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[54] MACHINE FOR DRAWING EXTRUDED PLASTIC TUBING OR ROD FROM AN EXTRUDER
10 Claims, 17 Drawing Figs.

[52]	U.S. Cl.	226/172, 226/177, 226/188
[51]	Int. Cl.	B65h 29/12
[50]	Field of Search	226/172, 176, 177, 171, 178

[56] **References Cited**

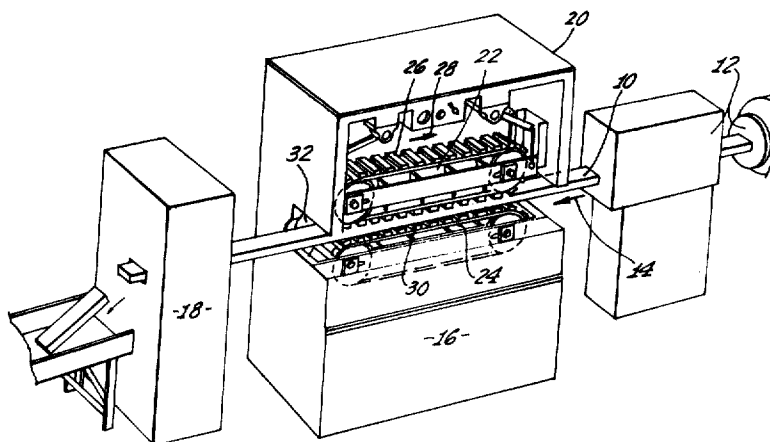
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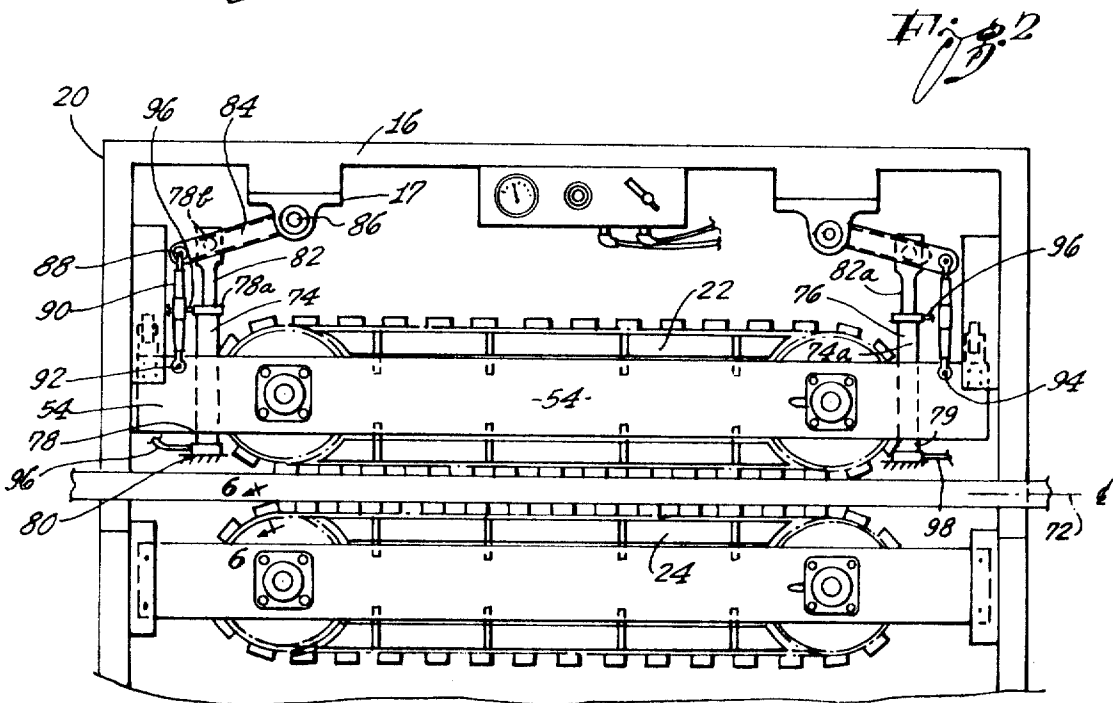
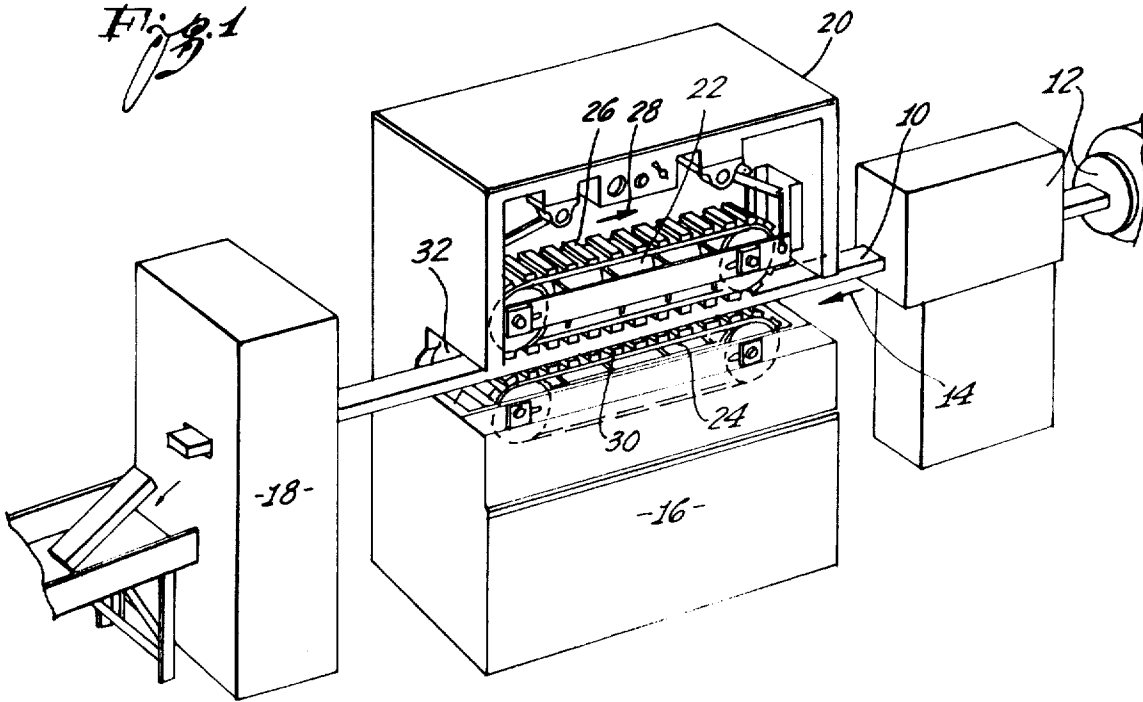
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ABSTRACT: In the type of machine which employs a pair of opposed driven endless belts or tracks moving in opposite directions to draw plastic pipe from an extruder, the present invention in its most complete embodiment utilizes two such pairs, both of which are disposed about a common axis, with each pair being normal to the other pair. Both of these pairs of tracks are displaceable radially with respect to such axis, preferably with one pair of tracks operable to come together completely and the other only to a distance at least as great as the width of the other pair of tracks. This displacement is accomplished by means of double acting fluid actuated piston-cylinder units, one end of which is secured to a frame supporting and/or housing the tracks, and the other end linked to displace the end or ends of one or more transverse element supporting the tracks. In the embodiment in which two pairs of tracks are employed, the displacement of the support elements for each pair of tracks may be accomplished simultaneously by crank actuated rotating sprocket elements which are connected for rotation by an endless chain to a crank driven sprocket which is operated by a double acting piston-cylinder unit connected to the crank. Continuous driving of all the tracks during displacement may be accomplished by the use of pairs of universal joints in conjunction with rotating drive rods.





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Fig. 3

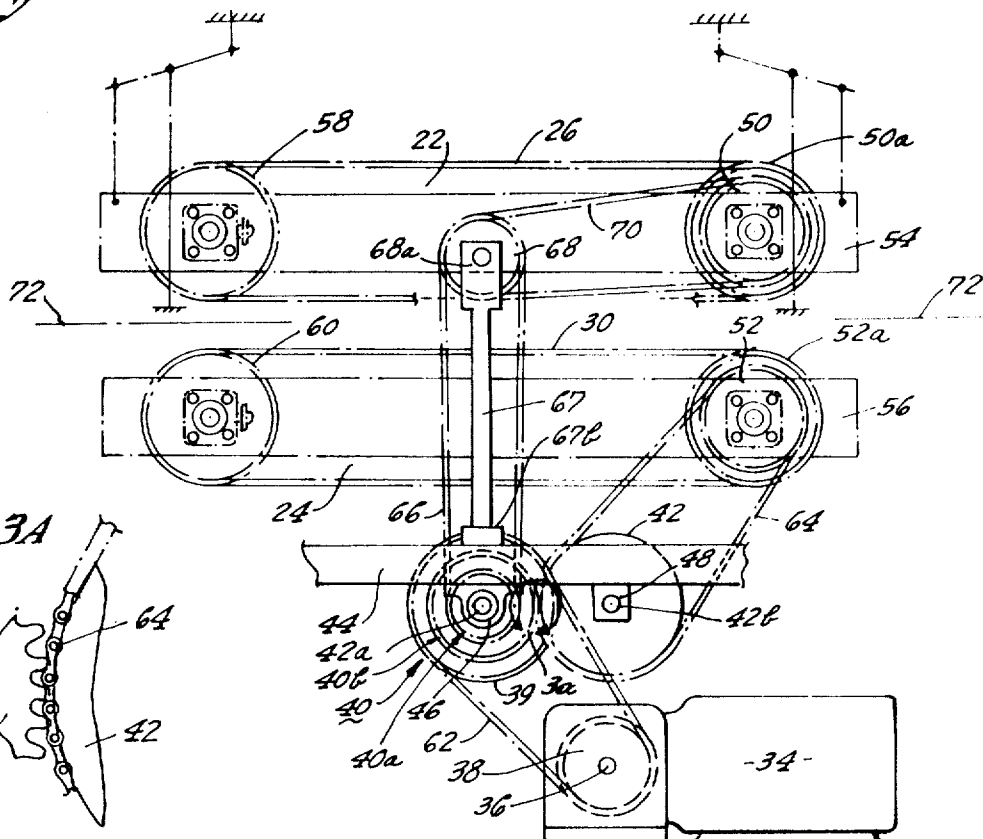


Fig. 3A

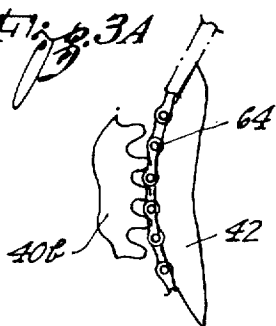


Fig. 6

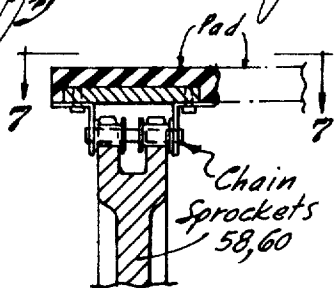


Fig. 4

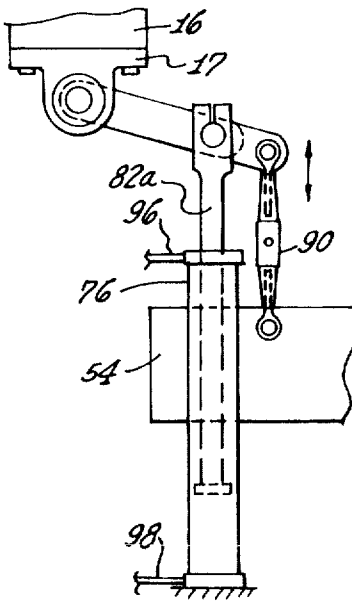


Fig. 5

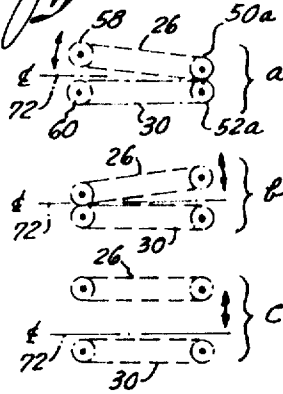
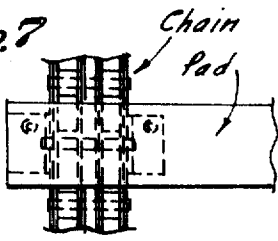
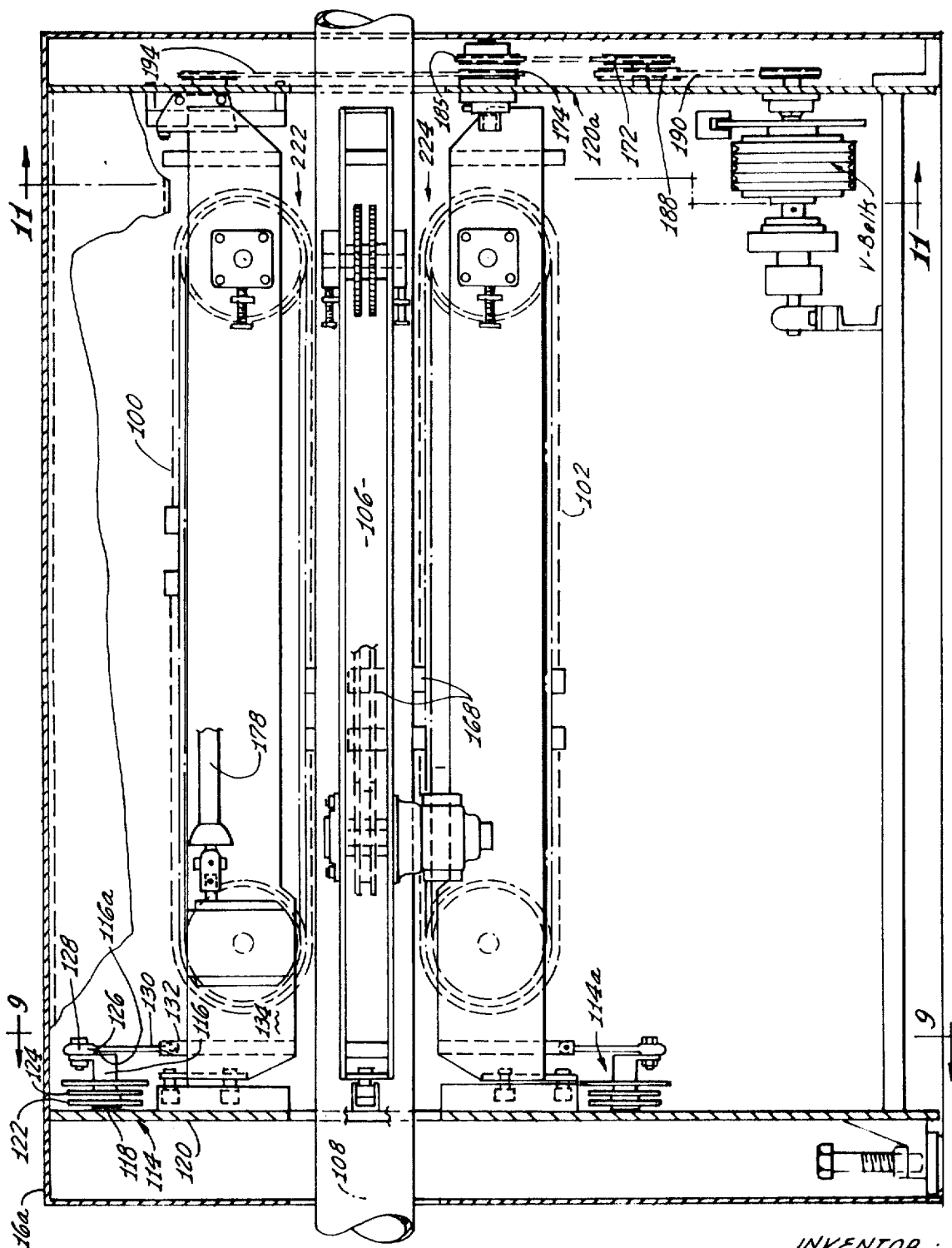


Fig. 7



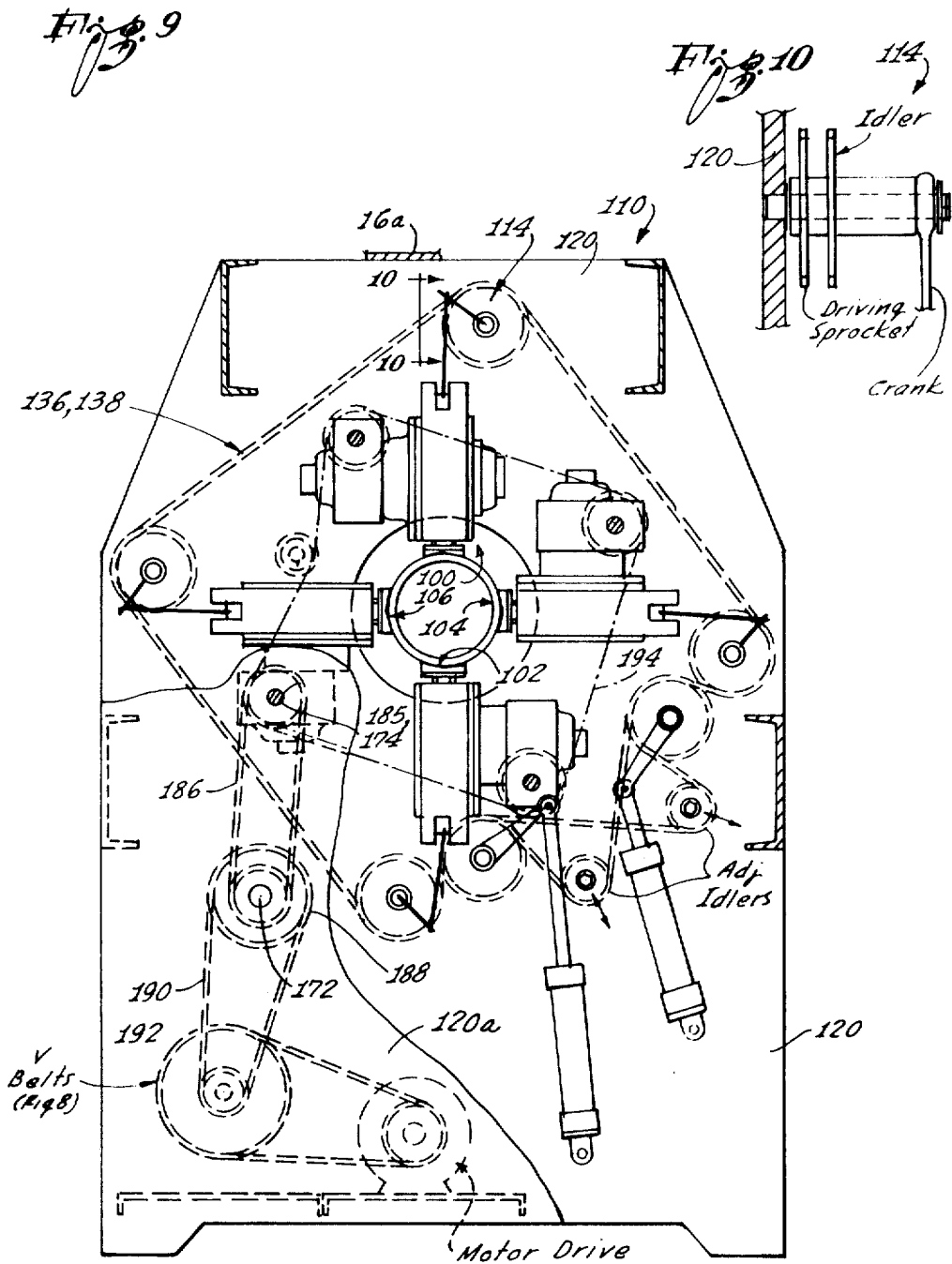
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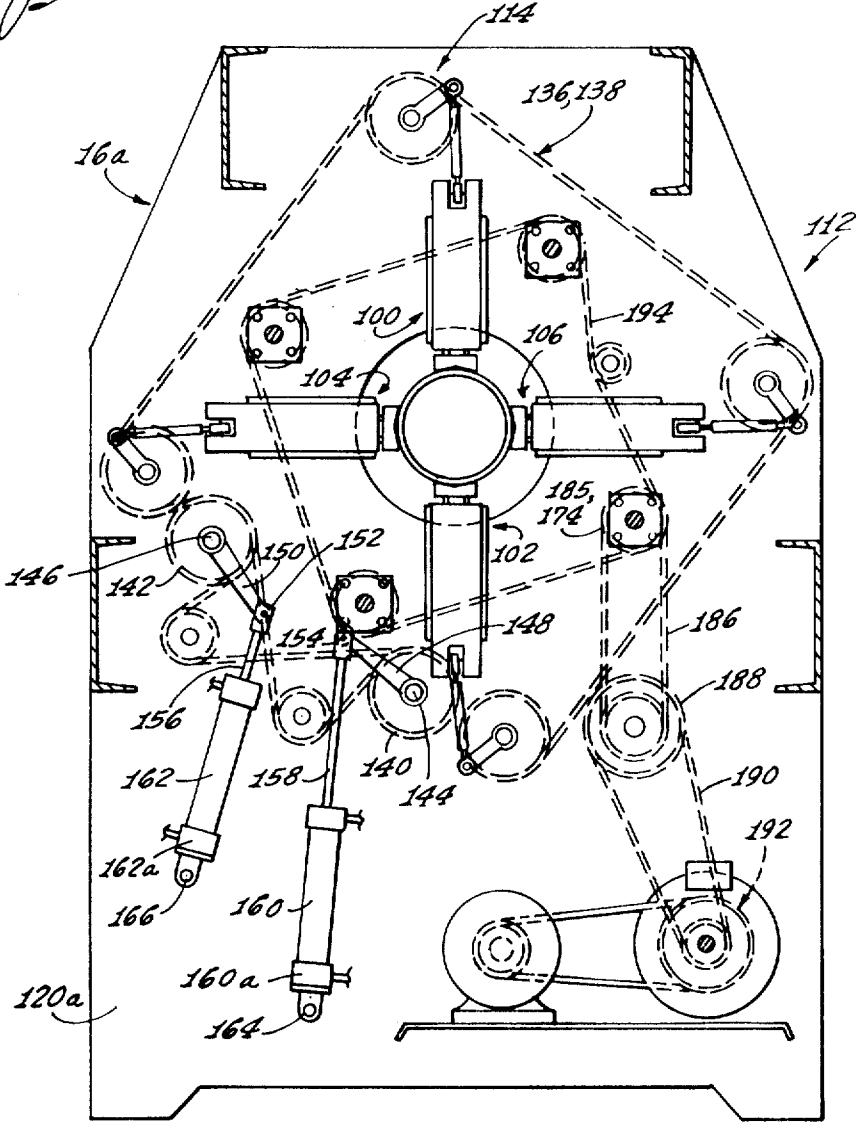
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Fig. 11 (Motor End)



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Fig. 12 (Two Chain System)

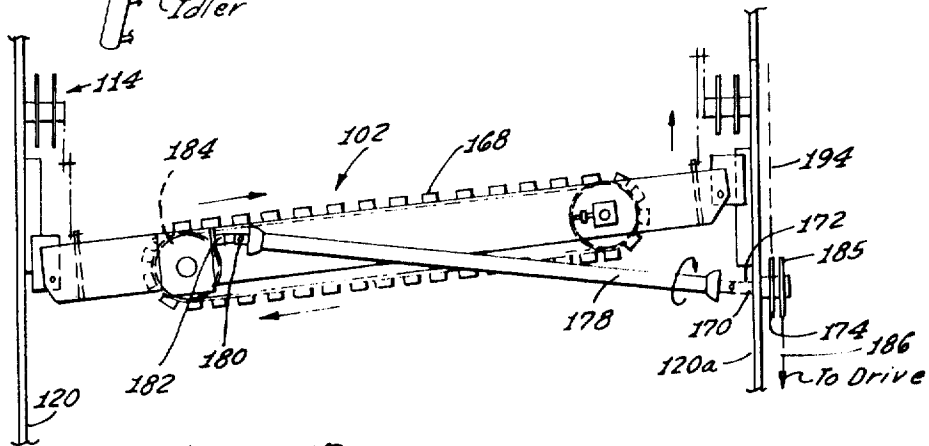
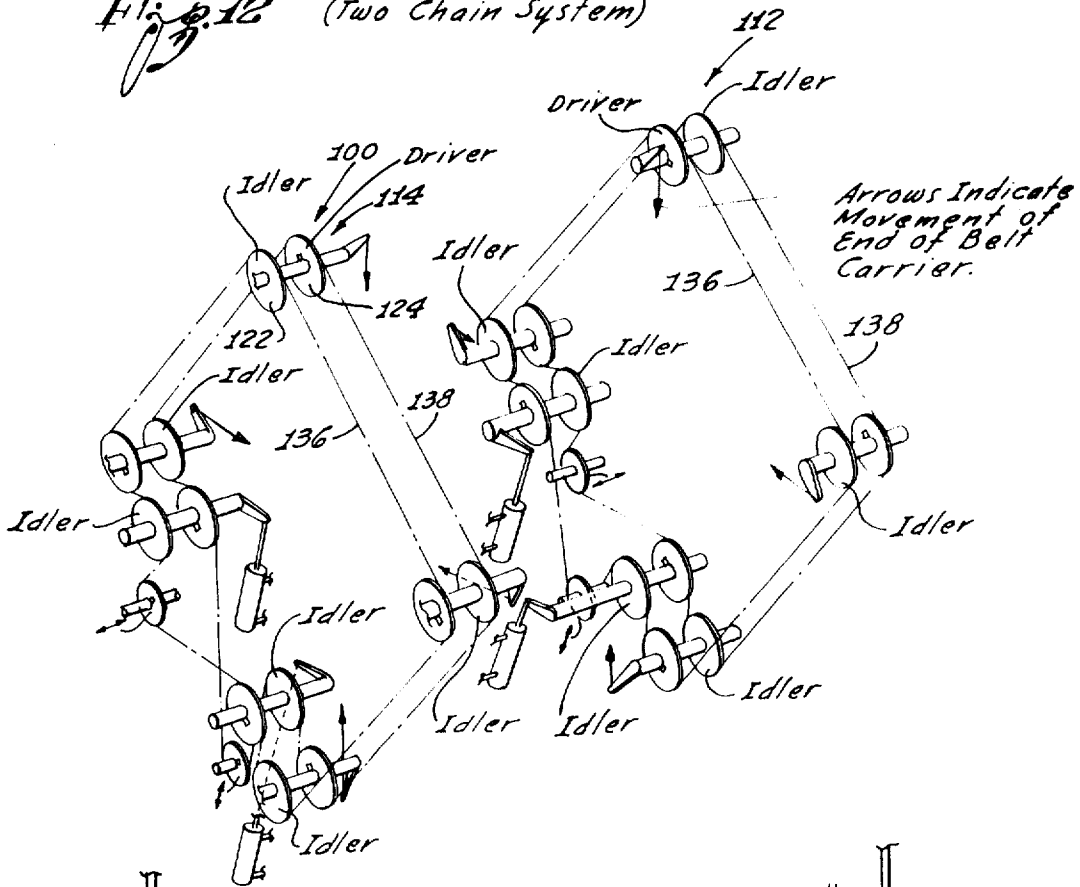


Fig. 13

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Fig. 16

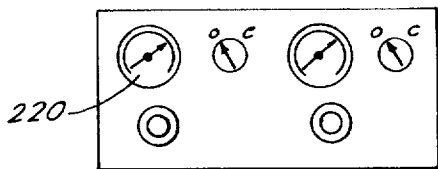


Fig. 15

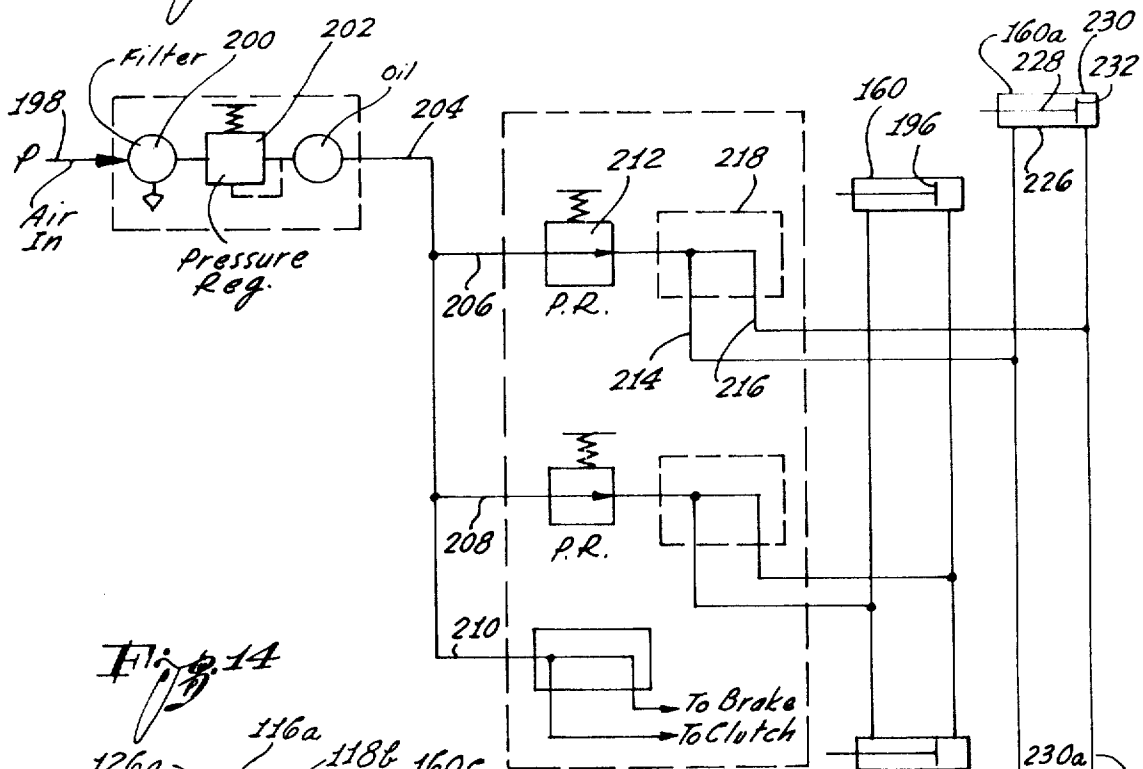
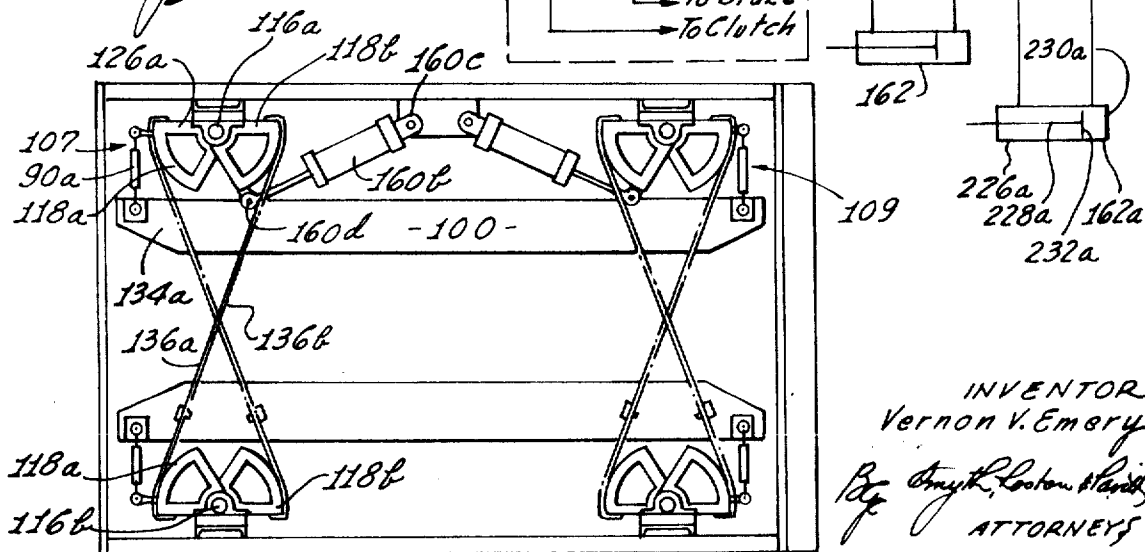


Fig. 14



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MACHINE FOR DRAWING EXTRUDED PLASTIC TUBING OR ROD FROM AN EXTRUDER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention falls in the field of machines which are designed to transport a longitudinally extending element which are fed to them from an entering position to a discharge position and which element may require some pulling force at the entering position to cause it to be so transported from the latter position to the point of discharge. The present invention has a particular contemplated application in providing a machine for drawing hollow plastic tubing or plastic rod from an extruder which is forming the element in a still somewhat plastic state.

2. Description of the Prior Art

Plastic bar, sheet and hollow pipe pulling machines have been known and in commercial use for many years. Examples of such pulling machines which have been on the market are those offered by Speedex (Engineering), Limited of England Gatto Machinery Development Corp. of Farmingdale, Long Island, N. Y., and Ferris Universal Machine Corp. of Palisades Park, N. J. In each of the machines offered by these manufacturers, a pair of endless belt tracks is disposed one above the other with their belts moving in opposite directions. When the end of the plastic pipe is inserted between the belts where they turn and both move inwardly toward and adjacent each other, the pipe, if it fits snugly between the belts will be drawn between the belts, moved horizontally and finally ejected in the area where the belts turn outwardly away from each other.

Since the machine must ordinarily handle different size pipes, some provision is made in these prior art machines for manually adjusting the spacing between the belts. Patents illustrating certain of these and other prior art devices are those issued to C. Gatto (U.S. Pat. No. 3,170,564), D. T. Slater (U.S. Pat. No. 3,285,485), A. L. Barnett, et al. (U.S. Pat. No. 3,184,040).

Endless belt or tractor-type machines have also been devised for pulling and feeding cables, wires, strands an other longitudinally extending elements. The following patents are illustrative of the various different concepts which have been utilized and/or patented in the plastic pulling field or other fields:

Inventor	Patent No.	Date Issued
G. A. Seeley	1,904,885	Apr. 18, 1933
E. H. Boddy		
et al.	2,045,997	July 7, 1936
L. O. Reichelt	2,251,291	Aug. 5, 1941
W. J. Flintjer	2,297,295	Sept. 29, 1942
H. A. Barnby		
et al.	2,372,646	Apr. 3, 1945
W. L. McNamara		
et al.	2,421,515	June 3, 1947
W. A. Morton		
et al.	2,438,448	Mar. 23, 1948
E. M. Enkur		
et al.	2,479,822	Aug. 23, 1949
J. W. Offutt	2,598,190	May 27, 1952
H. V. Kindseth		
et al.	2,674,366	Apr. 6, 1954
P. R. Powell	2,679,924	June 1, 1954
K. W. Hallden	2,767,829	Oct. 23, 1956
M. Meyerbach	2,742,144	Apr. 17, 1956
K. W. Hallden	2,797,798	July 2, 1957
C. C. Peck	2,915,171	Dec. 1, 1959
H. O. Lutcke	2,935,178	May 3, 1960
R. W. Gretter	3,024,956	Mar. 13, 1962
J. J. Chandler		
et al.	3,068,920	Dec. 18, 1962
E. E. Marshall	3,105,334	Oct. 1, 1963
J. Van Eldik	3,143,269	Aug. 4, 1964
D. T. Slater		
et al.	3,182,877	May 11, 1965
A. Castela	3,216,639	Nov. 9, 1965

One of the principal problems today in pulling plastic pipe by machines lies in the fact that labor employed to operate these machines is often quite unskilled and incapable of properly appreciating what adjustments must be made to accommodate different sizes of pipe and of making such adjustments, of knowing at what speed to operate the machine to pull the pipe and properly setting the machine for such speed, and of otherwise properly regulating the machines to accommodate different diameters and types of extruded elements. Such adjustments are often critical to successful start-up and continuous production runs of the machines.

Further, where the pipe is thin-walled and still somewhat plastic, if it is pressed too tightly between the endless belt drawing means, it may be undesirably flattened or otherwise distorted. Also, with prior art machines which provide only two belts, the pipe or other element passing between them may tend to wander laterally away from the central vertical plane through the belts. This may cause distortion of the plastic pipe or other problems.

It has become quite desirable, therefore, to provide a machine which overcomes these problems in an inexpensive, foolproof and practical manner.

While no one has yet placed upon the market the machine which automatically adjusts itself to accommodate a wide range of diameters of extruded plastic elements whether round, oval, straight, flat, warped or tapered, it has been noted that the U.S. Pat. to L. Pease (No. 3,386,564) discloses a "Feed Table" to handle different size logs as they are fed to a machine for processing them into building materials. The Pease machine provides a pair of endless belts which are adapted automatically to move apart and back together to accommodate different size logs. This bears some similarity to one feature of the present invention. Moreover, the Pease log-handling machine does so by utilizing an air pressure actuated cylinder. However, despite these similarities in object and certain mechanisms to those of the present invention, the Pease machine does not accomplish all the objectives of the present invention, nor could it be readily utilized without substantial modification to draw plastic pipe from an extruder. It is particularly not adapted to provide two pairs of endless belt devices to handle and preserve the shape of hollow plastic pipe.

SUMMARY OF THE INVENTION

In the preferred embodiment of the invention two pairs of opposed and oppositely moving endless belts are disposed normally to each other about a common axis. Each belt is displaceable radially with respect to said axis, the top and bottom belts being adapted to move over radii from contact with each other to a predetermined maximum distance, while the side belts are limited in their movement to come no closer together than the width of the top and bottom belts. This displacement is accomplished by a mechanism which serves to cause the ends of each pair of belts to move to and from each other simultaneously in reaction to any force or lack of force developed between each pair of opposed ends by the presence or absence of any object between such opposed ends. By this action, the machine readily accepts plastic tubing or other elongated plastic material of different diameters and shapes (within the range of movement of the belt ends), properly centers the tubing to prevent distortion, holds it in its generally circular shape, and draws it through the machine between the two pairs of belts for discharge at the opposite ends of these belts.

While this may appear to be a simple concept, it is not a simple one to execute—particularly when it is done economically in a relatively compact manner with a minimum number of components and with a reliable construction. This will be appreciated when one realizes that not only must a mechanism be provided to keep all four belts moving at all times and in any disposition of the ends of the belts, but mechanisms must be provided at both ends of the belts to render both pairs of

belt ends reactive to the presence or absence of any force developed between each pair of belt ends.

In the preferred embodiment of the invention these objectives are accomplished by providing orifices end plates as a part of the machine frame, each of such plates being perpendicular to the common axis about which the two pairs of belts are disposed, and the main orifice of each plate being generally centered with respect to such axis, to serve as a guide for the incoming or outgoing plastic tubing as it enters or leaves the pairs of endless belts. There is mounted on each end plate two series of five sprockets over each of which passes an interconnecting driving actuating chain. One of the sprockets of each series is connected with the rod of a piston-cylinder unit to be rotated thereby. Two of the other sprockets of each series serve as idlers, while the last two of the five sprockets are each linked to one end of the ends of one of a pair of the endless belts in such a manner that any rotation of the sprocket will displace the belt end radially with reference to the common axis mentioned above. Each of the two series of five sprockets has common axes for its four sprockets which are not connected with the rod of a piston-cylinder unit, but each of the idler sprockets of one series is disposed on an axle which rotates with one of the sprockets of the other series which is linked to displace the end of a belt. By this arrangement the two actuating chains may be disposed adjacent and parallel to each other for that part of their respective courses which take them over the coaxial sprockets, thereby saving both space and components, and enabling the sprockets to be disposed on one side of the end plate, and the belt-displacing linkage on the other side, if this should be desired.

It is also a feature of the invention to provide double-acting fluid actuated piston-cylinder units to operate the sprocket chain linkage arrangements last described, such units having one of either the cylinder or piston of the unit anchored to the end plate and the other connected to a bellcrank to rotate the driving sprocket. Each of these units is provided with fluid, such as air, under a preset pressure to one side of the piston, thereby to bring together to their closest possible points each pair of opposed belt ends. When any force is applied between the belts, as by the presence of a tubing end, such force is transmitted through the bellcranks, sprockets and chain assembly to the piston rod in opposition to the preset air pressure on one side of the piston. If the force so reaching the piston exceeds the preset air pressure, the piston will move and permit the ends of the opposed belts to open in response to the force so developed. Conversely, when less or no force is applied, the piston is then forced back by the preset air pressure to the maximum extent or to the position at which there is sufficient force to overcome such air pressure.

In an alternative and sometimes preferred two pair belt embodiment, all of the belt-displacing mechanisms may be disposed between the end plates of the machine frame and in lieu of the coaxial sprocket and chain and bellcrank assemblies, an entirely different set of assemblies may be provided, as follows: a pair of axles is rotatably mounted normal to the direction of movement of the belts when they are displaced, one axle at the top of the frame and one at the bottom. Each axle carries a radial arm, secured to rotate with the axle, and, spaced axially therefrom, a pair of sprocket angular sectors supported by radial elements secured to the axle also to rotate therewith. Crossing chains connect the opposite sprocket sectors of the two axle assemblies. One sector IS CONNECTED TO THE PISTON ROD OF A double-acting piston-cylinder unit of the type heretofore described while the cylinder of the unit is pivotably secured to the machine frame. The axle arm is linked by a turnbuckle to one end of the transverse belt support. A similar arrangement may be provided for the side belt displacement by simply disposing it 90° about the machine axis from that for displacing the top and bottom belts.

The problem of maintaining continuous movement of all four of the belts irrespective of the displacement of the ends of the belts with reference to the common axis is solved by providing four short sprocket driven drive shafts which extend

through one of the two end plates. The sprockets are driven by an endless chain which extends over each drive shaft sprocket as well as over a sprocket driven by a motor. Each drive shaft may then be connected by a universal joint to an intermediate drive shaft which, in turn, is connected by a further universal joint to a final drive shaft constituting a part of the endless belt assembly. By the use of two universal joints one on each end of the intermediate drive shaft, driving power may be continuously supplied to each endless belt assembly irrespective of its disposition with reference to the common axis.

In another but simpler embodiment of the invention provision is made to raise and lower only one of the two opposed endless belt assemblies by disposing a piston-cylinder unit vertically in the vicinity of each end of the upper endless track device to operate a lever which is linked to raise and lower such end of the device. As in the preferred embodiment, one end of the piston-cylinder unit is secured to the frame for housing or supporting the endless track devices. Since only one of the track devices moves relative to the other, it is only necessary to make special provision for continuous power for driving one displaceable track device. This is accomplished by locating a driven sprocket at a fixed location at least centrally of the sprocket on the endless track device end which serves to drive the endless track and providing an endless chain to engage both of the last said sprockets. The driving sprocket of the endless track device, which is not displaced of course, presents no problem and is connected by another endless chain which may be driven by another sprocket by a common motor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an embodiment of the invention in which only the upper endless belt device is displaceable.

FIG. 2 is a partial side elevation of the machine of FIG. 1.

FIG. 3 is a partially schematic and partially elevational view of the machine of FIG. 1, showing the belt-driving system.

FIG. 3A is an enlarged detail of the chain-sprocket engagement of FIG. 3.

FIG. 4 is an enlarged detail of the right-hand displacing mechanism of FIG. 2.

FIG. 5 is a schematic view of the displacement positions possible with the machine of FIG. 1.

FIG. 6 is an enlarged sectional view taken on the line 606 of FIG. 2.

FIG. 7 is a plan view taken on the line 7—7 of FIG. 6.

FIG. 8 is an elevational view partially broken away of a four belt embodiment of the invention.

FIG. 9 is an end elevation looking from the left-hand side of FIG. 8.

FIG. 10 is an enlarged detail of the idler-sprocket combinations employed in the FIG. 8 embodiment.

FIG. 11 is an end elevation looking from the right-hand side of FIG. 8.

FIG. 12 is a schematic view of the belt-displacing systems of the FIG. 8 embodiment.

FIG. 13 is a detail showing the driving system for each endless belt.

FIG. 14 is a side elevation of an alternative belt-displacing arrangement.

FIG. 15 is a schematic diagram of the air pressure and control circuit to operate the piston-cylinder units.

FIG. 16 is an elevation of a control panel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The manner in which a machine constructed in accordance with one embodiment of the present invention may be utilized is illustrated in FIG. 1.

A plastic bar or tube 10 is being discharged from an extruder 12 in the direction of the arrow 14. As the bar 10 moves away from the extruder 12, it enters the machine 16 and passes through it to a cutter or other processor 18. The

machine 16 in this embodiment of the invention is constructed within a housing 20 and includes a pair of endless track devices 22 and 24. The track 26 of the upper device is moved in the direction of the arrow 28 while the track 30 moves in the opposite direction. Any object such as the bar 10, therefore, which is caught between the moving upper and lower track 26 and 30 respectively will be pulled further in the direction of the arrow 14 and moved between the track devices 22 and 24, until discharged in the area 32, where the tracks 26, 30 both turn away from the bar 10.

As shown in FIG. 3, the tracks 26, 30 are continuously driven by the motor 34, through the drive shaft 36, which is fixedly secured to rotate a coaxial sprocket 38. Two further drive wheels 40 and 42 are mounted on the transverse frame member 44 by axles 42a, 42b respectively, which rotate in the bushings 46 and 48 respectively. Each track device 22, 24 is provided at one end with a sprocket 50, 52 respectively, mounted to rotate on transverse track support elements 54, 56 respectively. Sprockets 50, 52 are fixedly secured to the coaxial sprocketlike wheels 50a and 52a respectively to rotate with the latter. Hence, rotation of the sprockets 50 and 52 causes the wheels 50a and 52a to move the tracks 26, 30 respectively, to move not only about wheels 50a and 52a, but about the further sprocketlike wheels 58 and 60 rotatably mounted at the opposite ends of the transverse support elements 54 and 56 respectively.

The sprocket 38 is connected by a chain 62 with the outer sprocket 39 of the drive wheel assembly 40 which comprises such outer sprocket 39, an inner sprocket 40a with an intermediate sprocket 40b, all coaxially disposed with respect, and secured to each other so that the entire assembly 40 rotates as a unit. Sprocket 40b is engaged peripherally with chain 64 and with drive wheel 42 in the manner illustrated in detail in FIG. 3a, said chain 64 fitting tightly over wheel 42 and sprocket 52. Inner sprocket 40a is connected by a further chain 66 to an idler sprocket wheel 68, which is held at a fixed distance from a wheel assembly 40 by a vertical element 67, secured at its lower end 67b to transverse support element 44 and by a bracket (not shown) to the machine frame so that it stands rigidly to one side of the belt 26. Another idler wheel sprocket (not shown) is coaxial to and rotates with idler sprocket wheel 68 and, in turn, is connected by additional chain 70 to the sprocket 50, to cause rotation thereof.

In this embodiment of the invention, only the upper track device 22, is displaceable with respect to an axis 72 which passes midway between the upper and lower endless track devices 22, 24. The manner and extent to which the upper track device is so displaceable is illustrated schematically in FIG. 5. This displacement is accomplished by means of fluid actuated piston-cylinder combinations 74 and 76 shown in FIGS. 2 and 4. Considering the combination 74, the cylinder 78 is fixedly secured at one end to the housing frame 80 and a double-acting piston rod 82 extends from the end 78a of the cylinder 78 to connect slideably at 78b with lever 84, one end of which lever is pivotally mounted at 86 on the trunnion 17 of the machine housing 16. The opposite end of the lever 88 is linked by a turnbuckle 90 to the end 92 of the transverse support element 54. The piston-cylinder combination 76 is similarly but oppositely set up and linked to the opposite end 94 of the transverse support element 54.

It will be readily apparent that with this arrangement, whenever the piston shaft 82 is forced upwardly, it will elevate the end 92 of the transverse support element 54. Correspondingly, whenever the piston shaft 82a is forced upwardly, it will similarly elevate the opposite end 94 of the transverse support element 54. The manner in which these piston-cylinder combinations 74 and 76 are actuated by control of air supplied through conduits 96 and 98 to the cylinders 78 and 79, will be described more fully in conjunction with the operation of the FIGS. 8 through 15 embodiment.

By bringing track driving power up from the motor 34 through the sprocket wheel assembly 40, chain 66, the idler sprocket wheels 68, and chain 70 to the sprocket 50, with the

chain 66 being maintained rigidly, the track 26 may be driven continuously in synchronism with track 30, notwithstanding that the fact that either or both ends of track device 22 may be raised or lowered as shown in FIG. 5.

In the embodiment of the invention disclosed in FIGS. 8 through 15, there are four track devices 100, 102, 104 and 106, comprising two pairs both of which pairs are displaceable with respect to a common axis 108 through the machine. This displacement is accomplished by providing a series of chain operated assemblies 110, 112 in each end of the machine, which are shown schematically in FIG. 13.

Each end of each track device is held in position and displaced from its normal position by a subassembly which is typified by that shown in the upper left-hand corner of FIG. 8. In this subassembly 114, a rotatable shaft 116 is journaled in a sleeve socket 118 which is secured to the end wall 120 of the machine frame 16a. The subassembly 114 is provided with a rotatable idler sprocket 122 which rotates about the outer wall of the sleeve socket 118. A second sprocket 124 is secured to rotate with the shaft 116. The free 163 116a of the latter has a radiating bellcrank 126 rotatable with the shaft 116. This bellcrank 126 is orificed at 128 so that it may be pivotally secured to a linking element 130, the other end of which linking element is connected to an extension 132 of the transverse support element 134, on which the track device 100 is mounted.

Each of the four subassemblies 114 is connected by a driving pair of chains 136, 138. The subassemblies 114 are similar in construction except that successive assemblies alternate the location of their idler sprockets 122 and their sprockets 124 which are secured to rotate with the shaft 116 as shown in FIG. 12, and each chain 136, 138 also partially circumscribes and engages a driving sprocket 140 or 142. Each of these driving sprockets 140, 142 is secured to rotate on a shaft 144, 146 respectively, and from which shaft radiates a bellcrank 148, 150 respectively. Each of these cranks is connected at its outer extremity to the end 152, 154 of a piston rod 156, 158 of double acting piston-cylinder combinations 160, 162 respectively. Each of these piston-cylinder combinations is similar to the units 74, 76 which have been described in connection with FIGS. 1 through 7 embodiment of the invention. As in the latter, one end of the cylinder 160a, 162a is anchored at 164, 166 respectively to the end wall 120 of the machine 16a. It will be observed from FIGS. 11 and 12 that the assemblies 114, 114a are linked by the driving chains 136, 138 in such a manner that the crank rotating sprockets 124 of the subassemblies 114, 114a for any pair of the opposed tracking devices (e.g. 100, 102, 104, 106), will be rotated by the action of one of the piston-cylinder combinations (160 or 162) upon its crank (148 or 150) associated with its driving sprocket (140 or 142); while the driving sprockets 124 of the two alternate (and other pair of) subassemblies 114 will be rotated by the action of the other piston-cylinder combination (160 or 162) acting upon its bellcrank (148 or 150) and the driving sprocket (140 or 142). When a duplicate set of chain operated assemblies 110, 112 is disposed at the opposite end of the machine, it will be appreciated that each end of each of the four track devices may now be displaced by the actions of the piston-cylinder combinations 160, 162 and their counterparts at the opposite end of the machine. By the use of the idler sprockets 122 alternating in each subassembly 114 of the chain operated assemblies 110, 112, the operating chains 136, 138 may be disposed over parallel courses which are close together in such a manner that the action of one driving chain 136 will not affect or be affected by the action of the other driving chain 138. Consequently, each opposed pair of track devices (100, 102 or 104, 106) may be made to respond independently of the other, to any force developed between its ends.

Because both ends of all four track devices 100, 102, 104 and 106 are thus made displaceable with respect to the axis 108, special provision must be made in order to supply driving power continuously to drive the tracks 168 of each of said track devices. In lieu of the arrangement illustrated and

described in connection with the FIGS. 1 through 7 embodiment, there is provided in the FIGS. 8 through 15 embodiment the drive system shown best in FIGS. 9 and 13. Each of the walls 120, 120a is orifices and journaled at 170 to receive a rotatable shaft 172 which extends through the wall. A sprocket 174 is secured to rotate coaxially with the shaft 172 outside of the wall 120a, and the other end of the shaft 172 is connected by a first universal joint to a long drive shaft 178. The opposite end of the long drive shaft 178 is connected by a second universal joint 180 to a short drive shaft 182, which is carried by the track device 100 and includes a worm drive (not shown), which rotates a sprocket drive 184. The latter impels the track 168 for continuous movement. The sprocket drive 184 may drive the track 168 in a manner similar to that by which tracks 26 and 30 are driven by the FIGS. 1 through 7 embodiment.

Driving force is supplied to the sprocket-and-shaft combination 172, 174 by a chain 186, which is connected through and intermediate double-sprocket assembly 188, to the motor clutch drive assembly 192 by another chain 190. Chain 186 engages a second sprocket 185 which is coaxial to and rotates with shaft 172 and sprocket 174.

Each of the other track devices is similarly driven with the exception that no second sprocket 185 is provided, but in lieu thereof, the sprocket shaft combination 172, 174 is driven by a chain 194, which engages each of the sprockets 174. Any driving of the first described sprocket shaft combination by the chain 186 engaging the sprocket 185 will, therefore, drive all four sprockets 174 in the manner best illustrated in FIG. 9.

In the embodiment of invention illustrated in FIG. 14, there is shown an alternative set of assemblies 107, 109, for displacing the upper and lower endless track devices 100, 102 respectively in lieu of the chain sprocket assemblies of the FIGS. 8 through 13 embodiment. Since assemblies 107 and 109 are identical except reversed in their positioning, it is only necessary to describe assembly 107 to enable one to understand how both operate.

A pair of axles 116a, 116b are rotatably disposed on the top and bottom of the machine frame 16a. Each axle carries to rotate with it a radiating arm 126a and axially spaced therefrom a pair of sprocket sectors 118a, 118b. The arm 126a is linked by a turnbuckle 90a to one end of the transverse support element 134a for the endless track device 100 or 102. The sprocket sector 118a on one axle 116a is connected by a crossover chain 136a to the sector 118b on the other axle 116b. Conversely, the sector 118b on axle 116a is connected by another chain 136b to the opposite sector 118a on axle 116b.

To operate this assembly 107, a double-acting piston-cylinder 160b is disposed with its cylinder end 160c pivotally secured to the upper part of the machine frame 16a and its piston rod end 160d pivotally attached to one end of the sprocket sector 118b.

It will be readily apparent to one skilled in the art that any movement of piston rod 116d will effect a rotation of the axle 116a through the sprocket sector 118b with the result that not only will the end 134a of the track device 100 be displaced, but simultaneously, though the crossover chains 136a and 136b, an identical displacement will be imparted to the end of the track device 102.

While this particular mechanism of FIG. 14 is shown in an application for displacement of the top and bottom endless track devices 100, 102, it is contemplated that an identical set of assemblies (not shown) would be provided to displace the side devices 104, 106 shown in FIG. 9. This may be accomplished by simply providing identical assemblies 90° about the axis 108 with respect to the assemblies shown in FIG. 14.

Control of the disposition of each end of the four track devices and their displacement to response to any force or lack of force developed between the ends of proposed track devices is accomplished by air pressure applied to opposite sides of each piston 196 of the piston-cylinder combinations 160, 160a, 162, 162a, through an air circuit which is illus-

trated schematically in FIG. 15. Air under pressure is brought in through a line 198 from a source not shown, where it may be passed through a filter 200 and a pressure regulator 202. The purpose of this pressure regulator is to develop at the entrance to the line 204 a suitable operating pressure over a preselected range, as for example, 0-100 p.s.i. This pressure line 204 serves not only to supply air at the selected pressure to the two sublines 206, 208 to operate the piston-cylinder combinations 160, 160a, 162, 162a, but it also supplies the subline 210 which provides air to operate the clutch and brake, both of which are not shown in the schematic diagram, FIG. 15.

Each of the lines 206, 208 operates in a similar system, so that it is only necessary to describe that to which the line 206 is connected. The air at the pressure determined by the setting of regulator 202 arrives at subline 206 through line 204, to where it is delivered to a second pressure regulator 212. The pressure may be set by this regulator 212 at a pressure which is suitable for the particular size and wall thickness of the pipe which is to be pulled through the four track devices of the machine. Generally lower pressures are required on high-speed thin wall pipe (e.g., somewhere between 30 to 60 p.s.i.), while for larger diameters of pipe, such as 4 inches to 6 inches with a heavy wall, low range and higher clamp pressures up to 80 p.s.i. may be required. Air at the preset pressure from the regulator 212 enters a four-way valve schematically illustrated by the box 218. This valve determines whether air from regulator 212 passes or does not pass into either of the lines 214, 216. The pressure regulator 212 is spring actuated against a diaphragm to keep a constant regulated pressure in accordance with the dial setting of a dial 220 (FIG. 16).

In operation, the pressure regulator 212 is set at a pressure which can be overcome by the force of the pipe entering between the right-hand ends 222, 224 of the track devices 100, 102 (FIG. 8). For smaller, thin walled pipe, this pressure could be as low as 30 p.s.i., but for thicker walled pipe of 6 inch diameter, the p.s.i. setting could be twice that. The valve 218 is set so that air is supplied through line 214 to the left-hand sides 226, 226a of the cylinder 160a, 162a respectively at the particular p.s.i. setting. When force is developed by the presence of a pipe between the right-hand ends 222, 224 of the track devices 100, 102 (See FIG. 8), this force is transmitted through the linking element 130, bellcrank 126, sprocket 124, chain 136, sprocket 142, bellcrank 150 (FIGS. 8 and 11) to piston rod 156 of the piston-cylinder combination 162. When such force exceeds the set air pressure, the piston 196 will be moved to the left against the set air pressure. As this movement increases the pressure in the line 214 back to the regulator 212, the excess over the set pressure is bled off into the atmosphere by the regulator 212.

Should a greater size pipe enter between the track ends 222, 224, the ends are moved even further apart in response to the additional force developed against the preset air pressure. However, should a smaller diameter pipe enter or should no pipe be present at all between the ends 222, 224, the preset air pressure acts against the piston 196 to close the ends appropriately.

This same action occurs with respect to the opposite ends of the track devices 100, 102 as well as both ends of the devices 104, 106.

In the event that it should become desirable to open the devices manually, this may be readily accomplished by switching the four-way valve 212 to remove the air under pressure from the ends 226, 226a of the cylinders and to pass the air under pressure from the regulator 212 through the air line 216 to the opposite ends 230, 230a of the cylinders 160a, 226a. Thereby the pistons 232, 232a are driven to the left so that the rods 228, 228a actuate the chain operated assembly 110 to displace the ends of the track devices 100, 102 apart from each other.

The air circuit for the FIGS. 1 through 7 embodiment operates generally in the same way as that shown in FIG. 15 described above, with two modifications, however. Since this

embodiment has only two track devices, only one of which is displaceable, the circuit is considerably simplified in that only one piston-cylinder combination is required to be supplied with air as by a regulator 212, four-way valve 218 with lines 206, 214 and 216 to cylinder 226 in FIG. 15. The operation is slightly different in that it is desirable to provide some air pressure at all times on the right-hand end 230 of the cylinder 226 to enable the plastic pipe entering between the track devices to overcome the weight of the displaceable upper track device 22. This is not necessary where both upper and lower devices are displaceable since any weight of the upper device is conducted by the pipe to the lower device, thereby increasing the force applied against the latter. Desirably, therefore, with a single displaceable device, the piston 232 is supplied with pressure air on both sides so that it is in a pressure equilibrium state but the pressure is sufficient to eliminate most if not all of the weight of the upper device 22 as a factor which must be overcome before an inserted pipe can develop sufficient force to cause the air circuit and associated linkage to yield and displace the upper track device 22 upwardly.

I claim:

1. A machine for pulling elongated plastic material from extruding apparatus, said machine comprising:

- a. a pair of endless track devices, said track devices being flattened, of substantially identical dimensions and disposed adjacent and parallel to each other and each of said devices being displaceable at each end from its parallel disposition in relation to the other device;
- b. motive means to move the track of one of said endless tracks in a predetermined direction and at a predetermined speed, and to move the track of the other of said track devices in the opposite direction at the same speed;
- c. rigid support means to support said tracks in proper orientation relative to the extruding apparatus so that the area between the pair of tracks where both tracks are turning around toward each other is disposed to receive the material extruded from said apparatus and to draw the same through the spacing between said tracks in substantially the same direction as the material is being extruded;
- d. a pair of double acting piston-cylinder means, each of said means being fluid actuated, having a shaft driven by its piston, and having its cylinder or its piston-driven shaft fixedly secured to said support means and the other of said cylinder or shaft being operatively linked to one pair of the two opposed displaceable ends of said track devices, whereby the movement of said piston in its said cylinder displaces said opposed displaceable ends of each said track device by substantially identical distances from their parallel dispositions relative to such other; and each said piston-cylinder means being controllable by fluid pressure applied on each side of the piston, said pressure being such as normally to dispose the opposed ends of the track devices to which said piston-cylinder means is linked closely adjacent and parallel to each other, but said pressure being responsive to any force developed between the said track devices by the presence of any plastic material moving into the entrance area between the pair of tracks, to displace said opposed ends of the track device away from each other by only such distance as may be required to eliminate said force so developed between said pair of devices.

2. The machine as described in claim 1, wherein said motive means includes a clutch and planetary gears whereby said predetermined speed may be varied over a wide range but with sufficient deliverable power to pull plastic pipe of different sizes and conditions from the extruding apparatus, and such variation in speed may be accomplished while the machine is pulling without injuring any part of the machine.

3. A machine for pulling elongated plastic material from extruding apparatus, said machine comprising:

- a. pairs of endless track devices, said track devices being flattened, of substantially identical dimensions and each pair being disposed adjacent and parallel to each other and about a common axis, and one pair being disposed 90° relative to the other pair about said axis, and each pair of track devices being displaceable at each end from their parallel disposition in relation to each other to be moveable radially to and from said axis;
- b. motive means to move the track of one of said endless tracks of each pair of track devices in a predetermined direction and at a predetermined speed, and to move the track of the other of said track devices of the pair in the opposite direction at the same speed;
- c. rigid support means to support said tracks in proper orientation relative to the extruding apparatus so that the area between each pair of tracks where both tracks of the pair are turning around toward each other is disposed to receive the material extruded from said apparatus and to draw the same through the spacing between said tracks in substantially the same direction as the material is being extruded; C. RIGID SUPPORT MEANS TO SUPPORT SAID TRACKS IN PROPER ORIENTATION RELATIVE TO THE EXTRUDING APPARATUS SO THAT THE AREA BETWEEN EACH PAIR OF TRACKS WHERE BOTH TRACKS OF THE PAIR ARE TURNING AROUND TOWARD EACH OTHER IS DISPOSED TO RECEIVE THE MATERIAL EXTRUDED FROM SAID APPARATUS AND TO DRAW THE SAME THROUGH THE SPACING BETWEEN SAID TRACKS IN SUBSTANTIALLY THE SAME DIRECTION AS THE MATERIAL IS BEING EXTRUDED;
- c. rigid support means to support said tracks in proper orientation relative to the extruding apparatus so that the area between each pair of tracks where both tracks of the pair are turning around toward each other is disposed to receive the material extruded from said apparatus and to draw the same through the spacing between said tracks in substantially the same direction as the material is being extruded;
- d. a plurality of double-acting piston-cylinder means, each said means being fluid actuated, having a shaft driven by its piston, and having its cylinder or its piston-driven shaft fixedly secured to said support means and the other of said cylinder or shaft being operatively linked to the opposed displaceable ends of one pair of said track devices, whereby the movement of said piston in its said cylinder displaces the opposed displaceable ends of one of said pairs of track devices to which the piston-cylinder means is linked, radially of said axis by an identical distance to or from said axis; and each said piston-cylinder means being controllable by fluid pressure applied on at least one side of the piston, said pressure being such as normally to dispose the opposed ends of the track devices to which said piston-cylinder means is linked closely adjacent and parallel to each other but said pressure being responsive to any force developed between the last said track devices by the presence of any plastic material moving into the entrance area between the pair of tracks, to displace said opposed ends of said track device radially to or from said axis by only such distance as may be required to eliminate said force so developed between said pair of devices.

4. A machine as described in claim 3, wherein the motive means include a driving motor, an endless chain driven by the motor, four sprockets engaging said chain, four rotatable drive shafts, each sprocket serving to drive one of said shafts and each said shaft being coupled to drive one of said endless track devices through a universal joint; and a further shaft which is displaceable at its end remote to the universal joint, to the same extent as the end of the endless track device is displaceable thereby to enable said sprocket, drive shaft, universal joint and further drive shaft combination to drive the track device to which said combination is coupled in any position of said

device, whether closest to said axis or displaced therefrom to its greatest extent.

5. An apparatus for pulling an elongated element through a pair of endless track devices, said devices being supported in a rigid frame, their tracks moving in opposite directions, said devices being disposed parallel to, but spaced apart by a predetermined distance from each other, means to vary the spacing between opposed ends of said devices in reaction to force developed between such ends by the presence of said element or an element of greater or lesser thickness than that which has been previously pulled through said devices, said means comprising:

- a. a first bellcrank, said bellcrank being pivotable about one of its ends and having its other end linked to one end of a first one of said endless track devices in such manner that the pivoting of said bellcrank about its one end in a first direction, displaces said one end of said first device in a direction away from the opposed end of the second one of said devices, and the pivoting of said bellcrank about its end in the opposite direction displaces said end of the first device in the opposite direction toward said opposed end of the second device;
 - b. a second bellcrank, said bellcrank being pivotable about one of its ends and having its other end linked to the opposed end of the second said device in such manner that the pivoting of said second bellcrank about its one end displaces the end of said second device to which it is linked in a direction away from the opposed end of the first said device, and the pivoting of said second bellcrank about its end in the opposite direction displaces said end of the second device in the opposite direction toward said opposed end of the first device;
 - c. rotatable means, said rotatable means being linked to each of said first and second bellcranks whereby when said rotatable means is rotated in one direction each of said bellcranks is pivoted about its one end to displace the device end linked thereto in its respective first direction, while rotation of said rotatable means in the opposite direction effects the pivoting of each of said bellcranks to displace the device end linked thereto in its respective second direction;
 - d. a plurality of fluid-actuated double-acting piston-cylinders, one of each of said piston-cylinders being connected to rotate one of said rotatable means in both directions; and
 - e. valve control means for each of said piston-cylinders, the last said means providing fluid under predetermined pressure on at least one side of the piston to effect a predetermined disposition of the piston in the cylinder, but upon the application of any force upon the piston in a first direction, such piston may be moved in the direction of such force against said fluid under pressure until no further force is applied to the piston; whereby, when any force is developed between either pair of opposed ends of said devices by the presence of an object therebetween, such force is transmitted through said first and second bellcranks, the rotatable means and their respective linkages to their respective piston-cylinders to cause the latter to rotate said rotatable means and pivot said bellcrank to displace said opposed pair of ends of said devices away from each other, until such object no longer exerts any force between said opposed pair of ends of said devices, or is removed from a disposition between such opposed ends of said devices, whereupon the pistons are returned to their original respective disposition by the predetermined fluid pressure.
6. An apparatus for pulling a longitudinal element through two pairs of endless track devices, each pair being disposed normally with respect to the other about a common axis, said devices being supported in a rigid frame, the tracks of each pair moving in opposite directions, and each said device being disposed parallel to, but spaced apart by a predetermined distance from, the other device of its pair, means to vary the

spacing between opposed ends of each pair of said devices in reaction to force, developed between such ends by the presence of said element or an element of greater or lesser thickness than that which has been previously pulled through said devices, said means comprising:

- a. a first bellcrank, said bellcrank being pivotable about one of its ends and having its other end linked to one end of a first one of said endless track devices in such manner that the pivoting of said bellcrank about its one end in a first direction, displaces said one end of said first device in a direction away from the opposed end of the second one of said devices, and the pivoting of said bellcrank about its end in the opposite direction displaces said end of the first device in the opposite direction toward said opposed end of the second device;
 - b. a second bellcrank, said bellcrank being pivotable about one of its ends and having its other end linked to the opposed end of the second said device in such manner that the pivoting of said second bellcrank about its one end displaces the end of said second device to which it is linked in a direction away from the opposed end of the first said device, and the pivoting of said second bellcrank about its end in the opposite direction displaces said end of the second device in the opposite direction toward said opposed end of the first device;
 - c. a rotatable means, said rotatable means being linked to each of said first and second bellcranks whereby when said rotatable means is rotated in one direction each of said bellcranks is pivoted about its one end to displace the device end linked thereto in its respective first direction, while rotation of said rotatable means in the opposite direction, effects the pivoting of each of said bellcranks to displace the device end linked thereto in its respective second direction;
 - d. a plurality of fluid-actuated double-acting piston-cylinders, one of each of said piston-cylinders being connected to rotate one of said rotatable means in both directions; and
 - e. valve control means for each of said piston-cylinders, the last said means providing fluid on both sides of the piston to create a state of equilibrium in a predetermined disposition of the piston in the cylinder, but upon the application of any force upon the piston in either direction, such piston reacts to move in the direction of such force until no further force is applied to the piston, whereupon equilibrium on both sides of the piston is reestablished; whereby, when any force is developed between either pair of opposed ends of said devices by the presence of an object therebetween, such force is transmitted through said first and second bellcranks, the rotatable means and their respective linkages to their respective piston-cylinder to cause the latter to rotate said rotatable member and pivot said bellcranks to displace the opposed pair of ends of said devices away from each other, until such object no longer exerts any force between said opposed pair of ends of said devices, or is removed from a disposition between such opposed ends of said devices, whereupon the piston returns to its original equilibrium disposition.
7. The means as described in claim 6, wherein each of the bellcranks is secured to rotate with a first rotatable sprocket, the rotatable means comprising a second sprocket; and the first sprockets for the opposed track ends and the second sprockets are encircled by a driving endless chain, whereby the rotation of said second sprockets by their respective pistons, results in the simultaneous rotation of said first sprockets and the pivoting of their respective associated bellcranks and hence, displacement of the opposed ends of said devices.
8. The means as described in claim 6, wherein each bellcrank serving to displace one of a pair of opposed ends of said devices is secured to rotate with a first rotating sprocket, and an idler sprocket is provided to rotate independently of each

first sprocket but coaxially therewith, the rotatable means for each pair of devices comprises a second sprocket; and the first sprockets for one pair of opposed track ends, the idler sprockets coaxial with the first sprockets for the second pair of opposed ends and a second sprocket are encircled by a driving endless chain, whereby the rotation of such second sprocket by its associated piston, results in the simultaneous rotation of the first sprockets chained therewith and the pivoting of their respective bellcranks, and hence, displacement of the opposed ends of the devices linked to said bellcranks.

9. The means as described in claim 8, wherein the driving endless chain for the sprockets involved in displacing a first pair of opposed ends of said devices is disposed adjacent and parallel to the endless chain for the sprockets involved in displacing the second pair of opposed ends of said devices, which ends are disposed normally to the said first pair of ends, and said endless chains are moveable independently of each other.

10. An apparatus for pulling a longitudinal element through two pairs of endless track devices, each pair being disposed normally with respect to the other about a common axis, said devices being supported in a rigid frame, the tracks of each pair moving in opposite directions, and each said device being disposed parallel to, but spaced apart by a predetermined distance from, the other device of its pair, means to vary the spacing between opposed ends of each pair of said devices in reaction to force, developed between such ends by the presence of said element or an element of greater or lesser thickness than that which has been previously pulled through said devices, said means comprising:

- a. a first bellcrank, said bellcrank being pivotable about one of its ends and having its other end linked to one end of a first one of said endless track devices in such manner that the pivoting of said bellcrank about its one end in a first direction, displaces said one end of said first device in a direction away from the opposed end of the second one of said devices, and the pivoting of said bellcrank about its end in the opposite direction displaces said end of the first device in the opposite direction toward said opposed end of the second device;
- b. a second bellcrank, said bellcrank being pivotable about one of its ends and having its other end linked to the opposed end of the second said device in such manner that the pivoting of said second bellcrank about its one end displaces the end of said second device to which it is

linked in a direction away from the opposed end of the first said device, and the pivoting of said second bellcrank about its end in the opposite direction displaces said end of the second device in the opposite direction toward said opposed end of the first device;

- c. a pair of rotatable means, each of said rotatable means being secured to one of said first and second bellcranks to that any rotation of the rotatable means effects a pivoting of its bellcrank about its one end, and both of said rotatable means being connected to each other to rotate simultaneously but in opposite directions, whereby when, each of said rotatable means is rotated in one direction and the other rotatable means connected thereto is rotated in the opposite direction, the ends of each pair of endless track devices linked to the first and second bellcranks are displaced in either the first or second direction and when each of said rotatable means is rotated in the opposite direction, the said ends are displaced in the opposite direction,
- d. a plurality of fluid-actuated double-acting piston-cylinders, one of each of said piston-cylinders being connected to rotate one of said rotatable means in both directions; and
- e. valve control means for each of said piston-cylinders, the last means providing fluid on both sides of the piston to create a state of equilibrium in a predetermined disposition of the piston in the cylinder, but upon the application of any force upon the piston in either direction, such piston reacts to move in the direction of such force until no further force is applied to the piston, whereupon equilibrium on both sides of the piston is reestablished; whereby, when any force is developed between either pair of opposed ends of said devices by the presence of an object therebetween, such force is transmitted through said first and second bellcranks, the rotatable means and their respective linkages to their respective piston-cylinder to cause the latter to rotate said rotatable member and pivot said bellcranks to displace the opposed pair of ends of said devices away from each other, until such object no longer exerts any force between said opposed pair of ends of said devices, or is removed from a disposition between such opposed ends of said devices, whereupon the piston returns to its original equilibrium disposition.

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