTRACT**

A device for cutting holes within the wave troughs of a corrugated tube for drainage purpose in which tool supports are geared with the waves of the tube. These tube supports are in one embodiment arranged along endless chains. Preferably there are provided two endless chains with one of their branches opposite to one another and with two respective tool support means facing one another and having gripping jaws enclosing the tube.

20 Claims, 6 Drawing Figures

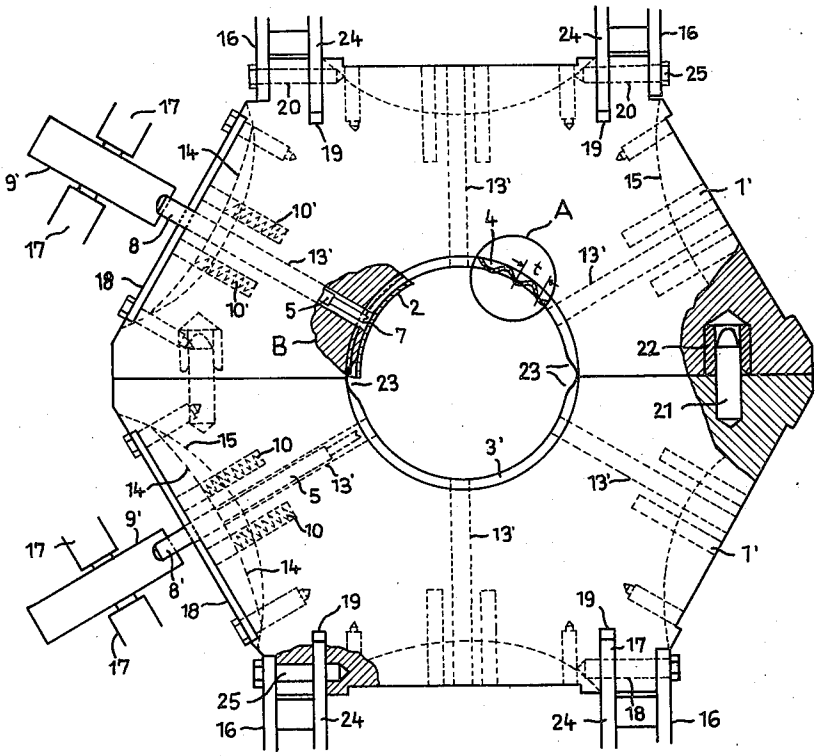


Fig.1

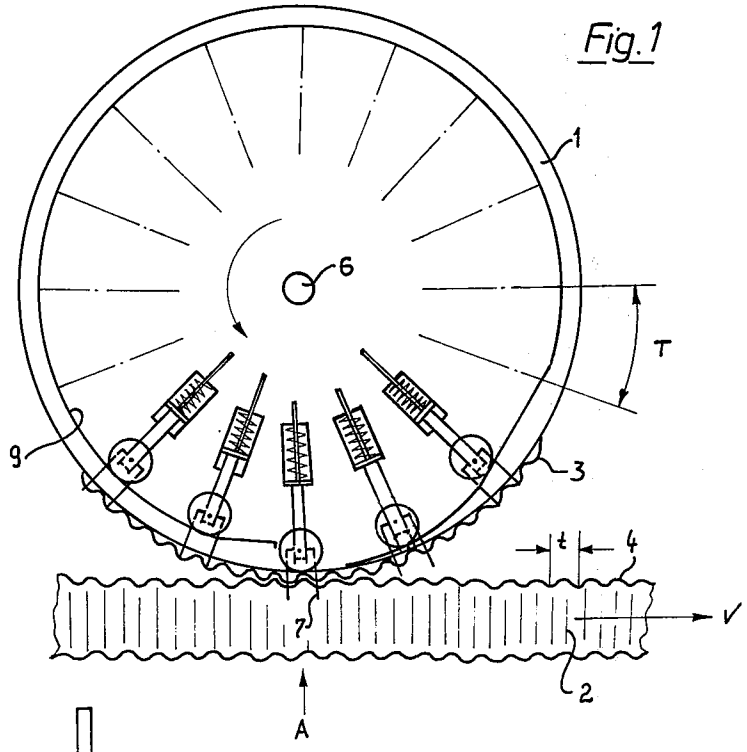


Fig.2

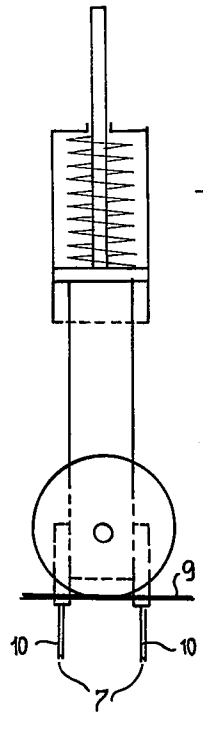
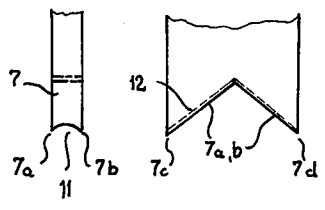


Fig.3



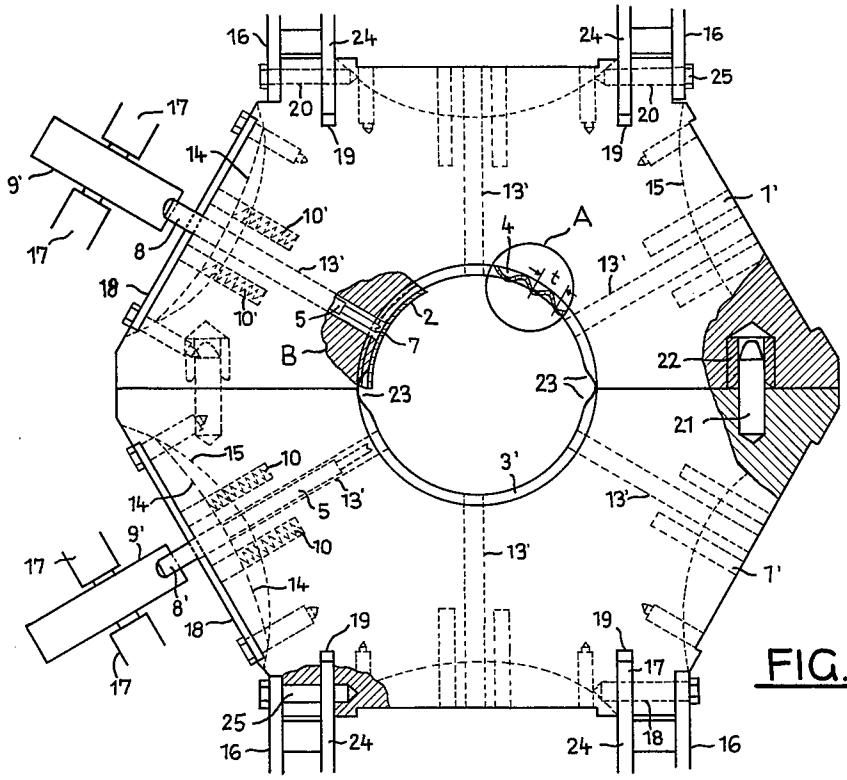


FIG.5

FIG.6

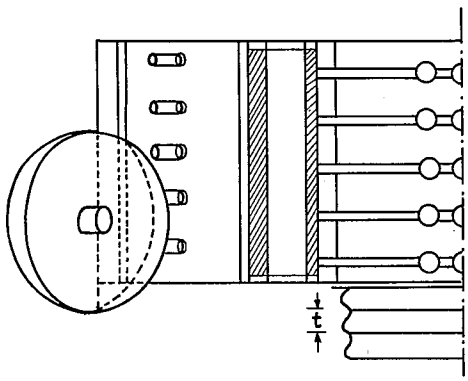
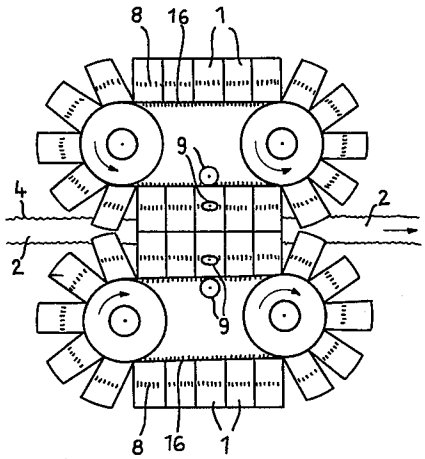


FIG.4



DEVICE TO CUT HOLES WITHIN THE WAVE TROUGHS OF A CORRUGATED TUBE, ESPECIALLY FOR DRAINAGE

The invention relates to a device for cutting holes within the wave troughs of a corrugated tube, especially for drainage.

It is known to provide warts within the wave troughs of corrugated draintubes and to slit said warts by rotating cutting tools in order to obtain openings for the water to be drained. The form of these known draintubes is complicated and different cutting devices are necessary for tubes with helical and circular wave troughs.

The main object of the present invention is to provide a cutting device of simple construction which ensures the high rate of production and is applicable for corrugated tubes with helical as well as circular waves.

In accordance with the invention the cutting tools are made as punching tools and the tool support is provided with means for an advance synchronously to the tube. The synchronism of tube and tool support makes it possible to use extremely high operating speeds and thereby to reach high outputs.

The punching tools each are connected to a cam follower operated by a stationary cam track.

The punching tools may be engaged by striker springs which are tensioned by said cam track whereas said cam track is provided with an interruption at the operating position, so that the punching tools are shooted forth by the striker springs.

The tool supports may be provided with tooth gearing the waves of the tube in order to obtain an exact synchronisation of the feed velocity and the advance velocity of the tool support.

A good adaptation to different conditions in association with a compact construction and high output may be obtained wherein the tool supports are arranged at endless chains and preferably at two endless chains with one of their branches opposite to one another and two tool supports facing one another to form gripping jaws enclosing and by said gearing transporting the tube.

These jaw-like tool supports are provided with coupling means for coupling always two tool supports wherever facing one another and each of said tool supports may support tools for half the circumference of the tube.

Two embodiments of the invention are shown in the drawing.

FIG. 1 shows a sideview of an embodiment with a wheel-like tool support,

FIG. 2 one of the tools used in the device of FIG. 1, in a larger scale,

FIG. 3 a cutting blade of the tool of FIG. 2 in a side- and frontview,

FIG. 4 a sideview of a second embodiment of a punching device with endless chains carrying the tool supports,

FIG. 5 in a larger scale two of the tool supports of FIG. 4 in the operating position, and

FIG. 6 a half sideview to FIG. 5.

In the drawing only the characteristic parts of the whole device are shown schematically as far as is necessary to understand the invention. FIG. 1 is showing a disk-like or wheel-like tool support 1 in connection with the tube to be punched advancing in direction of the arrow with feed velocity. In the operating position A the tool support 1 and tube 2 are advanced in the same direction with the same velocity v. The tool support 1 at its circumference is provided with tooth 3 for gearing with the waves 4 of the corrugated tube 2. Thereby an exact synchronuous advance is obtained and ensured so that the tool 5 when operated will punch the holes exactly within the ground of the wave troughs.

The gearing of tool support 1 and tube 2 will cause synchronising positive or negative forces accelerating or retarding the advance of the tube 2 feed from the extruder. These synchronising forces may easily be absorbed by the elastic tube.

The tool support 1 rotates around an axle 6 which is positioned crosswise to tube 2. A number of e.g. sixteen cutting tools 5 are arranged with a division $T = n \cdot t$ over the circumference of the tool support 1, said division T corresponding to an integral multiple of the wavelength t of tube 2, so that e.g. the next cutting tool 5 will reach its operating position after an advance of three wavelengths t.

The cutting tools 5 are slidable within guides 13 (not shown in FIG. 1 but in FIG. 4) and are supported by cam followers 8 in the form of rolls running at stationary cam tracks 9. The punching tools 5 are engaged by striker springs 10 which are tensioned by said cam track 9 whereas cam track 9 at the operating position A of the punching tools is provided with an interruption so that the punching tools are shooted forth by the striker springs 10. The cutting tool 5 is retracted from tube 2 and out of the hole which it has cut in the wall of this tube because it is retained by an edge at the circumference of the tool support 1. Finally the tool 5 will return after a rotation over 360° in the position for its next cutting operation.

In order to obtain an exact and undisturbed cutting and retracting operation of the cutting tool the cutting edges 7 are hollow-edged in a crossed direction namely in feed direction and crosswise to the feed direction as is shown at 11 and 12 in FIG. 2 and 3. Each cutting tool has two cutting edges 7 in a distance corresponding to the wavelength t of the waves 4 of tube 2. The cutting edges 7,7 are formed by a fore and rear roof shaped edge of a cutting blade 11 which is arranged crosswise to the feed direction. The inclination of said roof profile is made steep enough to ensure that both cutting edges 7,7 will reach the wall of tube 2 at first with their cutting tips 7c,7d.

In order to cut holes over the whole circumference of tube 2 several tool supports 1 may be arranged with angular positions from 60 to 60°. Only one of the tool supports is shown in FIG. 1.

FIGS. 4, 5 and 6 are showing a second embodiment of a cutting device according to the invention in which the tool supports 1' are arranged at two endless chains 16, 16 with one of their branches opposite to one another, so that in the area of these parallel facing branches always two tool supports 1',1' are facing one another and are forming gripping jaws enclosing the tube 2.

Within the area of said two branches the tool supports are forming an uninterrupted file of gripping jaws e.g. a file of five pairs of jaws 1',1'.

The jaws 1',1' are glaring by tooth 3' with the waves 4 of the tube 2. Each two support 1' is provided with coupling means 21, 22 for coupling always two tool

supports whenever facing one another. Said coupling means consist of wobblers 21 and sleeves 22.

Each of said tool supports 1' supports cutting tools 5 for half the circumference of tube 2 and extends over a plurality of e.g. over ten troughs of wave 4 of the tube taken along and is provided with rows of tools for producing holes within each *n*-th e.g. each second trough of waves. Preferably said rows of tools are arranged with a displacement of adjacent rows by one wavelength *t*.

In FIG. 5 only two of six cutting tools 5 are shown with their cam tracks 9'. Thus each tool support 1' includes three rows of five cutting tools (compare square section B in FIG. 5).

The cutting tools 5 are positioned in guides 13'. They are driven forth for punching operation by cam tracks 9' and are retracted into their rest position by restoring springs 10' which engage a cross pin 14 passing a cross hole within the shaft of tool 5. This cross pin 14 is a spring wire lying within a slit 15 of the tool support 1' and is assisting the action of restoring spring 10'.

The cam tracks 9' consist of idle rollers which are arranged in stationary supports 17. The velocity of the cutting movement depends on the diameter of said idle rollers 9'; it will be high with a small diameter and lower with a larger diameter. However, as the punching work is performed on the adjacent straight branches of chains 16, 16 it is possible to obtain very high velocities even with large diameters of said idle rollers. With an idle roller 9' of large diameter always several e.g. three or five cutting tools are sumultaneously actuated.

The cutting tools extend over the outside of the tool supports 1' with simple pin-like cam followers 8'. Said slits 15 for said cross pins 14 are closed by a cover 18 with holes for the passage of cam followers 8'.

The tool supports 1' are provided with slits 19 for the incorporation and with bores 20 for the attachment of connecting pieces 24 for connecting the tool supports 1' to chains 16.

We claim:

1. A device for cutting holes within the wave troughs of a corrugated tube for drainage purposes, said device comprising a feeding means for said tube to feed the tube in its longitudinal direction, a plurality of individual cutting tools extending radially of the tube, means for supporting said cutting tools including a plurality of gripping jaws substantially totally enclosing said tube and means defining a tooth gear for meshing with said corrugated tube, each said jaw carrying a plurality of spaced radially extending cutting tools, each said jaw having a surface for contacting the other jaw with said contacting surface having means associated therewith for interlocking and aligning the jaws, and cam means coupled to said cutting tools and operable to control said cutting tools.

2. The device of claim 1 including retracting springs for retracting said cutting tools.

3. The device of claim 1 wherein said gripping jaws includes an endless chain.

4. The device of claim 1 wherein said supporting means includes two endless chains and means supporting said chains opposite to one another.

5. The device of claim 4 wherein said tool supporting means carriers said tools in an uninterrupted fashion.

6. The device of claim 4 including coupling means for aligning said tool supporting means that are enclosing said tube.

7. The device of claim 4 wherein each of said gripping jaws supports tools for half the circumference of the tube.

8. The device of claim 4 wherein each of said gripping jaws extends over a plurality of troughs and is provided with rows of tools for producing holes within each alternate trough of wave.

9. The device of claim 1 wherein said cam means includes a cam follower and cam track having idle rollers.

10. The device of claim 1 including chain means, at least one being coupled to each gripping jaw for supporting the gripping jaws in diametrically disposed positions relative to the tube.

11. The device of claim 10 wherein the gripping jaws each surround approximately 180° of the tube.

12. A device for cutting holes in a corrugated tube for drainage purposes, said device comprising a plurality of cutting tools extending radially of the tube, a pair of jaw members for holding the cutting tools, each member having a wall from which the cutting tool may extend to pierce the tube and each member carrying a plurality of spaced radially extending cutting tools, said members each having means defining a tool gear for meshing with the corrugated tube, means for positioning and conveying the tube in a longitudinal direction wherein the jaw members of the pair substantially totally surround the tube and intermesh with the tube for the purpose of permitting a feeding of the tube and are positioned in facing relationship and means associated with each jaw member for aligning the pair of jaw members.

13. The device of claim 12 wherein the jaw members substantially totally surround the tube and intermesh with the tube for the purpose of permitting a feeding of the tube, and said means for positioning includes an endless pair of chains, one associated with each jaw member.

14. The device of claim 12 wherein the jaw members are conveyed along a portion of the tube and do not engage with the tube only tangentially.

15. The device of claim 14 wherein the jaw members are conveyed parallel to the tube.

16. The device of claim 6 wherein each said jaw has a surface contacting a facing jaw and said coupling means extends between said contacting surfaces.

17. The device of claim 16 wherein said contacting surfaces are flat and said coupling means includes at least a stud.

18. The device of claim 12 wherein each member of the pair has a surface in facing contact with a similar surface of the other member.

19. The device of claim 18 wherein said means for aligning includes at least a means extending from the contacting surface of one of said members.

20. The device of claim 19 wherein the means for aligning includes a pair of studs and like mating holes associated with the contacting surfaces.

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