United States Patent

Elsworth

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[54] **APPARATUS FOR CUTTING AN UNVULCANIZED VISCOELASTIC MASS**

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[52] **U.S. Cl.** **83/1,** 83/175, 83/648, 83/701

[51] **Int. Cl.** **B26d 3/00**

[58] **Field of Search**.....83/1, 4, 175, 701, 648; 25/105, 108, 112, 113, 104; 264/138, 139, 157, 158; 18/2 J; 222/346, 80

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[57] **ABSTRACT**

An unvulcanized viscoelastic mass is cut by a machine which applies tension at the line of cut. While applying tension at the line of cut, the machine also provides a means for maintaining the cut portions in spaced relationship and for continuously moving the mass into the cutting means. The apparatus is especially suitable for cutting silicone gum containing fillers, extenders, process aids and vulcanizing agents. The compounded gum is shipped to the ultimate consumer who vulcanizes the compounded gum to form silicone rubber. The rubber is used in high temperature automotive transmission gaskets, radiator hose, and fan belts.

8 Claims, 10 Drawing Figures

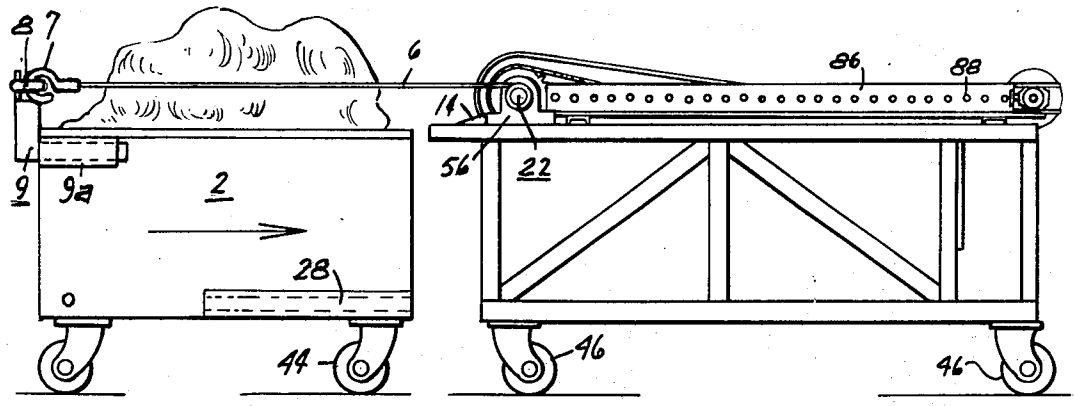
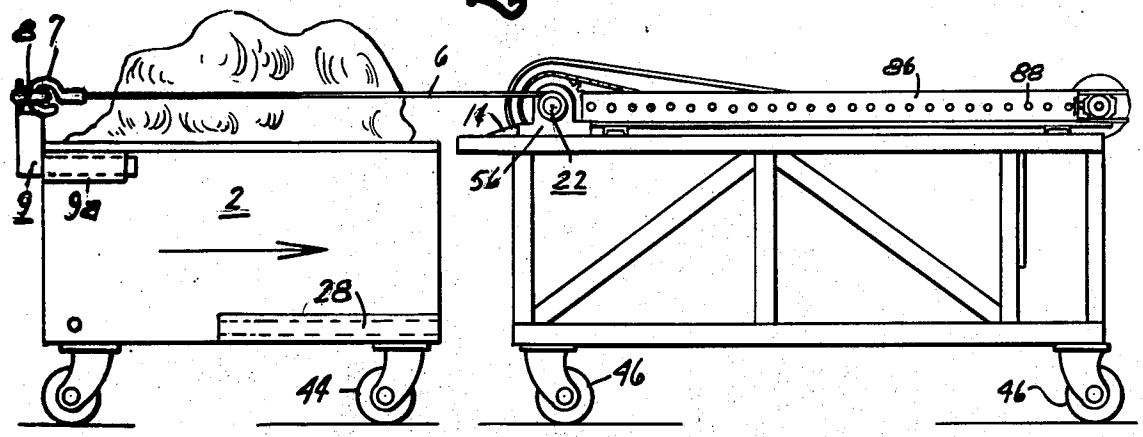


Fig. 1.



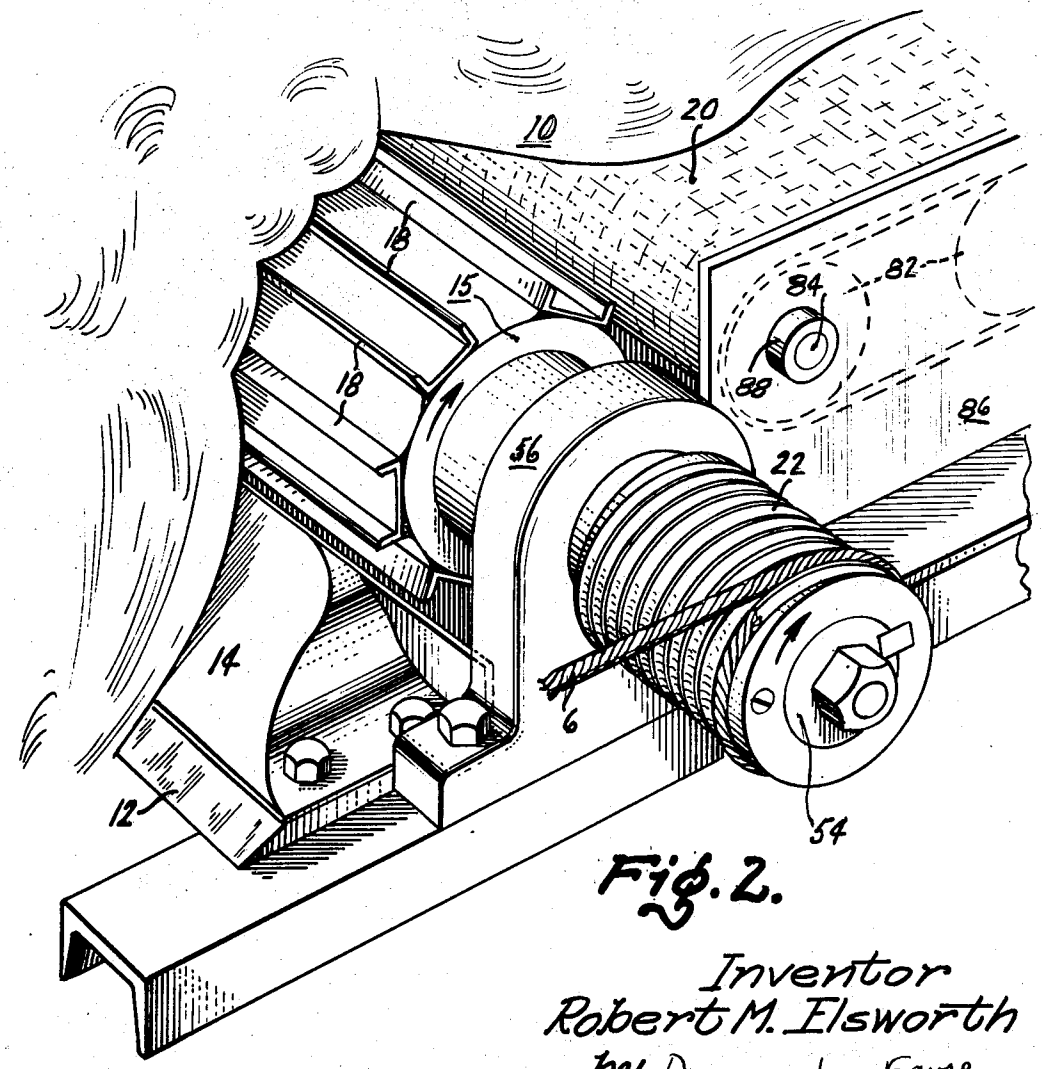
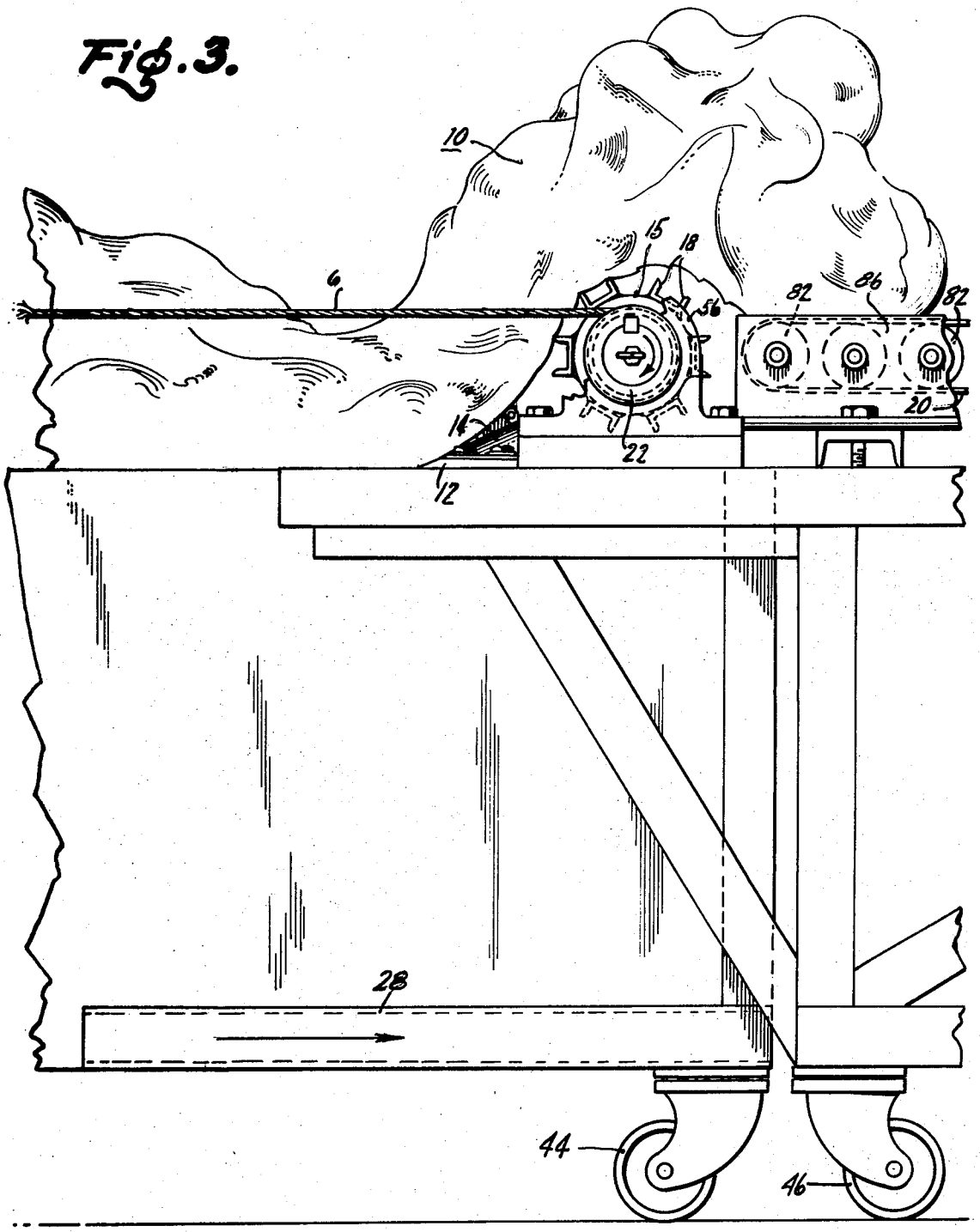


Fig. 2.

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Fig. 3.



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Fig. 4.

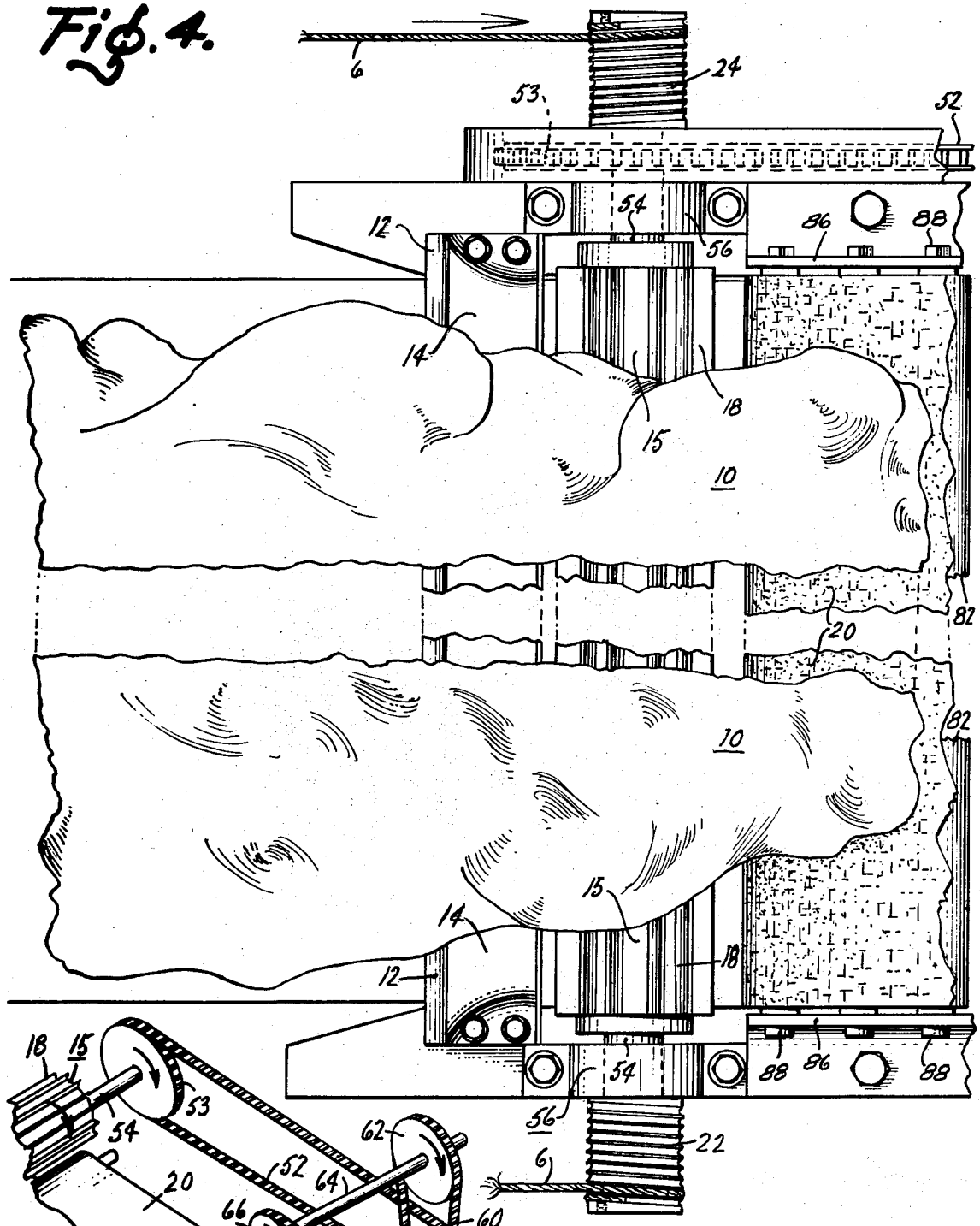


Fig. 5a.

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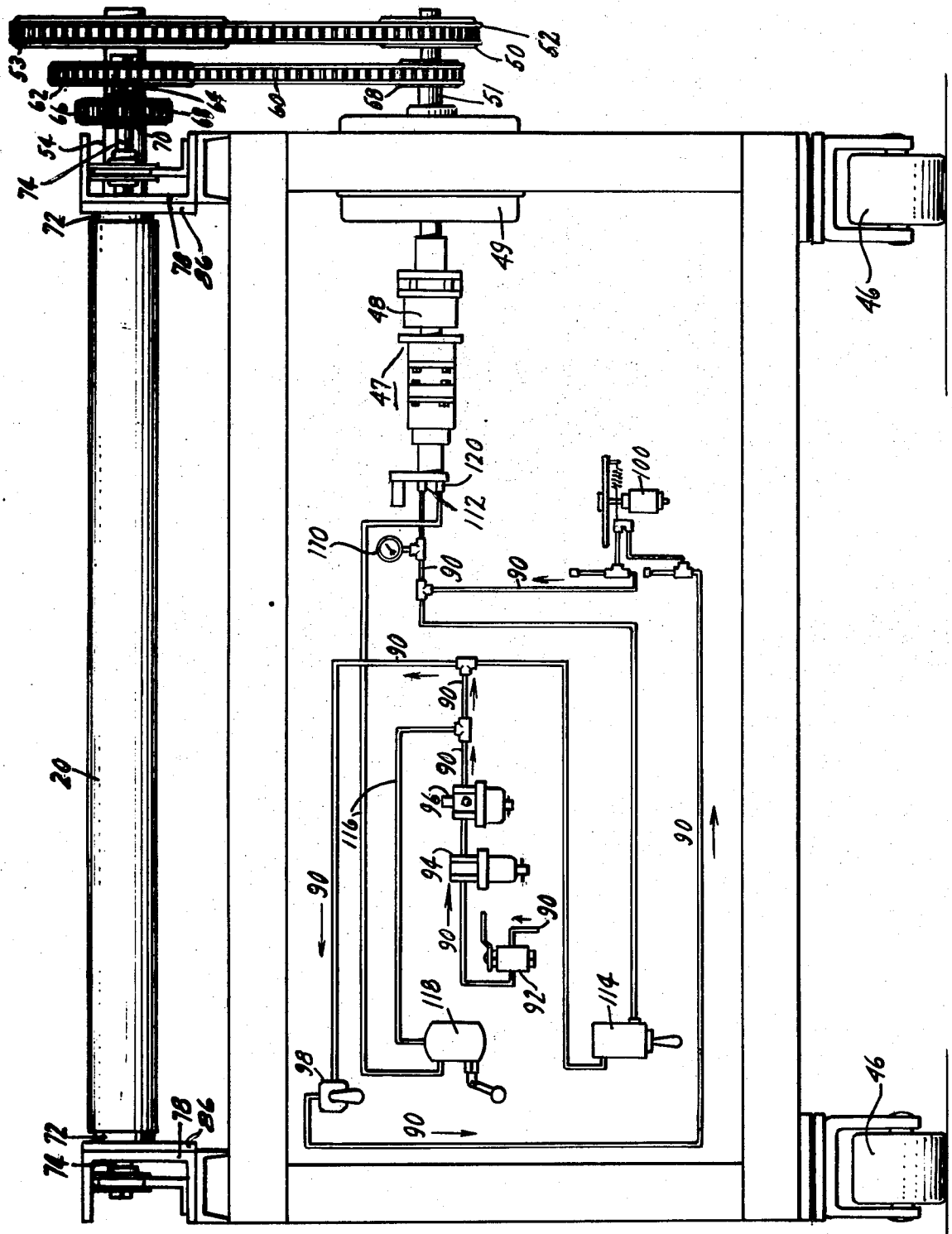


Fig. 5.

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Fig. 6.

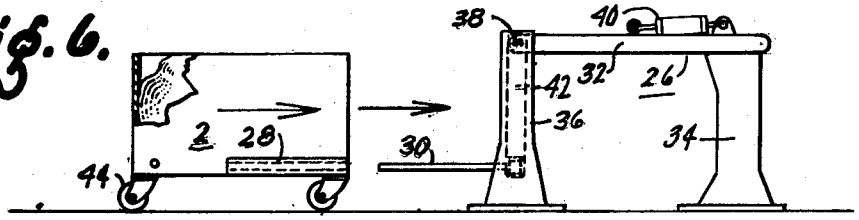


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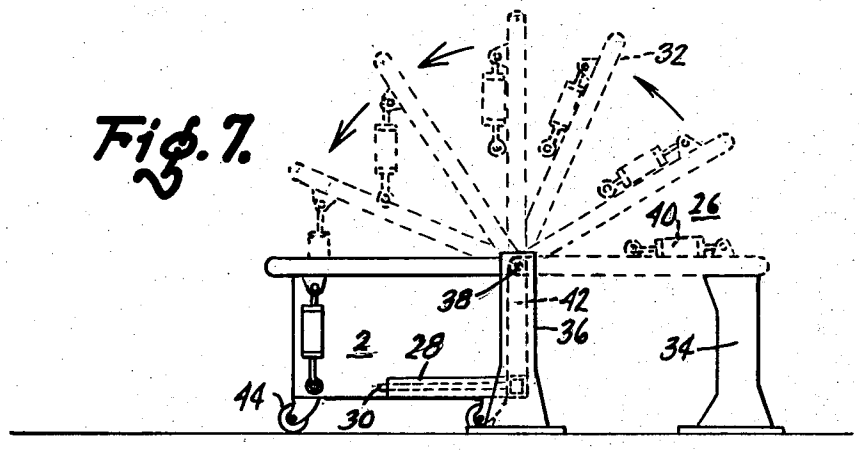


Fig. 8.

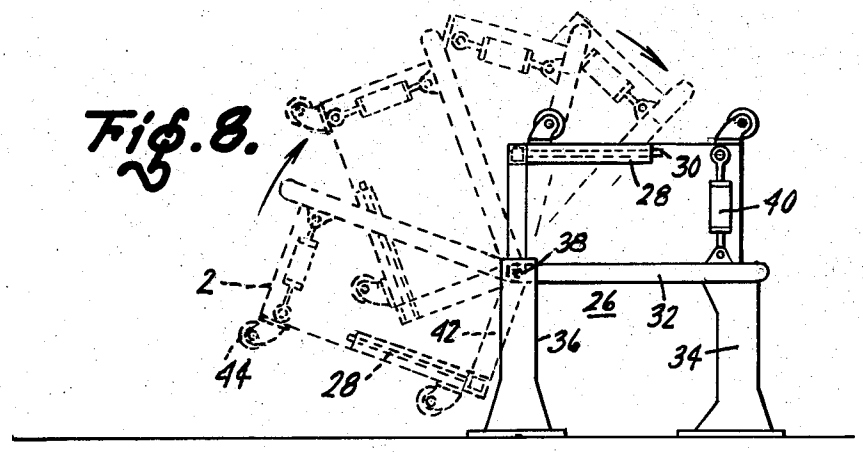
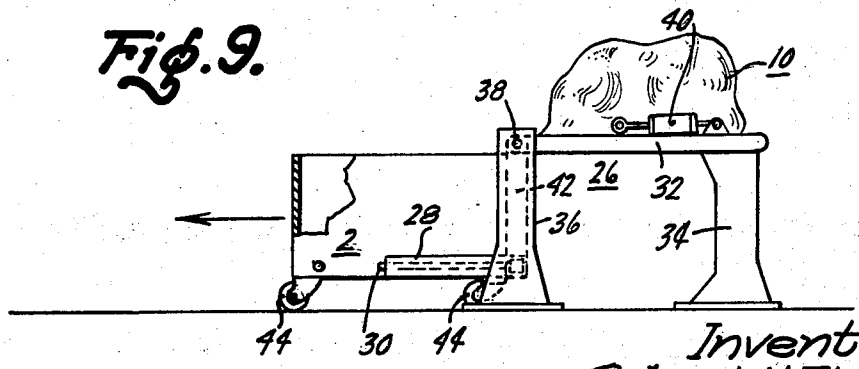


Fig. 9.



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APPARATUS FOR CUTTING AN UNVULCANIZED VISCOELASTIC MASS

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for cutting an unvulcanized viscoelastic mass.

Silicone rubber is made in much the same way that natural rubber and synthetic rubber is made, i.e., by cross-linking a high molecular weight gum. The gum generally contains added materials such as fillers, extenders, pigments, process aids, vulcanizing agents and the like. The gum containing these various additives is made by placing a mixture of the gum, filler, etc., into a doughmixer and thoroughly mixing the composition until it becomes completely homogeneous. This homogeneous product is called various things, such as R-gum (where the R indicates reinforced), compound (meaning the gum has been compounded with other materials), and gum base (meaning that the gum is now a base for a finishing operation which converts it to silicone rubber). At this stage of manufacture, the homogeneous material is an unvulcanized viscoelastic mass having a Williams plasticity of at least 200 and preferably having a Williams plasticity of from 300 to 800. The material is very difficult to handle. When a portion is cut from a larger mass and is allowed to again contact the larger mass it immediately adheres thereto and must be recut. If an attempt is made to cut the material as it leaves the doughmixer, it is in a heated condition and very uncomfortable to handle. If an attempt is made to cut the material after it is cooled, it is very stiff and difficult to cut. It is, however, necessary to cut the material in order that it may be placed in a filter press which removes any dirt which may have been picked up in the manufacturing process up to this point.

In the normal batch process production of the vulcanizable silicone compound, the material is first produced in a doughmixer, loaded into a cart and transported to the filter press. The mass extending above the top of the cart is removed and placed in the filter press and then the contents of the cart are unloaded onto a conveyor by turning the cart upside down upon the conveyor belt; the cart removed and the unloaded contents then automatically fed into the filter press. It is necessary that the surface of the unvulcanized viscoelastic mass in the cart be level so that a conveyor belt can be placed flat on the surface of the mass and the conveyor belt secured to the cart. The cart attached to the conveyor belt is then inverted to unload the cart. The job of levelling the top of the cart has normally been a tedious one performed by hand and has taken as long as 20 man hours per cart.

SUMMARY OF THE INVENTION

In accordance with the teaching of the present invention, the job of levelling the top of the cart filled with silicone compound is accomplished by an apparatus which cuts the compound at a plane parallel to the top of the cart while applying tension at the line of cut and holding the mass of compound which has been cut away from the remainder of the compound. The cutting is accomplished by knife, a moving band or a piano wire which starts its line of cut at the front of the cart. After the cut is started, a transporter-separator also, at the same time, moves the top portion of the cut material rearward to a conveyor belt thus preventing the top portion of the cut material from recontacting the mass in the cart and adhering thereto. The cutter, the transporter-separator and the conveyor are positioned on a frame which fits over and on both sides of the cart. By the relative movement of the cart and the frame, the cutter moves into the compound contained in the cart. It is immaterial whether the cart moves, the frame moves or they both move simultaneously.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the cart topper attached by a cable to a cart loaded with compound.

FIG. 2 is a perspective view of the cutting, transporter-separator and conveying portion of the topper.

FIG. 3 is a sectional side elevational view showing the relationship of the cutting and transporting portion, cutting the compound extending above the top surface of the cart, and the relation of the cutting and transporter-separator to the cart.

FIG. 4 is a top plan sectional view of the cutting and transporter-separator mechanism and its relation to the cart while the compound is being cut.

FIG. 5 is a schematic diagram of the drive means for the transporter-separator, conveyor and cable wind-up mechanism; and the controls for the drive means of the machine of the present invention.

FIG. 5A is a perspective elevational view of the drive means for the transporter-separator, conveyor and cable wind-up mechanism.

FIG. 6 shows the cart after the compound extending above the cart has been removed by the topper being brought to an unloading station.

FIG. 7 shows the conveyor system of the unloader station being brought down and placed upon the top of the cart.

FIG. 8 shows the cart and the conveyor system of the unloader station being placed in the unloading position.

FIG. 9 shows the cart removed from the load and placed back on the floor with the load left on the conveyor of the unloader station.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As is shown by FIG. 1, cart 2 is being drawn into topper 4 by cables 6. Cables 6 are terminated by hooks 7 which are attached to eyes 8. Eyes 8 are connected to cart 2 by removable bracket 9. Bracket 9 fits into channel 9*a* on each side of the cart.

FIG. 2 shows the cutting transporter-separator and conveyor action which occurs when the cart reaches the topper. Here the compound 10 is cut by blade 12 and deflected upward by deflector 14. When the compound reaches teflon-coated transporter-separator 15, it is contacted by protruding ribs 18 which transports the compound to teflon-coated conveyor 20, while also exerting a lifting force causing tension and separation at the line of cut of the compound.

As transporter-separator 15 which consists of a ribbed cylinder rotates, worm pulleys 22 and 24 which are mounted on the same shaft rotate at the same rotational speed. As is best shown in FIG. 4, the pitch of the grooves on worm pulley 24 is reversed from the pitch of the grooves on worm pulley 22 so that as the cable 6 is wound onto the worm pulleys it is wound from the

outer ends of the worm pulleys toward the inner end. As worm pulleys **22** and **24** are smaller in diameter than the diameter of transporter-separator **15**, the speed at which the cart is drawn into the topper **4** is less than the peripheral speed of the transporter-separator **15**.

As the cart moves into the cutter blade, the top of the load is removed by blade **12** carried by the transporter-separator and placed on conveyor belt **20**. When the operation is finished, the top surface of the compound within the cart is level. The cart is removed from the topper. The compound on conveyor **20** is then conveyed into a ram extruder. The ram extruder forces the compound through a filter screen which removes any dirt which is present in the compound. The compound is then cut into appropriate size pieces and shipped to the various silicone rubber fabricators who use the silicone compound for a large number of high temperature applications including the manufacture of automotive transmission gaskets, fan belts and radiator hose. Silicone rubber unlike conventional rubber does not harden and crack upon prolonged high temperature usage.

The contents of the loaded cart are also fed into the same ram extruder and processed in the same manner. The cart is emptied by the use of an unloader station **26**, shown in FIGS. **6**, **7**, **8** and **9**. Cart **2** at the lower edge has a channel **28** on each side. The cart is brought to the unloading station and two forks **30** of the unloading station are inserted into the two channels **28** of the cart. A conveyor **32** rests upon two upright members **34** and is pivotedly mounted upon two upright members **36**. The conveyor is then pivoted upon pivot point **38** and rotated 180° which brings it to the upper surface of the cart. It is, of course, necessary that the top surface of the compound in the cart be level. It is then attached to the cart on both sides by two adjustable attachment members **40** which are permanently pivotedly attached to the conveyor and detachably secured to the cart. The forks **30** are attached to two arms **42** which are also pivotedly mounted upon uprights **36** at the same pivot point as conveyor **32**. As shown by FIG. **8**, fork **30** and pivot arm **36** and conveyor **32** are rotated in a clockwise direction 180° resulting in the cart being in an inverted position on the top of the conveyor **32** which is again resting upon uprights **34**. The attaching means **40** are then removed from the cart and the forks **30** and pivot arms **36** are rotated in a counterclockwise direction 180° with the conveyor remaining in place leaving the load on the conveyor and returning the cart to the floor. The load of silicone compound is then fed to the before-described ram extruder and filter screen.

The cart **2** has wheels **44** and is free to roll into topper **4**. Topper **4** has wheels **46** and is free to roll in the opposite direction of the cart until the entire cart with the exception of the rearward cable connection bracket **9** has passed under cutter **12**. During the operation of the topper, it is immaterial whether the cart moves, the topper moves, on both move simultaneously.

The drive mechanism used in the topper is shown basically in FIGS. **5** and **5A**. The power source is air motor **47** which operates at 20,000 rpm. Gear boxes **48** and **49** are attached to the motor and reduce the speed to 3.5 rpm. Sprocket **50** is attached to output shaft **51** of gear box **49** and drives chain **52** which in turn drives sprocket **53**. Sprocket **53** is attached to shaft **54** upon which is mounted both worm pulleys **22** and **24** and transporter-separator **15**. As best seen in FIG. **4**, shaft **54** passes through bearing housings **56** where it is mounted and supported by bearings, not shown. The conveyor belt drive is best shown by perspective elevational view **5A**. There motor driven sprocket **58** drives chain **60** which in turn drives sprocket **62**. Sprocket **62** is mounted on a common shaft **64** with sprocket **66** and causes sprocket **66** to turn, which in turn drives chain **68**, driving sprocket **70** which causes roller **72** to turn by the torque exerted through shaft **74**. Roller **72** is covered with strips of a typical commercially available grit filled high friction anti-skid surface. Shaft **74** extends through brackets **78** and is supported therein by bearings, not shown. Conveyor belt **20** rides on a series of free rollers **82** and is driven by the rotation of shaft **74**. These rollers **82** are suspended by and rotate on internal nylon bearings, not shown. The bearings are attached to shafts **84** which protrude through flange **86** and are prevented from moving there-through by collars **88**. Collars **88** are larger than the holes in the flange through which shafts **84** protrude. Collars **88** are secured to shafts **84** by set screws, not shown. Rollers **82** are smooth, steel rollers and are free to rotate on nylon bearings.

The controls for the air driven mechanism contained on the topper are best shown by FIG. **5**. The air enters pipe **90** and the admission of the air is controlled by air valve **92**. The incoming air first passes through air filter **94** and then passes through air oiler **96**. Air conduit **90** indicates the path the air takes in the normal forward operation of the machine. When air valve **98** is open the machine assumes its curring operation. The air continues to pass through conduit **90** through shut-off valve **100** past pressure gauge **110** and into the forward inlet **112** of the air motor. When the air is turned on the motor continues in its forward speed until the wagon which is unloaded strikes shut-off valve **100**. This shuts off the supply of air passing through conduit **90** and automatically turns off the motor upon the completion of the topping off of a cart. If, for any reason, it is desired to run the motor in a forward direction after the automatic shut-off valve has cut off the air supply to the motor, this can be done by shut-off bypass valve **114** which merely provides a conduit around shut-off valve **100**. When it is desired to reverse the motor direction, air pressure is supplied to the motor in the opposite direction. This is accomplished by taking an air supply from the conduit **90** as it leaves the air oiler through conduit **116** to reverse valve **118**. Conduit **116** then provides the direction of the conduit used when the direction of air flow is reversed through the air motor. Conduit **116** then provides the high pressure air supply for air inlet **120** of the air motor. This allows the air motor to be reversed for such purposes as unwinding the cables in order that they may be disconnected from the cart and the cart removed from the topper.

The silicone compound which is used in the following examples is well known compound and the basic technology involved is taught in U.S. Pat. No. 2,744,878—Smith-Johannsen, 1956, U.S. Pat. No. 3,514,424—Noble et al., 1970, U.S. Pat. No. 3,017,378—Simpson, 1962, U.S. Pat. No. 3,464,945—

Martellock, 1969 and the prior art mentioned in the above-mentioned patents. The subsequent developments in the silicone rubber art which are also well known are the silicone rubbers containing fluorinated alkyl substituents and cyanoalkyl substituents which impart solvent resistance to the rubbers. The particular rubbers and compounds involved do not form a part of the present invention which is directed to a means for cutting the various compounds.

EXAMPLE 1

A silicone compound was prepared by mixing a polysiloxane gum, filler, extender, pigment, process aid and a vulcanizing agent in a doughmixer. The product had a Williams plasticity of 275. This compound was dumped from the doughmixer into a cart and transported to the topper. The cart was drawn into the topper and the compound extending above the top surface of the cart was removed by the topper. The compound which was removed was then loaded onto a conveyor and ram extruded through a filter screen. The cart was then unloaded onto the conveyor and the compound in the cart was ram extruded through a filter screen.

EXAMPLE 2

Example 1 was repeated using a compound having a Williams plasticity of 350.

EXAMPLE 3

Example 1 was repeated using a compound having a Williams plasticity of 500.

EXAMPLE 4

Example 1 was repeated using a compound having a Williams plasticity of 750.

EXAMPLE 5

Example 1 was repeated using a gum having a Williams plasticity of 900.

The foregoing examples and specification have of necessity been directed to only a few of the many variables which are practicable in the practice of the present invention. It should be understood, however, that many other variables are also within the scope of the present invention. The materials which can be cut include many others having a Williams plasticity of at least 200 and are not limited to silicones although silicone compound is preferred.

The height of the cut made into the compound contained in the cart can by minor obvious variations be changed. This can be accomplished by placing hydraulic jacks between the wheels of the cart and the body of the cart and/or hydraulic jacks between the wheels of the topper and the frame of the topper so that the heights of either one or both may be varied. Multiple cuts using various height machinery may also be accomplished. The cutting means is not limited to the blade recited in the examples but can include anyother cutting means well known in the art, including the afore-mentioned piano wire, moving band, and other well known cutting means.

Having thus described my invention, what I desire to secure by Letters Patent of the United States is:

1. An apparatus for cutting an unvulcanized viscoelastic mass positioned in a cart capable of being rolled, said mass having a Williams plasticity of at least 200 said apparatus having therein a frame, roller means on said frame such that frame is capable of moving horizontal cutting means mounted on the upper portion of said frame, horizontal deflector means mounted on said frame adjacent to said cutting means, a horizontal transporter-separator means having a shaft thereon and mounted on said frame adjacent to said elevational means and horizontal conveyor means mounted on said frame adjacent to said transporter-separator means comprising the improvement of worm gear means mounted on said shaft of said transporter-separator means and cable means connected to said worm gear means and having connecting means thereon such that cable means can be connected to said cart so that said horizontal-separator means can simultaneously act on the cut viscoelastic mass as well as force said cutting means through said viscoelastic mass through said worm gear means and said cable means.

2. The apparatus of claim 1 further characterized by the cutting means being a wire.

3. The apparatus of claim 1 further characterized by the cutting means being a band.

4. The apparatus of claim 1 further characterized by the cutting means being a blade.

5. The apparatus of claim 1 further characterized by the material being cut having a Williams plasticity of from 300 to 800.

6. The apparatus of claim 1 further characterized by the material being cut being a silicone compound having a Williams plasticity of from 300 to 800.

7. The apparatus of claim 1 wherein said transporter-separator means comprises a cylinder having horizontal ribs thereon.

8. The apparatus of claim 1 wherein said cart has brackets thereon with eyes attached to said brackets and wherein said connecting means on said cable means comprises hooks.

* * * * *